



LEBANON INTEGRATED MICRONUTRIENT, ANTHROPOMETRY AND CHILD DEVELOPMENT SURVEY

2023- 2024 (LIMA)

FINAL REPORT | 2024



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CHILD DEVELOPMENT SURVEY 2023 (LIMA)**

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Foreword

The multi-layered crisis in Lebanon has significantly compromised children and women's nutritional status. To better understand the overall nutrition and developmental status of the children and women, including the most hidden forms of malnutrition such as micronutrient deficiencies, and their potential impacts on the wellbeing, growth, and thriving of children, the Ministry of Public Health, with support from UNICEF, MERCY USA, WFP, world Bank, Groundwork, American University of Beirut, Harvard University, and with funding from a wide range of donors, has undertaken Lebanon's first Integrated Micronutrient, Anthropometric, and Child Development Survey, the LIMA Survey.

This survey provides state-of-the-art evidence on all forms of malnutrition and developmental deprivations among young children, adolescent girls, and women. It also unpacks the dietary patterns among these groups, as well as the underlying causes of malnutrition and developmental deprivation. Additionally, the survey offers critical evidence on the nutrition-related non-communicable disease risk factors among women.

The generated evidence is of strategic importance for several reasons. LIMA is the first-ever national survey measuring micronutrient deficiencies, known as cellular hunger, across all population and age groups in Lebanon. Additionally, LIMA is the first nationwide survey globally to measure nutrition and early childhood development outcomes during the first two years of life, revealing the associations between malnutrition and cognitive development during these critical years. Moreover, LIMA is the first national nutrition survey in Lebanon to offer a wealth of evidence on the nutritional status of adolescent girls, a group often overlooked in household nutrition surveys. Equally important, this survey provides evidence of heightened nutritional vulnerabilities among subpopulations, such as the refugees, calling for wider international support and responsibility sharing.

The wealth of evidence generated by LIMA avails a solid foundation for informed decision-making and shaping targeted nutrition and child development interventions. To promote integrated nutrition programs, accelerated collaboration across various sectors and systems including health, food, agriculture, education, water sanitation and hygiene, and social protection is needed. Additionally, elevating nutrition as a national priority necessitates collective commitments from multiple ministries, donors, international financial institutions, and other partners. By working together, we can ensure a healthier and brighter future for all.

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Collaborators:



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ABBREVIATIONS

AG	Adolescent girls (10-19 years)
AGP	α -1-acid glycoprotein
AUB	American University of Beirut
AUBMC	American University of Beirut Medical Center
BMI	Body mass index
BRINDA	Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia
CBC	Complete Blood Count
CI	Confidence Interval
CRP	C-reactive protein
DHS	Demographic and Health Survey
ECD	Early childhood development
ECDI2030	Early Childhood Development Index 2030
ELISA	Enzyme linked immunosorbent assay
FANTA	Food and Nutrition Technical Assistance
GDP	Gross Domestic Product
GSED	Global Scales for Early Development
HAZ	Height-for-age z-score
Hb	Hemoglobin
HbA1c	Glycated hemoglobin
HDI	Human Development Index
HPLC	High-pressure liquid chromatography
ITS	Informal tented settlements
IYCF	Infant and young child feeding
KIO3	Potassium iodate
LIMA	Lebanon Integrated Micronutrient, Anthropometry and Child Development Survey
LRI	Lower acute respiratory infection
MICS	Multiple Indicator Cluster Survey
MoPH	Ministry of Public Health
MUAC	Mid-upper arm circumference
NCD	Non-communicable disease
NPW	Non-pregnant women (15-49 years)
ppm	Parts per million
PPS	Probability proportional to size sampling
PSC	Preschool children (children 0-59 months of age)
PSU	Primary sampling unit
PLW	Pregnant and lactating women
PW	Pregnant women
QC	Quality control
QGIS	Quantum Geographic Information System
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
WAZ	Weight-for-age z-score
WFP	United Nations World Food Programme
WHO	World Health Organization
WHZ	Weight-for-height z-score

EXECUTIVE SUMMARY

Introduction

In Lebanon, there is recent anthropometric data describing the general nutrition situation of children. Data on micronutrient status is largely outdated or entirely missing for preschool children, adolescents, and women of reproductive age. In order to increase the understanding of the severity of anemia, micronutrient deficiencies, cardiometabolic risk factors and early childhood development and help design evidence-based nutritional intervention programs for nationwide implementation, the Ministry of Public Health, UNICEF, the American University of Beirut (AUB), Mercy USA and other stakeholders, have conducted the Lebanon Integrated Micronutrient, Anthropometry and Child Development Survey 2023 (LIMA 2023).

Aim and objectives

The overall aim of the LIMA 2023 was to obtain updated and reliable information on the current micronutrient and nutrition situation of several target groups living in Lebanon.

The objectives of the LIMA 2023 included assessing the nutritional and micronutrient status of specific subgroups of the Lebanese population, evaluating infant and young child feeding practices, assessing early childhood development, care and caregiver well-being, assessing the relative importance of likely causes of anemia, and estimating the extent and severity of nutrition-related non-communicable diseases. Moreover, the LIMA estimated the consumption of potentially fortifiable foods and evaluated the performance of the national salt fortification program.

The target population groups of the LIMA 2023 were preschool children 0-59 months of age (PSC), adolescent girls 10-19 years (AG), non-pregnant women of reproductive age 15-49 years (NPW), and pregnant women (PW). Data were collected from all PW when encountered in selected households, but their small number precluded stratum-specific conclusions. For the other target groups, most of the indicators measured are representative at the national level and for 10 strata: 8 governorates and 1 Syrian informal tented settlements (ITS) stratum and 1 Palestinian camps stratum.

Key nutrition and micronutrient indicators were: anemia prevalence in PSC, AG, NPW and PW; prevalence of iron deficiency (including iron deficiency anemia), vitamin A deficiency, vitamin D deficiency and zinc deficiency and levels of some inflammatory markers (alpha 1-acid glycoprotein (AGP) and C-reactive protein (CRP)) in PSC, AG and NPW; folate deficiency, vitamin B12 deficiency and lipid profile among AG and NPW; iodine status, diabetes, sodium and potassium excretion and hypertension in AG, NPW and PW. Other nutrition indicators of interest included prevalence of stunting, wasting, underweight, overweight and obesity among PSC; short stature, underweight, overweight and obesity in AG, underweight, overweight and obesity in NPW and acute malnutrition in PW and lactating women. Moreover, early child development was assessed in PSC and caregiver wellbeing in caregivers of surveyed PSCs. Further, the adequacy and coverage of iodized salt were evaluated.

Design

The LIMA 2023 was designed as a national cross-sectional survey with 10 strata: 8 geographical strata, one Syrian informal tented settlements (ITS) stratum and one Palestinian camps stratum. A sampling frame for 8 governorate strata was developed using a hexagon grid, similar to the one designed for Lebanon's 2021 Multi-Sector Needs Assessment. Satellite imagery was used to estimate the population in each hexagon, which served as a primary sampling unit (PSU). For the Syrian ITS stratum and the Palestinian camps stratum, separate sampling frames were developed with the help of the United Nations High Commissioner for Refugees (UNHCR) and the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), respectively. A two-stage sampling procedure was used to randomly select households and, subsequently, children, AG, and women.

In the first stage of sampling, the LIMA randomly selected 413 PSUs with probability proportional to size (PPS) sampling. Due to differences in household size and composition between the strata, stratum-specific sample sizes were calculated based on household size and composition reported in the Lebanon National SMART Survey 2021. Thus, different numbers of PSUs were randomly selected for each stratum: Akkar: 30; Baalbek- Hermel: 33; Beirut: 70; Bekaa: 40; El Nabatieh: 43; Mount Lebanon: 47; North: 43; South: 48; Syrian ITS: 27; Palestinian camps: 32. This resulted in 413 PSUs selected for the entire survey sample. At a later phase, more PSUs were added to Beirut, Mount Lebanon and the South, trying to increase the sample size and statistical precision in these strata. A total of 456 PSUs were completed by the end of the study. The second stage of sampling consisted of random selection with an equal probability of 20 households in each selected PSU. In PSUs with less than 20 households, all households were selected. The LIMA 2023 recruited all PSC, AG (10-19 years), and PW from selected households. However, NPW 20-49 years of age were included from 50% of households, as this yielded a sufficiently large sample size.

Results

In this executive summary, national estimates are presented Table 1. This table also refers the reader to the corresponding table in the report for more detailed results.

Table 1. Summary results of the LIMA 2023

Target group	Indicator ^a	Result	Table ^b
Household			
	Food insecurity	58.7 %	Table 13
	Iodized salt (≥5 ppm)	65.5 %	Table 17
	Adequately iodized salt (≥15 ppm) – International ^c	49.0 % ^c	
	Adequately iodized salt (≥35.6 ppm) – Lebanon ^c	8.2 %	
Children 0-59 months of age (unless otherwise indicated)			
	Low birth weight	19.7 %	Table 19
	Ever breastfed (0-23 months)	86.0 %	Table 20
	Early initiation of breastfeeding (0-23 months)	58.8 %	
	Exclusive breastfeeding under six months (0-5 months)	22.7 %	
	Introduction of solid foods (6-8 months)	60.0 %	Tables 21,22,23
	Minimum dietary diversity (6-23 months)	25.8 %	
	Minimum meal frequency (6-23 months)	47.1 %	
	Minimum acceptable diet (6-23 months)	10.7 %	
	Bottle feeding in the past 24h (0-23 months)	43.9 %	Table 31
	On-track early childhood development (0-23 months)	65.3%	
	On-track early childhood development (24-59 months)	69.3%	Table 34
	Stunting	13.9 %	Table 26
	Wasting	1.3 %	Table 27
	Severe acute malnutrition (SAM), combined MUAC+WHZ assessment	0.3 %	--
	Moderate acute malnutrition (MAM), combined MUAC+WHZ assessment	1.3 %	--
	Overweight or obese	4.4 %	Table 28
	Underweight	5.1 %	Table 29
	Small head circumference	3.6 %	Table 30
	Anemia ^d	16.9 %	Table 36
	Iron deficiency ^d	35.9 %	
	Iron deficiency anemia ^d	10.7 %	Table 37
	Vitamin A deficiency ^d	6.4 %	
	Vitamin D deficiency ^d	5.4 %	Table 38
	Vitamin D deficiency or insufficiency ^d	29.1 %	
	Zinc deficiency (sub-sample) ^d	39.4 %	Table 39
Non-pregnant adolescent girls (10-19 years)			
	Meets minimum dietary diversity	53.5 %	Table 47
	Short stature	5.8 %	Table 51
	Thinness	3.1 %	Table 52
	Overweight	19.9 %	
	Obese	10.0 %	
	Overweight or obese (combined)	29.9 %	Table 54
	Anemia	20.3 %	
	Iron deficiency	29.5 %	
	Iron deficiency anemia	13.9 %	Table 55
	Vitamin A deficiency	3.9 %	
	Folate deficiency	14.4 %	Table 56
	Vitamin B12 deficiency	17.7 %	Table 57
	Vitamin D deficiency	41.8 %	Table 58
	Vitamin D deficiency or insufficiency	78.4 %	
	Zinc deficiency (sub-sample) ^d	38.7 %	Table 59
	Urinary iodine median	131 µg/L	Table 60

Table continued on next page

Target group	Indicator ^a	Result	Table ^b
	Elevated HbA1c (diabetes or pre-diabetes)	3.4 %	Table 68
	Elevated triglycerides	33.8 %	
	Low HDL cholesterol	26.2 %	
	Elevated total cholesterol	2.9 %	
	Visceral/central obesity	21.9 %	
	Hypertension	2.6 %	
	Metabolic syndrome	4.4 %	
	Excess sodium intake (based on excretion)	57.7 %	Table 69
	Low potassium intake (based on excretion)	94.7 %	Table 71
Non-pregnant and lactating women (15-49 years)			
	Meets minimum dietary diversity	56.2 %	Table 78
	Undernutrition (low MUAC) ^e	10.2 %	--
	Underweight	4.7 %	Table 84
	Overweight	28.6 %	
	Obese	25.0 %	
	Overweight or obese (combined)	53.6 %	
	Anemia	35.3 %	Table 92
	Iron deficiency	38.5 %	
	Iron deficiency anemia	24.1 %	
	Vitamin A deficiency	1.5 %	Table 93
	Folate deficiency	18.0 %	Table 94
	Vitamin B12 deficiency	20.8 %	Table 95
	Vitamin D deficiency	37.9 %	Table 96
	Vitamin D deficiency or insufficiency	69.2 %	
	Zinc deficiency (sub-sample) ^d	35.0 %	Table 97
	Urinary iodine median, non-lactating women	108 µg/L	Table 98
	Urinary iodine median, lactating women	115 µg/L	Table 99
	Diabetes	3.4 %	Table 84
	Pre-diabetes	8.3 %	
	Elevated HbA1c (diabetes or pre-diabetes)	11.7 %	
	Elevated triglycerides	21.9 %	Table 85
	Low HDL cholesterol	47.5 %	
	Elevated total cholesterol	4.7 %	Table 86
	Visceral/central obesity	50.8 %	
	Hypertension	6.6 %	Table 87
	Metabolic syndrome	24.8 %	Table 88
	Excess sodium intake (based on excretion)	60.3 %	Table 109
	Low potassium intake (based on excretion)	93.0 %	Table 111
Pregnant women			
	Meets minimum dietary diversity	46.4 %	Table 116
	Undernutrition (low MUAC)	2.9 %	--
	Anemia	24.8 %	Table 117
	Urinary iodine median	149 µg/L	Table 118
	Diabetes	0.1 %	Table 119
	Pre-diabetes	5.6 %	
	Elevated HbA1c (diabetes or pre-diabetes)	5.7 %	
	Hypertension	6.4 %	Table 120

^a See text of the method section for case definitions.^b Refer to the table indicated for a more detailed analysis of the outcome, including group-specific results by age, region, wealth quintiles and other analyses.^c Denominators for "adequately iodized salt" are all households that provided a sample.^d Only children 6-59 months of age.^e Only in lactating women.

Discussion

Lebanon's Integrated Micronutrient, Anthropometry and Child Development Survey (LIMA) is a national cross-sectional survey that collected data from households and individuals in all of Lebanon's governorates and among Syrians living in Informal Tented Settlements and the Palestinian camp population.

LIMA is the first national survey in Lebanon that comprehensively describes the micronutrient and nutrition status of children under 5 years of age, adolescent girls, non-pregnant and pregnant women. Specifically, the survey assessed micronutrient deficiencies and anemia, stunting, wasting, underweight and obesity, early childhood development status, dietary patterns, the underlying causes of malnutrition and developmental deprivation, prevalence of nutrition related non-communicable diseases risk factors (salt intake, smoking, lipid profile, diabetes, and blood pressure) and the effectiveness of the national salt iodization program. Because of the large number of indicators examined for each population group, the LIMA permits a wide-ranging understanding of the health and nutritional issues of the various target groups and enables informed decision-making and shaping targeted nutrition and child development interventions. The generated evidence is of strategic importance for several reasons:

1. LIMA is the first national survey measuring micronutrient deficiencies in Lebanon.
2. The first national nutrition survey in Lebanon, offering wealth of evidence on nutritional status of adolescent girls.
3. The first national survey globally measuring the nutrition and ECD outcomes during the first 2 years of life, which permits the examination of associations between all forms of malnutrition and children's early development.
4. The first time globally that ECD outcome data was collected using the newly released Global Scales for Early Development-Household Form (GSED-HF 1.0) launched in February 2023 to monitor the holistic development of children in the critical first two years of life.

Household level findings

Household food insecurity poses a major problem in Lebanon and affects households of all nationalities but is more prevalent among Syrian households. Only 15% of Syrian households were classified as food secure, while 46% and 59% of Lebanese and Palestinian households were classified as food secure, respectively. The LIMA data clearly showed that household food insecurity access negatively affects the diet of household members and favours the development of child undernutrition and certain micronutrient deficiencies in children, adolescent girls and women.

The LIMA also found that the performance of Lebanon's salt iodization program is not optimal, as only 49% of salt is adequately iodized according to the international cutoff of 15 ppm and only about 8% of the salt is adequately iodized according to the Lebanese standard (35.6 ppm).

Surprisingly, Akkar stratum has a higher prevalence of adequately iodized salt in households (78%), followed by the Syrian ITS (63%). A national market assessment of the salt iodization program conducted in 2013/2014 found similar results to the LIMA, with only 44% of salt samples adequately iodized according to international standards.

Breast feeding and complementary feeding

The LIMA assessed the 17 indicators recommended by the 2021 WHO/UNICEF IYCF guidelines and found similar results as the 2021 SMART survey. While there are laws and legislations in place to improve IYCF practices in Lebanon, the LIMA shows that these have not yet led to an improvement in practice. A high proportion (>80%) of children <2 years of age were ever breastfed. The proportion of the other breastfeeding practices, however, was sub-optimal. To illustrate, only 60% of children were given breastmilk within 1 hour after birth, and only 23% of children < 6 months of age were exclusively breastfed. Regarding complementary feeding indicators in children 6 and 23 months of age, the LIMA found that only a small proportion of children have minimum dietary diversity (26%), minimum meal frequency (47%), and minimum acceptable diet (11%). The LIMA also found that the prevalence of all three aforementioned indicators increases with household wealth, reflecting the strong link between socio-economic status and the diet quality of infants and young children, consistent with a multi-country analysis of five countries (including Lebanon) from the MENA region.

Early childhood development

Overall, about 65% of children 0-23 months old and 69% of children 24-59 months old are developmentally on track. On average, 73% of children aged 36-59 months across 68 low- and middle-income countries were found to be developmentally on track, with a variability (SD=14.5) indicating significant differences across regions [1]. Specifically, in the MENA region, percentages of children on track aged 36-59 months were higher: 79% in Iraq (2018), 77% in Algeria (2019), and 84% in Palestine (2020) [2], highlighting regional variations in early childhood development outcomes. When comparing these figures to Lebanon, it is important to note the absence of a directly comparable dataset that includes a wider age range of children, specifically those aged 24-36 months. This broader inclusion criteria for Lebanon suggests caution in direct comparisons due to the differing age ranges considered in the datasets.

In the LIMA 2023 survey, in both age groups, a lower percentage of Syrian children are developmentally on track (61% and 55% respectively) compared with the national estimates, highlighting a need for targeted support given the profound impacts of displacement on children's outcomes. The percentage of children with on-track development among children from the poorest households is lower than among children from the wealthiest households in both age groups (64% compared with 71% for 0-23 months; 54% compared with 92% for 24-59 months). In both age groups, significant sub-group differences were observed with respect to household food security access. Among children 0-23 months, 74% of children living in food secure households are developmentally on-track compared with 59% and 70% of children

living in moderate and severe food insecure households respectively, while about 80% of children 24-59 months of age living in food secure households are developmentally on-track compared with 68% and 60% of children living in moderate and severe food insecure households, respectively. This data suggests that the consequences of poverty, such as inadequate nutrition, limited learning opportunities, and stressful living conditions, can have impacts on a child's development outcomes.

With respect to feeding practices and anthropometry, significant sub-group differences were observed among the younger age group (0-23 months old) with a lower percentage of children developmentally on track if they do not meet the threshold for receiving a minimal dietary diversity or minimal acceptable diet. In this age group, a significantly lower percentage of children were found to be developmentally on track compared with non-stunted children (53% compared to 68%). Among older children (24-59 months old), significant sub-group differences were observed among those exposed to low birth weight with a lower percentage of children developmentally on-track (64%) compared with normal weight children (76%). These findings further underscore the importance of adequate nutrition alongside safe and stable living conditions and early learning opportunities for better developmental outcomes.

Dietary diversity of adolescent girls and women

Just about half of the adolescent girls and women achieve minimum dietary diversity, which is similar to the results of a nationwide survey in Jordan [3]. Sub-group analyses revealed that poverty is a driver of poor diet — a well-documented association — as the lowest proportion of those with minimum dietary diversity live in households of the lower wealth quintiles or in food insecure households. Moreover, a smaller proportion of individuals with Syrian nationality have a minimally diverse diet, a population group with the highest prevalence of food insecurity (access).

Chronic and acute malnutrition

The data shows a drastic increase in chronic malnutrition over the last two years, indicating a deterioration of the nutritional situation in Lebanon.

While the prevalence of short stature and thinness in adolescent girls is relatively low, the national prevalence of stunting in children < 5 years of age is 14%, denoting a medium public health problem. Stunting prevalence two times higher than that reported in the SMART 2021 [4] and in surveys conducted in other countries in the region [3,5].

Subgroup analysis revealed a significant difference in stunting by nationality, with a prevalence of 19% among Syrian children. Alarming, the stunting levels in children in the Syrian ITS stratum is 39%, a very high public health concern as classified by the WHO [6]. The national underweight prevalence is relatively low at about 5% but affects a larger proportion of Syrian children (8%) and children living in the ITS stratum (16%). The national wasting prevalence identified by the LIMA is very low (1.3%) but reaches moderate health significance in children aged 0-5 months (6%). Similarly low wasting prevalences were found by the 2021 SMART.

Both stunting and wasting are inversely associated with wealth quintile, with prevalences decreasing as household wealth increases. In addition, stunting is also inversely associated with food security access status.

Obesity and cardiometabolic risk factors

Overweight and obesity in children under 5 years of age are on the rise in low- and middle-income countries. However, the LIMA found that the percentage of overweight and obesity among PSC in Lebanon is low (4.4%) and comparable to the SMART (3.7%). In contrast to stunting and wasting, overweight and obesity are positively associated with wealth quintile and food security access.

With 30%, the prevalence of overweight or obesity among AGs is of high public health relevance. In addition, almost 22% have a high waist circumference, a measure of central obesity. Rates of diabetes, total cholesterol, hypertension, and metabolic syndrome among AGs are below 6%, but the large proportion of AG having high triglyceride or low HDL levels is of concern.

More than half of the NPW are either overweight or obese, with a substantial increase by age from 18% in NPW aged 15 to 19 years to 74% in NPW between 40 and 49 years old. In addition, around half the NPW have visceral obesity with a very similar pattern when it comes to age stratification. These results denote a high public health problem in Lebanon. The occurrences of metabolic abnormalities are high in NPW especially for triglycerides (about 22% have elevated triglycerides) and HDL (about 48% have low HDL). Overall, 25% of NPW were diagnosed with metabolic syndrome.

Anemia and iron deficiency

At the national level, the anemia and iron deficiency prevalence are considered a “moderate” (i.e., 20-39%) public health problem in all target groups except pre-school children, where the anemia prevalence denotes a “mild” (i.e., 5-19%) public health problem according to WHO classification. The anemia results also indicated that anemia in Lebanon is caused primarily from nutritional deficiencies. Approximately 60% to 70% of anemic participants present a concomitant iron deficiency, and significant associations with other micronutrient deficiencies were also observed. Anemia of chronic inflammation could also contribute to the anemia burden as inflammation is significantly associated with anemia in adolescent girls.

Among PSC, the observed prevalence of anemia is 26 percentage points lower than the SMART survey, which reported a rate of 43%. This difference likely stems from the different pre-analytic methods used by both surveys. The LIMA’s collection of venous blood (rather than capillary blood) and that analysis of hemoglobin concentration using a complete blood count (CBC) analyzer (rather than a portable analyzer) suggests that there is minimal bias in the hemoglobin concentrations measured by the LIMA. Moreover, the hemoglobin levels in LIMA were adjusted for the altitude as recommended by the WHO for analysis of anemia in children, whereas this adjustment was not utilized by the SMART survey.

Iron deficiency prevalence tends to be more present in participants also suffering from certain other micronutrient deficiencies, with the exception of zinc, which is negatively associated with iron deficiency. Moreover, the LIMA found that the consumption of infant formula and supplements prevents children from developing iron deficiency.

Vitamin A deficiency

While the prevalence of vitamin A deficiency is very low in adolescent girls and non-pregnant women and does not pose a public health problem; 6.4% of children are vitamin A deficient, which is considered a problem of mild public health relevance.

Vitamin A plays a crucial role in maintaining normal vision, strengthening the immune system, and supporting growth and development. While the LIMA generally found a low prevalence of vitamin A deficiency in the various target groups, notable associations were observed. Specifically, higher prevalences (>10%) of vitamin A deficiency were found among children experiencing diarrhea, fever, and lower respiratory infections. These findings may indicate that vitamin A deficiency children are more prone to diseases and infections due to compromised immune function. However, it is not clear whether vitamin A deficiency is a cause or consequence of infections.

Folate and vitamin B12 deficiency

In Lebanon, the prevalence of folate deficiency is 14.4% among AG. This is slightly lower than B12 deficiency, which occurred in 17.7% of girls. AG residing in the Syrian ITS have the lowest folate deficiency (4.5%) but the highest B12 deficiency (22.9%).

Eighteen percent (18%) of NPW have developed folate deficiency and 20.8% vitamin B12 deficiency. While the prevalence of folate deficiency is similar across the nationalities, vitamin B12 deficiency varies. Consistent with the AG findings, vitamin B12 deficiency in NPW is by far the highest in the Syrian ITS stratum. This notable disparity is also evident in the Syrian NPW, who are the most deficient in B12.

It is noteworthy that serum folate was measured using a protein-binding assay. However, no thresholds for folate deficiency were defined using such assays. Hence, the threshold used in this survey was set at a serum folate level below 10 nmol/L, the concentration at which homocysteine levels start to increase, in order to detect folate deficiency at an early stage.

Vitamin D deficiency

A recent meta-analysis pooling over 300 studies and 8 million participants from 81 countries highlighted higher prevalence of vitamin D deficiency in the Eastern Mediterranean region and lower-middle-income countries. Indeed, despite plentiful sunshine in Lebanon, vitamin D deficiency is a serious public health problem.

Relatively, a small proportion of children under 5 years have vitamin D deficiency (5.4%). However, this number increases by 6 folds when accounting for insufficiency as well. Data in children reveals an alarming situation in the Palestinian camps where 50% of children have vitamin D deficiency. In contrast, only 0.5% of children living in the Syrian ITS developed it.

Overall, 1.3% of the Lebanese children are deficient, compared to 8.8% of Syrians and 13.2% of Palestinians.

More than 40% of AG have vitamin D deficiency and almost 80% have suboptimal vitamin D status (deficiency and insufficiency). A strong association was found between vitamin D deficiency and veiling practice (66% deficient among veiled versus 20% deficient among unveiled) as well as vitamin D deficiency and sun exposure index (57% lowest index versus 18% and 16% in the higher indices).

The percentage of NPW with vitamin D deficiency is 37.9%, and with vitamin D deficiency or insufficiency is 69.2%. A very similar pattern was observed in the different strata and among different nationalities, veiling practices, and sun exposure indices between NPW and AG.

Iodine deficiency

Median UIC among AG is 131 µg/L, indicating an adequate status. Data suggest a higher median among Palestinian AG compared to Lebanese and Syrian. Strata analysis also supported a higher UIC among AG residing in the Palestinian camps, followed by Akkar and North.

Median UIC in non-pregnant non-lactating women (NPNLW) is 108 µg/L. While no differences were found among nationalities, women living in Syrian ITS have the highest urinary concentration. NPNLW living in Mount Lebanon have an insufficient iodine status with a mUIC of 88 µg/L. Median concentration in non-pregnant lactating women was 115 µg/L.

Pregnant women have a median concentration of 149 µg/L, indicating a borderline iodine insufficiency.

Despite the low compliance from salt industries, we found a significant dose-responsive relationship between levels of salt iodization (non-iodized, iodized, and adequately iodized) and iodine status of AG and NPNLW using urinary iodine concentration as an indicator. The same relationship was observed for PW and non-pregnant lactating women, but without reaching significance, which is probably due to the small number of those women in the sample.

Zinc deficiency

Zinc deficiency prevalence is surprisingly high in all population groups ranging from 35% in non-pregnant women to 38% in pre-school children and can be considered of public health importance in all population groups [7]. While the prevalence is substantially higher than reported by a national micronutrient survey conducted in Jordan [3], a high prevalence of zinc deficiency (24%) was found by a survey of adult women from six districts across Lebanon [8]

Minimum dietary diversity in adolescent girls and women

In adolescent girls, LIMA shows a larger proportion achieving MDD (54%) and smaller proportion suffering from severe food poverty (13%) compared to children, with Lebanese

having better indicators than Syrians and Palestinians. Also, MDD is positively associated with wealth quintile, food security access and vitamin D status.

The percentages among NPW are similar to the ones of AG, with around 56% of women achieving MDD and 12% having severe food poverty. It is worth mentioning that a higher prevalence of women of Palestinian nationality meet a MDD followed by Lebanese and Syrian, respectively. However, the lowest proportion of severe food poverty is noted among Lebanese women.

Surprisingly, MDD is associated with higher levels of iron deficiency in children and folate deficiency in adolescents and NPW. The findings hint at an imbalance between dietary diversity and nutrient adequacy, potentially due to “micronutrient dilution”. This occurs when a diverse diet includes many foods of low nutritional value, thereby diluting the density of essential nutrients.

Sodium and potassium intake

Sodium and potassium excretions were used to estimate intake based on a spot urine sample. Mean sodium intake is 2.6 g and 2.8 g per day in AG and NPW, respectively, which is similar to the data reported in the literature. Around 60% of the sample population exceed their daily sodium recommendations. Notably, about 75% of NPW with hypertension have excessive sodium consumption, compared to 60% of women without hypertension.

The Lebanese Action on Sodium and Health (LASH) was established in February 2012. This initiative targets reducing sodium intake to counteract the increasing prevalence of hypertension among the population. Despite the valuable steps LASH has taken to enhance salt reduction skills and create a low salt environment, there remains a significant need for continued and enhanced efforts in this area.

Examining sodium in relation to potassium intake provides a more comprehensive understanding of the risk factors and their impacts on health. Mean potassium intake is estimated to be 1.8 g/d in AG and 2 g/d in NPW; only 5% and 7%, respectively, meet the recommendations. The common assumption that the Lebanese people consume enough potassium, considering the easy access and low cost of local fruits, vegetables, and legumes, is not backed by the results of this study. There is a need for increased efforts to return to the traditional Mediterranean diet, which emphasizes consuming fresh foods.

Wheat flour intake

Bread is an indispensable staple food in Lebanese cuisine, contributing to around 17% in children and adolescents (6 to 20 years) and 18% of the daily energy intake in adults older than 20. The average estimated wheat flour intake is 74 g/d among AG participating in the LIMA, aligning closely with a study conducted in adults living in Beirut. No differences are seen by nationality, stratum, wealth quintile, or household food security access. On the contrary, while the same consumption is estimated for NPW, variation of intakes is observed by nationality, with Syrian women consuming the highest amount (83 g/d) and the Lebanese the lowest (69 g/d). Wheat flour intake is highest among women in the Syrian ITS stratum (108 g/d). Among the Lebanese governorates, wheat flour intake is estimated to range between 57 g/d and 94 g/d with a fair intra-stratum variability in most strata.

Strengths and limitations

A key strength of the LIMA is the measurement of an extensive suite of biomarkers from urine and venous blood samples. The use of venous blood samples, in particular, is a key strength of the LIMA, as it removes potential preanalytical biases (e.g. dilution from interstitial fluid, small sample volume) that can occur with capillary blood sampling. There is a growing body of research that indicates that using capillary samples frequently results in lower hemoglobin concentrations and subsequently cause artificially high anaemia prevalences [9]. Also, the LIMA measured hemoglobin via complete blood count (CBC), which increases the certainty of the hemoglobin results. Furthermore, the measurement of hemoglobin using venous blood with a CBC is the method recommended in WHO's 2024 hemoglobin/anemia guidelines [10]. Another strength of the LIMA is the inclusion of early childhood development indicators and indices. Early childhood development indicators are infrequently collected as part of surveys that measure the nutritional status of children using biomarkers. As such, the LIMA can uniquely assess the associations between micronutrient and nutritional status and various developmental indicators. Moreover, the LIMA is the first survey globally that collected ECD outcome data using the newly released Global Scales for Early Development- Household Form (GSED 1.0) launched in February 2023 to monitor the holistic development of children in the critical first three years of life.

A key limitation of the LIMA is that, as a cross-sectional survey, the association between any two variables *cannot* be considered causal. Another limitation is that part of the data collection occurred during the summer months, when many residents of Lebanon move to secondary residences. This could have slightly biased some results, as households that relocated in the summer were considered "away for an extended period" and thus were not considered eligible.

Recommendations

Implement the national nutrition strategy and Scaling Up Nutrition movement

Following a rigorous multi-sectoral consultative process with key national nutrition stakeholders, Lebanon's Ministry of Public Health launched, for the first time, a National Nutrition Strategy for Lebanon (2021-2026) in 2022. This strategy comes at a critical time where the country is facing several crises that have severe impacts on the health and nutrition of people in Lebanon. The results of LIMA survey reaffirm the need to scale up coordinated, multi-sectoral nutrition programming in order to avoid exacerbation of the nutrition situation.

A multi-system approach to nutrition programming is needed to address and remedy the nutrition and health problems revealed by the LIMA survey. To successfully address nutrition-related issues, it is imperative that nutrition programs are integrated with other sectors. The national government is responsible for upholding children's and women's rights to adequate nutrition, and programming should contribute to strengthening the capacity of national food, health, social protection, education and WASH sectors. This can help ensure that all children, adolescents, and women have access to nutritious, safe and affordable foods, and benefit from adequate nutrition practices and services. While responding to immediate needs is critical, long-term development assistance efforts to strengthen the nutrition governance in Lebanon is needed for longer term improvements in the nutrition and health status of Lebanon's population.

Despite all the efforts made to date, policy makers, donors and development partners are facing an inertia to support and invest on Lebanon's nutrition agenda. To sensitize all stakeholders and partners, and to promote integrated nutrition programs, it is recommended to accelerate collaboration across various sectors and systems, including health, food, agriculture, education, WASH, and social protection. This is a national priority and can be supported by the Scaling Up Nutrition movement by establishing the National Nutrition Council to support the operationalization of the multi-sectoral component of the National Nutrition Strategy. To achieve this aim, it is imperative to mobilize commitments from multiple ministries, donors, international financial institutions, and other partners to raise the profile of nutrition in the humanitarian and development agenda.

Improve household food security and reduce child food poverty

Addressing food insecurity in a challenging context, as in Lebanon, where poverty is dramatically increasing, requires a multidisciplinary, multisectoral approach. Both immediate and long-term programs are needed. While many agencies are already involved in food security programs and reducing poverty initiatives, efforts are still required to target people of all nationalities in the community and camps. Moreover, the large proportion of children suffering from food poverty demonstrates that the current social protection and food assistance schemes are not sensitive to the needs of children during early years. As such, social protection systems that respond to the nutritional needs of the most vulnerable groups should

be designed and activated. Food parcels could be distributed to the most vulnerable, ensuring sufficient calories and nutritious foods. In addition, the availability and affordability of nutritious foods should be increased – including fruits, vegetables, eggs, fish, meat, and fortified foods for young children – by incentivizing their production, distribution, and retail. Concurrently, it is important to implement national standards and legislations to protect young children from unhealthy processed and ultra-processed foods and beverages and harmful marketing practices targeting caregivers. Also, integrating cash-based transfers into food assistance programs has been proven effective in increasing food access and dietary diversity. Any cash and social transfer programs must be sensitive to the nutritional needs of young children to end child food poverty – particularly severe food poverty in early childhood – in response to humanitarian crises. In addition, nutritional programs that include the distribution of supplementary foods and micronutrient powders can help to improve nutritional status alongside improvements in food security status. These programs yield better outcomes through enhanced nutrition knowledge. Hence, nutrition education and awareness programs stand as foundational pillars to witness steady improvement in the community. Social protection programs can be used to improve caregivers' knowledge about child feeding and nutrition by providing education and counselling and by encouraging the use of essential nutrition services. School feeding programs providing meals and snacks to children are also shown to overcome some poverty-related obstacles and enhance food security. On the other hand, long-term programs will be required for the sustainability of the approach. These interventions can include agricultural support and capacity building for farmers, kitchen gardening, and other activities that foster self-sufficiency.

Improve infant and young child feeding practices

The LIMA found that some breastfeeding and complementary feeding practices are suboptimal. While the LIMA cannot determine the reason underlying these suboptimal breastfeeding behaviors, it is plausible that insufficient information and/or support are provided to women during the antenatal and postnatal period. As such, the continued expansion of Lebanon's BFHI and breastfeeding counselling can be recommended. In addition to expanding the BFHI and counseling, we recommend greater involvement of physicians in private practices to promote breastfeeding, as they have great influence, and their engagement could facilitate and increase adherence. Moreover, it is recommended that breastfeeding promotion be established as an integral part of ante and postnatal care to raise awareness of the importance of breastfeeding. In addition, to clearly identify the barriers to optimal breastfeeding practices after birth, research about the breastfeeding support provided at hospitals/clinics and the breastfeeding-related knowledge, attitudes and practices of women who have recently given birth should be conducted.

In addition to breastfeeding, complementary feeding indicators also must be improved in Lebanon. As complementary feeding is influenced by multiple factors across the food system, a holistic approach is warranted. Potential programs to alleviate problems with complementary feeding practices must focus on providing adequate foods to improve the

children's diet, which depends on the availability, access, affordability and desirability of such foods. At the same time, adequate health, nutrition, WASH, and social protection services will have to be provided as they are critical for the quality of the child's diet. In addition, programs are needed that improve caregivers' knowledge, which has been shown to translate into better feeding, care and hygiene practices [11]. As the LIMA found children in certain strata have poorer dietary diversity and meal frequency practices, geographic targeting of behavior change communication and social protection programs or integration of nutrition sensitive elements under existing social protection programs should be considered. In addition, since household wealth status is a clear risk factor for sub-optimal complementary feeding practices, income support programs (e.g., cash transfers) can be targeted to children in low-wealth households. These programs can also be implemented alongside awareness campaigns that stress the importance of a diverse diet and frequent feeding of children 6–23 months of age.

Reduce the prevalence of overweight and obesity

Overweight and obesity is a serious public health problem in Lebanon with high relevance, especially among older women. Given that retaining pregnancy weight after childbirth poses a major risk factor for later overweight and obesity, initiatives targeting pregnant women serve as a strategic opportunity to reduce this problem among adult women. Consequently, it is advised to include behavioral change communications and counseling for mothers to antenatal and postnatal care services. Importantly, promoting breastfeeding practices might also help lose pregnancy weight. Exclusive breastfeeding (and extended breastfeeding) has been recognized as an effective postpartum weight loss strategy, especially when combined with an adequate healthy diet.

This problem should be tackled through policy enforcement and community engagement. Modifications along the food system that can occur at the policy, private sector, public health, medical, community, or individual level are needed to promote the production and purchasing of healthy foods. Policies could include taxation measures to limit the affordability and marketing of high-sugar and high-fat foods and to promote the availability and affordability of healthy foods. Prevention is more straightforward and effective than treatment; this also applies to weight control. Improving nutritional knowledge by introducing the concept of healthy eating habits and encouraging physical activities are cost-effective measures that were reported to be impactful. Initiating awareness campaigns within schools to promote healthy eating habits could serve as a starting point.

Also, since media has recently become an important influencer in people's lives, leveraging it could be advantageous and reach more people in a timely manner. A platform, such as a social media page or mobile application, can be created where medical and nutritional information is shared. Other interventions can also consist of regular screening for overweight and obesity in primary care settings, facilitating early intervention and management. In addition to screening, weight management programs at community centers and healthcare facilities that

offer affordable nutrition counseling and follow-ups, as well as physical activity guidance, provide behavioral change communication in a more personalized approach.

In addition, policies can be established to promote physical activity. According to the WHO, though numerous societal and environmental factors influence weight gain and retention, “dietary factors and physical activity patterns are considered to be the major modifiable factors underlying excessive weight gain that, if corrected, can serve to prevent obesity” [12].

Reduce undernutrition in children

While undernutrition is not a severe problem in Lebanon, the drastic increase of stunting in children below 5 years of age from 2021 to 2023 is of concern and may indicate that current programs in Lebanon are not meeting the nutrition needs of small children. In addition, inappropriate feeding practices of infants and young children may contribute to high prevalence of stunting. Exclusive breastfeeding in the first 6 months of life should be promoted and supported to ensure adequate nutrition and protection of infants from gastrointestinal infections. The consumption of healthy, diversified diets in the complementary feeding period (6-23 months) should also be promoted to consistently improve the diversity and quality of diet for young children. Adequate feeding habits could be promoted via social protection programs by improving caregivers’ knowledge about child feeding and nutrition through education and counselling and by encouraging the use of essential nutrition services. Moreover, hygiene promotion initiatives and behavior change interventions should be expanded targeting households and child hygiene practices to prevent infections, particularly given the high prevalence of diarrhea and its significant role in stunting.

Enforce the iodization law and establish regulatory monitoring procedures

The results from the LIMA show that the coverage of iodized salt is low, and that this low coverage is associated with poor iodine status in certain subgroups.

It is recommended to enforce the law 178/2011 and ministerial decrees [13,14] to increase the coverage of adequately iodized salt in Lebanon. Lebanon’s 2016 ministerial decree requires monthly monitoring of the iodization status of all salt manufacturers, and the 2011 law stipulates the penalties for noncompliance that would be imposed by the Ministry of Public Health in collaboration with the Ministries of Industry and Economy.

In parallel with the enforcement of the iodization law, program managers should liaise with salt manufacturers to understand iodization bottlenecks and areas where technical capacity can be improved. In order for Lebanon’s salt manufacturers to conform to national standards and legislation, a clear understanding of their operational and technical challenges is required. Adequate iodization is only possible when all salt producers in Lebanon have the technical and logistical capacity to control the performance of the iodization process.

Establish sustainable regulatory monitoring procedures via a partnership between the Ministry of Public Health and Ministry of Economy and Trade. Consistent regulatory monitoring is needed to ensure that quality control measures are met by the salt producers in

Lebanon and are applied to salt imports. Regulatory monitoring data should be routinely collected and analyzed to document the compliance of different salt producers and importers and can be collected at the level of production and distribution. This data can also be used to further interpret the results of the LIMA survey and can provide valuable insights to the program managers of Lebanon's salt iodization program.

Address anemia and micronutrient deficiencies via fortification

Based on the findings of the LIMA, the fortification of wheat flour with multiple micronutrients can be an effective strategy to reduce the prevalence of anemia, iron deficiency, and other micronutrient deficiencies in Lebanon. Ninety-one countries mandate the fortification of wheat flour [15] and wheat flour programs have proven to be effective tools to reduce the prevalence of micronutrient deficiencies, anemia and neural tube defects [16–18]. Moreover, the WHO recommends the fortification of wheat flour with multiple micronutrients as a public health strategy to reduce the prevalence of anemia and micronutrient deficiencies [19].

The LIMA showed that wheat flour is widely consumed in Lebanon and that the daily per capita consumption is high enough (about 75 g) for wheat flour to be a viable fortification vehicle. Based on the deficiency prevalences found in children, adolescent girls, and women, the fortification with multiple micronutrients (e.g., iron, zinc, folic acid, vitamin B12) is warranted. Any flour fortification program in Lebanon should also consider the inclusion of several B vitamins, such as vitamin B1, B2, B3, and B6, as these vitamins can be added to a fortification program with only modest cost increases [20]. However, given the relatively low prevalence of vitamin A deficiency, the addition of vitamin A to the premix is not recommended.

To ensure that a flour fortification program can be implemented, a feasibility assessment must be conducted prior to conducting program-related activities, such as identifying stakeholders, establishing fortification legislation and standards, estimating program costs, and establishing monitoring and compliance procedures. Monitoring the compliance with fortification standards by manufacturers and importers is critical to ensure that a fortification program is effectively implemented. Moreover, it will be imperative to identify a coordination mechanism with the right governance approach to ensure that the procedures agreed upon are implemented effectively.

The LIMA also found high levels of vitamin D deficiency and insufficiency, and fortifying staple foods is also an effective approach to improve vitamin D status. Milk, dairy products, margarine, and vegetable oils are suitable vehicles for vitamin D as they all are good sources of fat, a nutrient needed for vitamin D absorption. According to the FAO's Food Balance Sheet data [21], 53 grams per day per capita of vegetable oils were consumed in 2021. Due to this level of consumption, vegetable oils should be considered for fortification. To determine if vegetable oils are indeed a viable food vehicle for vitamin D fortification, research estimating the intake of vegetable oils is needed along with a feasibility study to identify policy changes required to initiate the fortification process.

Address anemia and micronutrient deficiencies via supplementation

Micronutrient supplementation is a common public health strategy to reduce the prevalence of micronutrient deficiencies. In Lebanon, various supplementation programs could be considered to reduce the high prevalence of certain micronutrient deficiencies.

Due to the high prevalence of vitamin D deficiency in adolescent girls and women, and the important role of vitamin D for bone health and growth in infancy, it is recommended to implement a vitamin D supplementation program targeting all population groups. The recommended dose for each population group must take into consideration national and international guidelines to guarantee optimal vitamin D status. The administration of supplement to infants should commence in the first month of life and be accompanied by parental education, which has shown to reduce non-compliance and improve vitamin D status in children [22]. In addition, administering a high dose of vitamin D during pregnancy should be considered, as studies have shown a beneficial effect on the vitamin D status of newborn infants [22]. The Lebanese vitamin D guidelines launched in 2022 suggested no screening for vitamin D deficiency and no supplementation with vitamin D at a community level for the Lebanese adult population. However, the panel suggested supplementation with vitamin D among the institutionalized Lebanese adult population [23]. Despite these recommendation, immediate action in Lebanon is needed to address the high prevalence of Vitamin D insufficiency/ deficiency.

There is ample evidence that universal iron and folic acid (IFA) supplementation reduces maternal anemia, iron deficiency, and the risk of low birth weight [24]. IFA supplementation among pregnant women has also been shown to improve maternal survival and gestational outcomes and should therefore be strengthened in Lebanon.

Supplementation may also be preferable to address micronutrient deficiencies in children, as the fortification of staple foods may not be the most appropriate approach to reach young children aged 6-23 months, as their caloric intake is limited compared to their micronutrient requirements. As such, micronutrient powders programs may be envisioned to address micronutrient deficiencies in young children. In addition, even though vitamin A deficiency in children only poses a mild public health problem, a vitamin A supplementation program can counteract the development of vitamin A deficiency while strengthening children's immune systems and reduce the risk of mortality due to measles, diarrhea, and other illnesses.

To achieve a high supplementation coverage, it is recommended that children, adolescent girls and women be targeted specifically during their Primary Healthcare Centers (PHCs) visits and pre- and post-natal care visits. In addition, the distribution of supplements beyond PHCs is warranted to reach children, adolescent girls and women in rural areas and ITS. Community based distribution by community health workers and midwives, as well as schools or other community platforms, has proven to be an effective tool to increase supplement coverage [25]. As the consumption of supplements in Lebanon is generally low across all target groups, any supplementation program must be accompanied by promotional activities and behavior

change communication to ensure high consumer compliance. In addition, to ensure successful distribution of supplements and achieve a high coverage the appropriate infrastructure must be in place and viable distribution channels must be identified. Awareness could be further increased by engaging the private sector and collaborating with medical associations, dietitians, and physicians.

Promote Early Childhood Development

Children with poor nutrition and growth are at risk of poor early development, which has long-term detrimental impacts including academic attainment, poor adult physical and mental health, and lower productivity and human capital [26]. Addressing nutritional risks such as household food security and promoting IYCF programs, particularly among at-risk groups will support child nutrition outcomes but may be insufficient to promote optimal child development (learning, social-emotional and behavioral development)[27,28]. Maternal and child health services (e.g., antenatal care, immunization, and well-baby visits) provide opportunities to integrate early stimulation and responsive care advice to promote early childhood development as well as screening and early interventions for children at-risk of developmental delays and disabilities [29–32].

1. INTRODUCTION

1.1. Country overview

Lebanon is located on the eastern Mediterranean coast. According to the UN Population Division, Lebanon contains approximately 5.6 million people with a median age of 28 years old [33]. Since 2015, the size of Lebanon's population has decreased by approximately 2% per year on average.

In the past few years, Lebanon has experienced a large-scale economic and financial crisis, which has contributed to a ranking drop in the Human Development Index (HDI). As of 2021, Lebanon was positioned at 112 out of 191 countries and territories evaluated in the HDI [34]. The World Bank estimates that in 2020, over half of Lebanon's population lived below the national poverty line, and these numbers were reported to exceed 75% in 2021-2022 [35]. The rate of poverty in Lebanon is increasing; recent data by the Directorate-General for Neighborhood and Enlargement Negotiations show that 80% of the Lebanese live in poverty and 36% below the extreme poverty line, while 90% of the Syrian refugees cannot cover their basic needs [36] (under the global absolute poverty line of 2.15 standardized USD per person per day) [37].

In addition, the World Bank estimated that Lebanon's real Gross Domestic Product (GDP) declined by approximately 10.5% in 2021 on top of the 21.4% decrease in 2020, for a total diminution of about 36.5% between 2019 and 2021 and downgraded Lebanon from an upper-middle income country to a lower middle-income country in 2022 [35,38]. Lebanon's economic instability has also contributed to high levels of inflation from 2019-2022, with inflation preceding the global inflation caused by global increases in the demand for goods and global supply chain challenges, resulting in a drastic reduction in purchasing power, and thus a large proportion of the population unable to meet their basic needs. Lebanon's domestic economic situation is compounded by the Ukraine-Russia war, as the conflict has delayed shipments of maize and wheat to Lebanon from both countries, which has subsequently increased Lebanon's food prices [39].

1.2. Nutritional situation of the Lebanese population

Undernutrition, including micronutrient deficiencies, must be overcome to achieve progress in human and economic development. Women of reproductive age, particularly during pregnancy and lactation, exhibit increased nutrient needs and are therefore a vulnerable population group. Additionally, because of the critical link between maternal and child nutrition, public health efforts have turned to ensuring adequate child nutrition during the first "1,000 days" — from conception to a child's second birthday. In Lebanon, recent data show that child food poverty is high, and girls are more vulnerable to severe food poverty. More than 90% of children do not meet minimum dietary diversity: 3 out of 4 children eat less than 4 food groups per day and more than 25% of children are fed at most 2 food groups.

In Lebanon, there are recent anthropometric data describing the general nutrition situation of children. However, data showing the micronutrient status of the population are scant or outdated.

Regarding the general nutrition situation in children, a 2021 SMART survey in Lebanon is the most recent data source. This survey estimated that 7.0%, 1.8%, and 3.7% of preschool-age children (PSC) <5 years of age were stunted, wasted, and underweight, respectively [4] (see Table 2). Among Syrian and Palestinian refugee populations, higher levels of malnutrition were observed: the prevalence of stunting was 25.8% and the prevalence of underweight was 13.4% in Syrian refugee PSC. Among Palestinian refugee children, the prevalence of stunting was 10.1%, and the prevalence of underweight was 5.7% [4].

Nationally, the 2021 SMART survey estimated that 3.7% of PSC were overweight or obese. The survey also found that 41.3% of Lebanon's preschool-age children 6-59 months of age were anemic, with the highest anemia prevalences found in Mount Lebanon (64.9%) and North (61.5%) governorates. Also, the same report showed that 41.9% of non-pregnant women (15-49 years) are anemic, among whom 2.3% suffered from severe anemia (<8.0 g/dl). A 2003 survey of women 15-45 years of age from government health centers found that 17.0% were anemic [40]. No more recent survey data measuring the prevalence of anemia in Lebanese women of reproductive age could be found. Nevertheless the 2019 World Health Organization (WHO) anemia projections for Lebanon estimate that 28.3% of non-pregnant women and 27.7% of pregnant women are anemic [41].

Data on micronutrient status is largely outdated or entirely missing for PSC, adolescents, and women of reproductive age. A national study from 1998 found that the prevalence of iron deficiency anemia was 13.4% in women of reproductive age and 11.1% in PSC [42,43]. Among school-age children and adolescents, a school-based survey from 2013/2014 from Greater Beirut and Mount Lebanon estimated that the prevalence of iron deficiency among boys and girls 8 – 18 years of age was 14.2% [43]. The iron deficiency prevalence was significantly ($p<0.001$) higher among girls (20.8%) compared to boys (7.9%). Among girls, the prevalence of iron deficiency consistently increased by age group, with the highest prevalence of 29.3% found in girls 15-18 years of age. A 2003 survey of women 15-45 years of age from government health centers found that 27.2% of women had iron deficiency, and 7.7% had iron deficiency anemia [40]. This same survey observed that folate and vitamin B12 deficiencies affected 25.1% and 39.4% of Lebanese women, respectively [40].

Regarding zinc deficiency, no data was identified for preschool children or adolescents, but a 2003/2004 survey of adult women from six districts across Lebanon found that 24.3% of adult women were zinc deficient [8].

Regarding vitamin D, a 2014 cross-sectional survey from greater Beirut found that 71.9% and 39.1% of women aged 35 to 55 years old were deficient in vitamin D using the cutoffs of 20 ng/mL and 12 ng/mL, respectively [44]. An analysis of clinic/hospital data collected between 2011-2016

from male and female outpatients from Beirut estimated that the prevalence of vitamin D deficiency was 61.8% in females and 33.9% in males 1 to 80 years of age using the cutoff of <20 ng/ml [45]. Unfortunately, this study did not estimate the vitamin D deficiency for different age groups, but it noted that the largest number of male and female subjects with vitamin D deficiency were between 30-40 years of age.

Regarding iodine, a cross-sectional study of 1403 schoolchildren (6- to 10 years old) from all districts of Lebanon between 2013 and 2014, showed a median urinary iodine concentration of 66.0 µg/L [46]. Another hospital-based survey from 2018 found that pregnant women (n=400) had a sufficient iodine status, with a median urinary iodine concentration of 183 µg/L [47], above the WHO threshold of 150 µg/L [48].

Table 2. Prevalence estimates for nutrition-relevant data in the recent past in Lebanon

Nutrition indicator	2021 SMART [4]	2018 [47]	2003/2004 [8]	2003 [40]	Other
Household					
Adequately Iodized salt (iodine $\geq$ 15 ppm) (%)		80.0			
Children 6-59 months					
Anemia (%)	41.3				
Iron deficiency (%)					
Iron deficiency anemia (%)					11.1 [42]
Vit A deficiency (%)					
Zinc Deficiency (%)					
Vitamin D deficiency (%)					
Stunting (<-2SD) (%)	7.0				
Wasting (<-2SD) (%)	1.8				
Underweight (<-2SD) (%)	3.7				
Overweight (>+2SD WHZ) (%)	3.7				
Adolescents					
Anemia (%)					
Iron deficiency (%)					14.2 [43]
Iron deficiency anemia (%)					
Vit A deficiency (%)					
Zinc Deficiency (%)					
Vitamin D deficiency (%)					
Non-pregnant women 20-49 years					
Anemia (%)	41.9			17.0	
Iron deficiency (%)				27.2	
Iron deficiency anemia (%)				7.7	
Vit A deficiency (%)					
Zinc Deficiency (%)			24.3		
Vitamin D deficiency (%)					39.1 [44]
Folate deficiency (%)				25.1	
Underweight (BMI<18.5, %)			3.4		
Overweight/obese (BMI>25, %)			54.6		
Median UIC (μ g/L) [†]					
Pregnant women					
Median UIC (μ g/L) ^{††}		183			

1.3. Programs to combat micronutrient deficiencies in Lebanon

The iodization of salt is one of the main public health nutrition programs implemented in Lebanon. While the program was started in 1971, the salt iodization standards of *law 178/1971* were updated in 2011, and the current implementation decrees mandate that salt be iodized with 60–80 mg of potassium iodate (making a concentration of 35.6–47.4 ppm of iodine) [47]. Various small-scale household and market surveys conducted since 2019 indicate satisfactory performance of the salt iodization programs; however, the results of these studies are not representative, and performance of the salt iodization program was only based on whether iodization was mentioned on the package label or not [47]. No other fortification programs take place in Lebanon.

On another hand, vitamin and mineral supplementation is widespread in Lebanon. A recent survey found that the use of dietary supplements changed during the pandemic in Lebanon. This study reported that >70% of men and women >18 years of age take some type of vitamin and/or mineral supplement. Multivitamins were reported to be taken by 28% of adults, with 40%, 30%, and 15% of adults taking vitamin D, zinc, and folate supplements, respectively [49]. Although this study reports supplementation for men and women combined, the researchers note that vitamin and mineral supplementation is higher among women.

1.4. Rationale for the survey

Data on the nutritional and micronutrient status of young children and women are scarce in Lebanon. Apart from anthropometric indicators and anemia prevalence in children, no recent comprehensive assessment of nutritional status measuring either micro- or macro-nutrient indicators is available in any population group in Lebanon; let alone for vulnerable groups such as young children, non-pregnant women of reproductive age, and pregnant women. Moreover, recent data on early childhood development (ECD) is lacking in Lebanon.

The Lebanon Integrated Micronutrient, Anthropometry and Child Development Survey (LIMA) 2023 will both increase the understanding of the severity of micronutrient deficiencies and help design evidence-based nutritional intervention programs for nationwide implementation. The LIMA will also provide a baseline against which to measure the future progress of various national nutrition programs. Furthermore, by including multiple target groups, the data produced by the LIMA can be used by multiple governmental agencies to design nutrition programs and activities. Moreover, the survey will simultaneously collect data on under-nutrition and over-nutrition to provide information about the extent of the triple burden of malnutrition. Lastly, data on ECD and caregivers' mental health will further identify strategic areas for integrated child health, nutrition and development policies and programs in Lebanon.

1.5. Objectives

The LIMA 2023 was nationwide in scope and collected data from 5 target groups: 1) households, 2) children aged 0-59 months (PSC, blood from children 6-59 months of age), 3) adolescent girls 10-19 years old (AG), 5) non-pregnant women of child-bearing age, 15-49

years (NPW) [this group also includes lactating women], and 6) pregnant women of any age (PW). For more details on the survey population, see chapter 2.4. Indicators collected varied by population groups and are detailed below.

Primary and secondary objectives were proposed initially by the Ministry of Public Health and discussed by all national stakeholders in a series of meetings. They were subsequently revised based on the input of GroundWork and the technical committee.

1.5.1. Primary objectives

2. To measure the prevalence and severity of anemia in all population groups by measuring hemoglobin concentration.
3. To measure the prevalence of iron deficiency and iron-deficiency anemia in children 6–59 months of age, adolescents 10-19 years old and non-pregnant women 15-49 years. Indicators used to calculate iron deficiency (e.g., ferritin) were adjusted for the presence of inflammation using CRP and AGP levels and the approach developed by the *Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia* (BRINDA) project [50].
4. To measure the prevalence of vitamin A deficiency in children 6-59 months of age, adolescents 10-19 years old and non-pregnant women 15-49 years of age. Indicators used to calculate vitamin A deficiency (retinol and retinol-binding protein [RBP]) were adjusted for the presence of inflammation using CRP and AGP levels in all aforementioned groups except non-pregnant women 15-49 years of age; the BRINDA project does *not* recommend adjusting RBP concentrations for this population group [51].
5. To measure the prevalence of vitamin D deficiency in children 6-59 months of age, adolescents 10-19 years old and non-pregnant women 15-49 years of age.
6. To measure the prevalence of zinc deficiency in a sub-sample of children 6-59 months of age, adolescents 10-19 years old and non-pregnant women 15-49 years of age.
7. To measure the prevalence of folate and vitamin B₁₂ deficiencies among adolescents 10-19 years and non-pregnant women 15-49 years of age.
8. To measure urinary iodine concentration in adolescent girls 10-19 years, non-pregnant women aged 15-49 years and pregnant women (any age).
9. To estimate sodium and potassium intake in adolescent girls, non-pregnant women aged 15-49 years and pregnant women (any age) by measuring urinary sodium and potassium excretion.
10. To measure indicators of acute and chronic inflammation using CRP and AGP, respectively, in order to assess the inflammatory status of children 6-59 months of age, adolescents 10-19 years old, and non-pregnant women 15-49 years of age. As previously mentioned, inflammatory markers were also used to adjust micronutrient concentrations prior to estimating the prevalence of iron and vitamin A deficiency.

11. To measure lipid profile in adolescent girls 10-19 years and non-pregnant women 15-49 years of age, using serum triglycerides, total cholesterol, and HDL cholesterol concentrations.
12. To measure the prevalence of diabetes in pregnant women, non-pregnant women 15-49 years of age and adolescent girls 10-19 years using glycated hemoglobin (HbA1c concentration).
13. To measure the prevalence of hypertension in pregnant women, non-pregnant women 15-49 years of age and adolescent girls 10-19 years.
14. To measure the prevalence of acute malnutrition (wasting) using weight-for-height z-scores (0-59 months of age) and mid-upper arm circumference (MUAC, 6-59 months of), chronic malnutrition (stunting) using height-for-age z-scores, underweight using weight-for-age z-scores, and overweight and obesity using weight-for-height z-scores in children 0-59 months of age; in the same age group estimate the long-term effect of undernutrition by measuring head circumference-for-age.
15. To measure the prevalence of chronic malnutrition (small stature) in adolescents 10-19 years of age by calculating height-for-age z-scores; in the same age group, measure the prevalence of thinness calculated using the body mass index (BMI)-for-age z-scores, overweight and obesity by calculating BMI-for-age z-score.
16. To measure the prevalence of chronic energy deficiency and overweight and obesity in non-pregnant women 15 – 49 years of age by calculating BMI.
17. To measure the prevalence of undernutrition in lactating women (0-6 months after delivery) and pregnant women by measuring MUAC.
18. To measure and define the prevalence of Early Childhood Development (ECD) indicators for pre-school children 0-23 months of age using Global Scales for Early Development Household Form (CGS) and pre-school children 24-59 months of age using UNICEF's ECD Index 2030 questionnaire. As part of this objective, care in early childhood and the caregiver's wellbeing were assessed.
19. To assess the functionality of the national iodization program by measuring the household coverage of adequately iodized salt using iodometric titration.

1.5.2. Secondary objectives

Other variables which may influence various types of malnutrition and child development or play a potentially causative role were also assessed. Such additional variables included socio-economic status, household food security access, livelihood coping strategies, individual food consumption patterns, dietary diversity, infant and young child feeding and breastfeeding practices, intake of micronutrient supplements, and others. Further, a module on wheat flour consumption was included since wheat flour fortification is an effective, simple, and inexpensive strategy for supplying multiple vitamins and minerals. Additionally, a short module on household purchases of supposedly fortified salt was included.

2. METHODOLOGY

2.1. Sampling frame development

The sampling universe consisted of all households residing in Lebanon at the time of survey data collection, regardless of nationality and/or ethnicity. To make separate estimates of each outcome for Lebanon administrative zones, 8 explicit strata were created representing the 8 governorates. In addition, to make separate estimates of each outcome for Lebanon's refugee population, 2 explicit strata were created for Syrian refugees in informal tent settlements (ITS) and Palestinian refugees in camps. For the Palestinian camps stratum, PSU lists and maps from the 2017 Population and Housing Census in Palestinian camps and Gatherings in Lebanon (PHCCG-2017) [52] were provided by UNRWA, and for the Syrian ITS stratum, updated settlement lists for all governorates including GPS coordinates were provided by UNHCR. The enumeration areas (EAs) of the two refugee strata were selected using probability proportional to size (PPS) sampling.

As Lebanon has not implemented a nationwide census since 1932, geographic data and mapping techniques were used to construct a sample frame for the 8 governorate strata of the LIMA. For that, PSUs were created by overlaying a hexagonal grid over all governorates of Lebanon. Hexagons, rather than squares or equilateral triangles, were used as they have the lowest perimeter-to-area ratio of the aforementioned shapes. Of all shapes, circles have the lowest perimeter-to-area ratio, however, a grid constructed using circles does not tessellate (i.e., it contains gaps) and thus cannot be used to establish PSUs that cover all areas of a country [53,54]. The diameter of each hexagon was 0.620 kilometers in six of the eight governorates: Akkar, Baalbek-Hermel, Bekaa, El Nabatieh, North, and South. For the Beirut and Mount Lebanon governorates, smaller hexagons, each with a diameter of 0.124 kilometers, were initially used due to the higher population density in these governorates. Expansion of the hexagons was considered at a later stage when a PSU held fewer households than required.

The *difference* function in the Quantum Geographic Information System (QGIS) was utilized to remove the 12 Palestinian camps from the hexagonal grids used to overlay Lebanon. Geographic data containing the boundaries of the 12 Palestinian camps were provided by UNRWA. Geographic data with the precise locations of the Syrian ITS were not available and thus, could not be excluded from the sampling frame. The *difference* function in QGIS was also utilized to remove airports and military installations. This layer was manually developed by GroundWork using information available on Google Maps.

To estimate the population of each hexagon/PSU, an open-source High Resolution Settlement Layer (HRSL; [55]) displaying the estimated population density was accessed first. This layer provided the estimated number of people residing in a 30-meter square pixel grid. Second, to calculate the population residing in each hexagon/PSU, QGIS' *zonal statistics* function was used to sum the values of the pixels from the HRSL layer within each hexagon/PSU.

To estimate the number of households residing in each hexagon/PSU, the estimated population for each hexagon/PSU was divided by the average household size in the governorate measured by the 2021 SMART survey [4]. Hexagons/PSUs with <1.0 household were considered uninhabited and were excluded from the sampling frame. The remaining hexagons/PSUs were used for the first stage of selection, where a predefined number of hexagons/PSUs was selected separately for each stratum. PPS sampling was used to select hexagons/PSUs in each stratum. After the random selection of all PSUs, their list and locations were shared with local experts for ground verification.

2.2. Geographic scope and basic sampling frame

Stratum-specific sample sizes were calculated due to differences in household size and composition. Thus, different numbers of PSUs were randomly selected for each stratum to achieve the desired sample size. The LIMA included the following numbers of PSU in the different strata: Akkar: 30; Baalbek- Hermel: 33; Beirut: 70; Bekaa: 40; El Nabatieh: 43; Mount Lebanon: 47; North: 43; South: 48; Palestinian camps: 32; Syrian ITS: 27 (Figure 1). Nationally, the LIMA selected 413 PSUs. In a later phase, 30 additional PSUs were added to Beirut, 20 to Mount Lebanon and 1 to the South, accounting for the lower response rate and eligibility in these strata to improve statistical precision of the outcomes. At the end of the project, the total number of PSUs was set at 464. Due to unforeseen security circumstances, data collection was stopped in El Nabatieh stratum and the Palestinian camps ahead of time. Therefore, 2 PSUs from El Nabatieh and 6 PSUs from the Palestinian camps were incomplete, resulting in 456 completed PSUs in total.

In each PSU, a maximum of 20 households were randomly selected. In all strata except for the Syrian ITS, PSUs with less than 20 households the area was expanded in an attempt to meet the required number of households. When expansion failed its purpose, all households ended up being selected. In the Syrian ITS stratum, all households were selected when PSUs had less than 20 households. In each selected household, all members of each target group were recruited for the survey with the exception of non-pregnant women 20–49 years of age. Due to the large number non-pregnant women 20-49 years of age, this population group was recruited in a random subsample of one half of selected households.

Separate samples were selected for each of the 10 strata to produce stratum-specific estimates. Samples collected from the 10 strata were combined and appropriately statistically weighted to produce nationally representative estimates. The approach for the LIMA 2023 enabled the calculation of sufficiently precise estimates for each stratum to make stratum-specific conclusions and recommendations, except for pregnant women, where only national estimates were obtained with reasonable precision. Moreover, the sampling approach enabled the calculation of sufficiently precise separate estimates for Lebanese citizens and Syrians residing in the settled population.

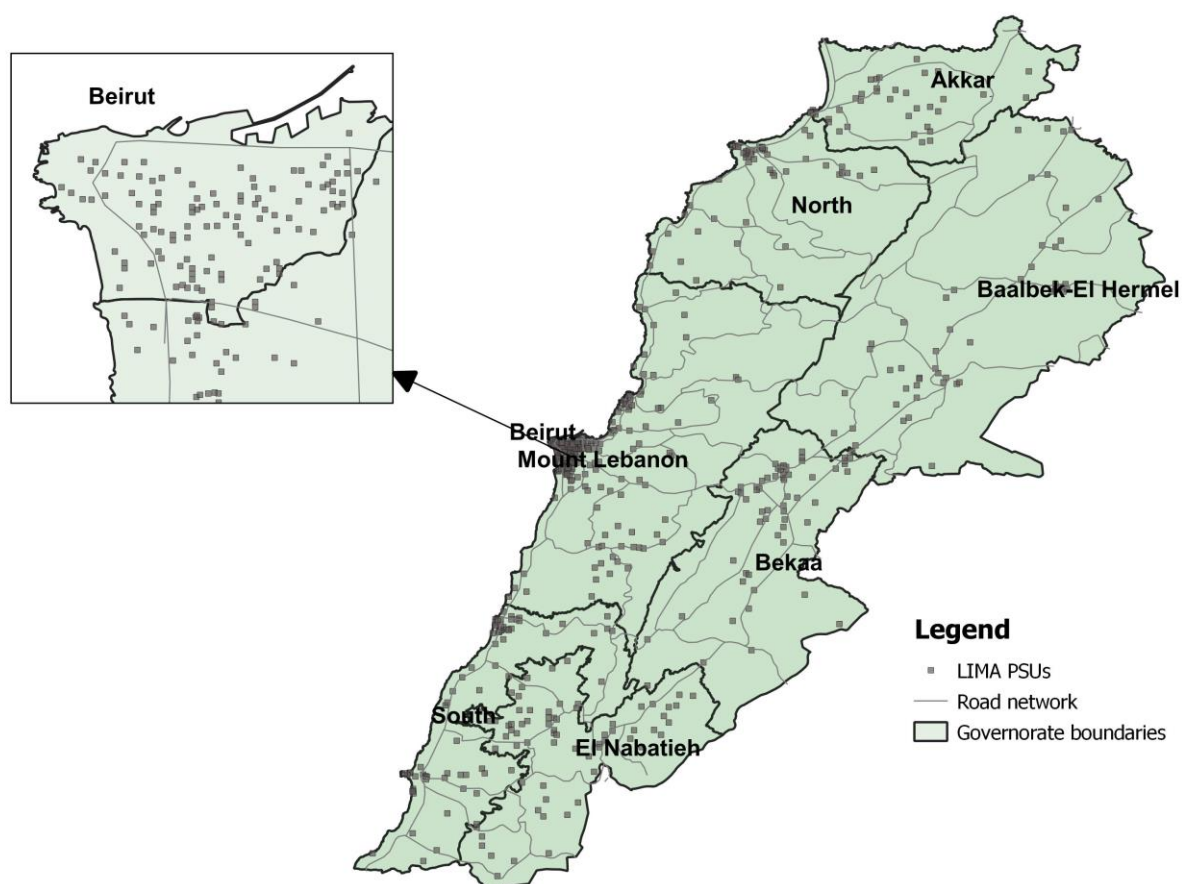


Figure 1. Lebanon`s administrative zones and PSUs selected for LIMA

2.3. Sampling approach and sample size determination

The LIMA 2023 was a cross-sectional stratified survey based on a probability sample, large enough to produce stratum-specific estimates for priority nutrition and health indicators. These estimates were expected to yield acceptable precision for decision-makers to draw conclusions and make programme decisions.

For the sample size calculation, the key indicator used was anemia prevalence among children 6-59 months of age, as anemia was one of the key indicators of the LIMA and the only primary biomarker that was recently assessed in young children nationally and by stratum.

The Fisher's formula for estimating the minimum sample size for prevalence descriptive studies was used as follows:

$$n = \frac{Z_{\alpha/2}^2 P(1-P)}{d^2} * DEFF * \frac{100}{RR}$$

Where:

n = minimum sample size, expressed as number of units of analysis

$Z_{\alpha/2}$ = Z value corresponding to 95% confidence intervals

α = the probability of type I error, set at 0.05

P = the assumed prevalence

d = the allowable sampling error, or ½ the desired confidence interval

DEFF = design effect

RR = response rate expressed as a decimal

The calculated number of children and women needed for the survey sample had to be converted to the number of households to select, which was done by accounting for the average household size and the proportion of the general population made up of the specific target group in each of the different strata using the SMART 2021 data.

Response rates were based on the ones reported for the SMART 2021, and separate response rates for each target group and stratum were used as part of the sample size calculations. Household response rates ranged from 87%-98%. Assumptions made and used to calculate the required sample sizes were as follows: Akkar 87%; Baalbek- Hermel 92%; Beirut: 88%; Bekaa 97%; El Nabatieh 89%; Mount Lebanon 97%; North 97%; South 89%; Palestinian camps 98%; Syrian ITS 92%. For pre-school children, all calculations assumed 90% and 80% response rates for questionnaire data and blood samples, respectively. For women (pregnant and non-pregnant), response rates for questionnaire data were assumed to be 95%; response rates for blood were assumed to be 90%. For adolescent girls, questionnaire data and blood response rates were both assumed to be 85%.

In total, 8120 households were calculated to be selected to ensure a sufficient sample size of households, children, and non-pregnant women. For PSC, the selection of 8120 households should have resulted in approximately 2616 eligible PSC for the entire survey sample, about 1892 of whom had biological specimens. Further, about 3624 NPW should have been eligible, 3261 of whom had biological specimens collected. Young women aged 15-19 years belong to two target groups: NPW and AG. Thus, for the target group of AG, only girls aged 10-14 years were to be additionally recruited. The selection of 8120 households should have resulted in the recruitment of about 2073 AG (10-19 years), about 1803 with a blood sample.

2.4. Study populations

The study participants were recruited from the randomly selected households located in the designated PSUs. Table 3 lists the inclusion criteria for enrolment into the survey, disaggregated by target population groups. There were no specific exclusion criteria other than the negation of the inclusion criteria. Importantly, since non-pregnant females aged 15-19 years belong to both the AG and NPW target groups, three separate target groups were used as part of the inclusion criteria for the survey (Table 3): AG 10-14 years of age, AG/NPW 15-19 years of age, and NPW 20-49 years of age. However, during data analysis, all 15-19 years old females were attributed to the AG target group, and a sub-sample of the same females aged 15-19 years (from half of participating households, see section 2.1) were attributed to NPW, such that the AG group included females from 10-19 years, while the NPW group comprised females 15-49 years of age.

Table 3. Inclusion criteria by targeted population groups

Target population	Inclusion criteria
Households ¹	- Household head or spouse or other adult household member gives written consent for survey data collection - Members currently reside in Lebanon regardless of nationality and/or ethnicity
PSC	- Age between 0-59 months of age at the time of survey data collection - Considered a household member by adults living in the household - Mother or caretaker gives written consent for interview and collection of biologic specimens
AG	- Age between 10-14 years of age at the time of survey data collection - Considered a household member by adults living in the household - Written assent obtained from participating adolescent girl - Mother or caretaker gives written consent for interview and collection of biologic specimens
AG/ NPW	- Age 15-19 years at the time of survey data collection - Currently non-pregnant by self-report - Considered a household member by other adults living in the household - Written assent obtained from AG/NPW if <18 years - Gives written consent for survey data collection; if <18 years, mother or caretaker gives written consent for interview and collection of biological specimens
NPW	- Age 20-49 years at the time of survey data collection - Considered a household member by other adults living in the household - Currently non-pregnant by self-report - Gives written consent for survey data collection
PW	- Currently pregnant by self-report - Considered a household member by other adults living in the household - Gives written consent for survey data collection

¹ A person or a group of related or unrelated persons, who live together in the same dwelling unit, who acknowledge the same person as the head of the household, who share the same or common living arrangements are considered as a household.

2.5. Ethical consideration

In order to ensure that the survey follows principles to protect respondents and prevent unnecessary risks to survey respondents, ethical approval for the study was obtained from the AUB ethical review committee (see Appendix 8.6 for approval letter). In addition, the Early Childhood Development and Care component was approved by the Ethical Review Board of the Harvard T.M.H. Chan School of Public Health (see Appendix 8.6 for approval letter).

The survey was conducted in line with the UNICEF procedures for ethical standards in research, evaluation, data collection and analysis [56] and followed UNICEF's ethical reporting guidelines [57]. Furthermore, the survey respected UNICEF's Child Protection Code. The utmost care was taken to ensure that no human rights were violated and that the survey complied with all the principles of the international human rights framework [58].

For household interviews, written consent was sought from the household head or, in his/her absence, from another adult household member. The selected females 18-49 years of age and child/ girl caregivers were asked to provide written informed consent for themselves and their participating children. Moreover, adolescent girls 10-17 years old were asked to provide written assent (see Appendix 8.7 for information sheet and consent and assent forms). It was stated in the consent forms that participation in the LIMA was voluntary and that participants could withdraw from the survey at any point, including before giving blood samples. Interviews, measurements (e.g., blood pressure, anthropometry), urine and blood taking were conducted in the selected households.

Confidentiality of information from the respondents was upheld with the utmost care throughout data collection, processing, analysis, and storage. Identifying records in both electronic and paper forms, were stored under lock and key (or password) at all times, and access was exclusively granted to identified survey personnel. Specific identifying information was stripped from all electronic databases used by the survey management team for data analysis before the submission of the databases to national stakeholders.

No blood was taken from children younger than 6 months to protect them from undue discomfort due to the blood collection. Furthermore, if the first attempt of blood sampling failed, the technicians asked the participant (or caregiver) if they agreed to a second attempt. If granted and the second attempt failed, no more sampling attempts were made.

Participants diagnosed with malnutrition or hypertension were directly referred to a health facility by the health professionals of the team (anthropometrics and phlebotomists). Participants with severe anemia or diabetes were contacted by the survey team within 48 hours of data collection and referred to a health facility.

As part of the consenting process, individuals were asked to provide their phone number or email address, which enabled the LIMA team to provide them with their biological results (e.g., complete blood count, HbA1c, serum Vitamin D, Vitamin B12, folate, triglycerides, total and HDL cholesterol, and urinary sodium, potassium, and creatinine) within 72h of collection. If an individual did not wish to share contact information, all the data collection continued, and the individual was told that they would not be informed about their blood results.

2.6. Field work and data collection

This chapter provides a description of the approach taken to collect data in the field and includes operational details about how the LIMA fieldwork was conducted.

2.6.1. Community mobilization and sensitization

Prior to the training and fieldwork, a comprehensive sensitization plan was developed. It aimed at preparing the team to prevent and face data collection barriers, engaging and informing community leaders, and creating a conducive environment for household/individual participation.

An official letter from the Ministry of Public Health (MOPH) was issued and sent to the Ministry of Interior (MOI) and the Ministry of Defense to explain the study objectives and to get their approval to access the selected areas. The MOI then disseminated a circular to the municipalities to facilitate the work of the field teams. Other informative letters were also shared with the medical doctors overseeing the primary healthcare systems in the governorates. These letters, endorsed by the MOPH, provided a detailed overview of the micronutrient survey's objectives and anticipated outcomes, and aimed to secure support and cooperation in sensitizing the community and facilitating access to regions.

In addition, several informative meetings and trainings took place before the launch of the survey. A hotline number was dedicated to address community queries and answer questions from the field. Hotline personnel received online training during which concerns for participation were proactively discussed and addressed, so that personnel could answer clearly and coherently any questions. Also, an induction session for the MOPH inspectors was conducted. Approximately 50 officers from all governorates gathered at the ministry, where they were thoroughly briefed on the entire survey process. Moreover, a meeting with nutrition sector partners was convened, ensuring that all relevant agencies were well-informed about the survey's objectives, timeframe, key indicators, and the locations/areas where data collection took place.

Community awareness efforts involved direct contact by UNICEF's regional focal points and Mercy-USA's team to communicate with municipality leaders and explain the scope of the survey. The aim was to secure clearance for survey teams to access the selected communities. Further coordination took place with Syrian ITS and Palestinian camps strata by contacting camp directors and staff appointed by UNRWA and UNHCR.

Right before the survey training commenced, a media-covered launch event was held at the MOPH on July 13, 2023. This event garnered public attention and served to underscore the project's importance.

2.6.2. Training of survey teams and field testing

For the recruitment of field workers AUB initiated an outreach campaign to solicit candidates for various positions integral to the study. Applications were critically reviewed and candidates that met the inclusion criteria were shortlisted. Shortlisted candidates underwent thorough background checks, including reference verification. Subsequently, virtual interviews were conducted to assess their suitability for the project.

Prior to data collection, team members were thoroughly trained, and all survey instruments were pre-tested during the training. The training consisted of classroom instruction and practice, and of field testing of all survey procedures.

Listers were trained on how to locate the PSU, read maps and identify the boundaries of the PSU, identify and list eligible households and randomly select households for participation in the survey.

Interviewers received extensive classroom training on each questionnaire, whereby they discussed each question, practiced reading the questions, and role-played interviews in Arabic. In addition, instructions were provided on how to record, save, and upload data on the tablet computers (Galaxy, Samsung™) and the data entry software (KoboCollect) used in the survey.

As part of classroom training, anthropometrists and phlebotomists were trained on anthropometric and blood and urine collection techniques. Two standardization exercises were conducted for the survey anthropometrists, whereby an anthropometrist, assisted by a phlebotomist, measured and recorded a) the length or height, MUAC, weight, and head circumference of 10 children and b) height, weight, and waist circumference of 10 women, and their results were checked for precision as well as for accuracy when compared with instructor's "gold standard" measurements. Blood collection procedures were practiced, which included blood collection technique, as well as training on labelling of blood and urine samples, processing of samples, labelling of aliquots, pipetting procedures, and maintenance of the cold chain when transporting the specimens.

Team leaders and regional supervisors rotated between the different training sessions to internalize all aspects of the survey.

Following classroom training, two days of field testing were undertaken in four PSUs in Mount Lebanon that were not included in the survey sample. The teams conducted the listing and household selection, interviews, anthropometry, and phlebotomy. Specimens were transported to AUB Medical Centre (AUBMC) for analyses.

Approximately 20% more field workers than required were enlisted for the training to ensure that all survey staff ultimately hired could successfully implement the survey procedures. To assess their understanding of field procedures, a written exam containing questions about various survey procedures was given to all survey staff towards the end of the training. The results of this exam, as well as the results of the anthropometry standardization exercises, blood collection abilities and observations from the survey trainers were used to a) identify the best-performing team members, and b) identify survey workers that could not adequately understand and implement the survey procedures. These individuals were released and were not included in the field work.

2.6.3. Household listing and selection

Prior to data collection, all households located in the selected PSU were listed in order to create a complete and updated list of households for all selected PSUs. This list served as a sampling frame for the final selection of households included in the LIMA 2023 sample.

In total, 13 listing teams, each consisting of 2 listers, conducted the listing in the 10 strata. The teams were trained by international experts. Each listing team was linked to a data collection team. Clearance from the municipality officials was obtained for each PSU before the listers entered the PSU. The household listing was conducted a few days before the actual data collection teams arrived at the PSU for data collection. The household listing exercise

consisted of delimiting the PSU by using maps and updating the maps by adding newly built structures. Subsequently, every household residing in the selected PSU was listed on a household listing form (mini census), and information about the head of the household (name, phone number if available) along with information helping to locate the household were collected. Once the listing had been completed, the listers selected 20 households at random using random number tables and recorded the selected households in a separate form, i.e., the cluster control form. Upon arrival of the data collection team, the household listing form and the cluster control form were handed over to the data collection team leader. During the handover, listers showed the teams the location of the selected households.

2.6.4. Labelling of forms and biological specimens

Laboratory testing results had to be matched with interview data from enrolled children, adolescents, and women. This matching was done using a unique survey identification number assigned to each child, adolescent girl and woman recruited for the LIMA. These identification numbers were pre-printed on labels to be applied to various forms and blood and urine tubes. Several copies of matching labels were available to apply to all laboratory aliquots from the same child, adolescent girl, or woman. This code number was entered into the electronic data collection platform (KoboCollect) more than once to minimize the chance of errors.

The laboratory technicians at AUBMC responsible for biomarker analyses (e.g., CBC, HbA1c, vitamin D, vitamin B12, folate, triglycerides, HDL and total cholesterol, sodium, potassium and creatinine) linked the unique survey identification numbers with their internal bar-code system. To do this, the technicians manually entered the unique survey identification number on the label of each vacutainer and urine tube, and then fixed and scanned the internal bar-code to the same vacutainer/ tube. After completion of analyses, samples were sent to the AUB Nutrition Research Laboratory for aliquotation of plasma and serum into labelled cryovials for later analyses (zinc, urinary iodine) and shipment to international laboratories.

2.6.5. Field work: Collection of data

Data collection in the 455 PSUs was conducted between July 24 and November 14, 2023.

Each of the 13 teams comprised one team leader, four interviewers, one phlebotomist, one anthropometrist and one driver. The members of each team are listed in Appendix 8.10. One team was assigned to each of Akkar, Baalbek-Hermel, Bekaa, El Nabatieh, North, Palestinian camps, and Syrian ITS; and two teams were assigned to each of Beirut, Mount Lebanon, and South. Teams were responsible for data collection in all randomly selected households in the selected PSUs. All reasonable attempts were made to recruit selected households. At least two repeat visits were made before dismissing a household as absent.

Tablet computers were used for direct data entry during field data collection. One questionnaire tool was developed on KoboCollect, and this tool was able to collect all the household-level information and individual-level information (i.e., information from children and adolescent girl/ women) into one form. This process ensured that all individuals could be linked to their respective household data, and that all children could be linked to their mother

or caretaker. Skip patterns were built into the electronic system to speed up the interviewing process by automatically skipping over irrelevant questions. In addition to the electronic questionnaire, a series of supporting paper-based instruments were used to facilitate field work and ensure high-quality field work.

2.6.6. Field work: Interviews

Interviewers administered the household questionnaire component first, followed by the child and adolescent girl/ woman questionnaires component if the household had eligible children and/ or adolescent girls/ women. During the household interview, a household roster was completed. Household and individual questionnaires were available in English and Arabic. Interviews were conducted in the interviewee's preferred language. All questionnaires are provided in Appendix 8.11. Discrepancies between the English and Arabic versions of the questionnaires were discussed and harmonized during questionnaire reviews; lastly, during training and field testing, any remaining issues were corrected in all versions of the questionnaires.

Where available, standard questionnaire modules were used, such as infant and young child feeding (IYCF) questions from WHO and UNICEF [59] and questionnaires for early childhood development [60,61].

To help the respondents recall food products, interviewers used a picture catalogue containing commonly used food products, e.g., infant cereals, fortified foods, iron supplements, etc. Similarly, for the women's questionnaire, the 24-hour recall module was adapted from existing tools [62].

Salt specimens (approx. 50 g) were collected in every second recruited household by the interviewers after completion of the household interview. For selected adolescent girls, women and children, interviewers prepared and labelled a biological form (see Appendix 8.11) and handed out a labelled urine beaker to selected adolescent girls and women. Participants were instructed to hand over the biological form and urine beaker to the anthropometrist and phlebotomist upon their arrival. The form was then completed by the anthropometrist and phlebotomist, who recorded anthropometric measurements, blood pressure in adolescent girls, non-pregnant and pregnant women, and the estimated volume of urine and blood collected from the participants that consented to provide urine and/ or blood samples. The interviewers then entered the information from this paper-based form whenever time allowed into a corresponding electronic data entry form on their tablet computers.

The following data was collected about the household:

- General household demographics;
- List of household members;
- Water supply, household water treatment, sanitation facilities used, and handwashing practices adopted by members of the household;
- Ownership of land, animals, and durable goods, and characteristics of the dwelling, such as materials of the roof, walls, and floors, in order to estimate socio-economic status;
- Household food insecurity access (HFIAS) [ADD ref 109];
- Consumption estimation of salt.

The following data was collected about pre-school children:

- Date of birth, weight at birth and estimated age;
- Presence of fever, diarrhea, and/or acute respiratory infection in the past 2 weeks;
- Priority IYCF, as recommended by WHO and UNICEF [59], focusing on current breastfeeding, introduction of complementary foods, and dietary diversity;
- Consumption of vitamin and mineral supplements in the recent past, and if the supplements were recommended by a doctor;
- Early childhood development as recommended by UNICEF and WHO [60,63];
- Sun exposure.

The following data was collected from adolescent girls, non-pregnant women and pregnant women and recorded in the woman's section in the electronic data collection form:

- Age;
- Marital status;
- Educational level;
- Menstruation, pregnancy or lactation status;
- Presence of fever, diarrhea, and/or acute respiratory infection in the past 2 weeks (adolescent girls only);
- Minimum dietary diversity and wheat flour consumption;
- Consumption of vitamin and mineral supplements in the recent past, and if the supplements were recommended by a doctor;
- History of cardiometabolic diseases;
- Sun exposure;
- Cigarette smoking (to adjust hemoglobin values).

A separate questionnaire on caregiver wellbeing and nurturing care was administered to caregivers of included children in up to 7 households per PSU (depending on eligibility) by an interviewer specifically trained on early childhood development tools. This interviewer followed the anthropometry and phlebotomy sub-team to the household to collect data. The following data was collected from caregivers of eligible pre-school children:

- Child trauma;
- Early learning;
- Stimulation with fathers or other caregivers;
- Child protection;
- Access to key services and resources;
- Father involvement in care;
- Attitudes towards domestic violence;
- Maternal decision making;
- Access to key support services and resources.

2.6.7. Field work: Anthropometry and phlebotomy

Interviewers handed the urine beaker to participants who were instructed to fill it and give it to the anthropometrist/phlebotomist. A spot urine sample was collected from each selected adolescent girl and woman. Urine samples were aliquoted in the field and placed into cold boxes.

Weight measurements from selected children, adolescent girls and non-pregnant women were taken using standard methods [64] on a SECA scale (UNICEF, # S0141021) that measured weight to a precision of ± 0.1 kg. For children who could not stand by themselves, the mother or caregiver was first measured alone, then together with the child, so that the child's weight was obtained by automatic subtraction using the scale's tare function. The scales were calibrated every morning using a 2.5 kg calibration weight and results were entered into a scale calibration monitoring spreadsheet. Scales were replaced if the deviation from target was more than 0.1 kg. Children's height or length was measured to the nearest 0.1 cm by using a standard wooden height board (UNICEF, #S0114530). For adolescent girls and non-pregnant women, height was measured to the nearest 0.1 cm using a stadiometer (UNICEF, #S0114520). MUAC was measured on children (6-59 months; UNICEF, #S0145620), pregnant women and lactating women (up until 6 months after delivery; UNICEF, #S0145630). Only MUAC was measured in pregnant women to assess their nutritional status since weight measurements do not provide useful anthropometric information during pregnancy. Head circumference was measured in children using a SECA 212 measuring tape and waist circumference was measured in adolescent girls and non-pregnant women using a SECA 201 measuring tape with an error range of ± 0.5 cm. Each anthropometric measurement was carried out twice in order to ensure a high quality. A third measurement was conducted in case the first two measurements were too far apart (> 0.1 kg or > 0.5 cm).

Afterwards, participants were asked to sit down. Before withdrawing blood, the phlebotomist measured blood pressure for adolescent girls and pregnant and non-pregnant women on their left arms, three times within 10 minutes by a semi-automatic blood pressure device (OMRON 300). The average of the 3 measurements was recorded in the biological form and then entered into KoboCollect.

For children (6-59 months), adolescent girls and non-pregnant women, blood was collected via venipuncture from the antecubital vein (if possible) into 5 ml serum SST vacuum tubes and 3 ml plasma EDTA vacuum tubes. For pregnant women, blood was collected via venipuncture into 3 ml plasma EDTA tubes only. Immediately after blood collection tubes were gently inverted and placed in a cool box containing cold packs to ensure they were stored cold but not frozen at +4 °C to +8 °C and in the dark until further processing later the same day. The temperature in the cold boxes was monitored using thermometers every two hours. All blood tubes were labelled, and labels were written on a log form that was shared with the AUBMC laboratory each day along with the collected blood tubes.

Participants found to have moderate or severe acute malnutrition, hypertension, diabetes or severe anemia were referred for treatment at the nearest health hospital or clinic (see Appendix 8.12 for the referral form).

At the end of each day, the team leader reviewed and collated the biological forms and consent forms, and reviewed data collected in KoboCollect. Interviewers were notified of any errors and/or omissions, whereupon they were instructed to make the necessary corrections, when needed.

2.6.8. Cold chain and processing of blood samples

Following collection, all blood samples were placed on cold packs (at +4 °C to +8 °C) in the dark until processing. Phlebotomists recorded the temperature inside the cold boxes containing the cold packs every two hours. If the temperature was below +4 °C or above +8 °C, phlebotomists removed or added one cold pack, respectively, and monitored the impact on the temperature inside the cold box.

Every evening, when the field teams stopped their daily work, log forms having all collected labels were shared with the lab staff and the blood and urine samples were transported to AUBMC laboratory. Upon receiving, the temperature of the cold boxes was checked, the labels and types of tubes were checked and the AUBMC bar-codes referring to the survey labels were put on the tubes. The EDTA tubes were analyzed first for the CBC and then for HbA1c. The SST tubes were centrifuged, and serum was assessed for vitamin D, folate, vitamin B12, total cholesterol, triglycerides, and HDL. Spot urine was analyzed for sodium, potassium, and creatinine. Tubes were later transported to the AUB Nutrition Research Laboratory for aliquoting and urinary iodine concentration determination. Aliquots were shipped to Jordan and Germany in two batches: towards the middle and after the completion of data collection.

2.6.9. Supervision of fieldwork

Supervision was provided continuously and consistently. During the first week of field work, intense supervision was conducted to identify and address any flaws, as well as initial quality assurance. In addition to team leaders, roaming supervisors from various organizations ensured that the correct survey procedures were followed, i.e. a follow-up quality assurance measure.

Mercy-USA, along with AUB's field Officer, provided training to regional focal points of other partners on fieldwork supervision. The training included the presentation of a monitoring checklist covering all survey components and activity implementation details, as well as individual and team performance assessments. Mercy-USA conducted field supervisory visits 2 to 3 times weekly, with feedback, comments, and challenges reported to GroundWork for necessary action. Corrective measures were discussed during the weekly call with all survey team leaders.

2.7. Definitions of indicators and specimen analysis

2.7.1. Infant and young child feeding indicators

The 2021 WHO/UNICEF guidelines on indicators for assessing infant and young child feeding (IYCF) practices [59] were used to assess various breastfeeding and complementary feeding practices in children 0-23 months of age. These guidelines define minimum diversity as consuming foods and beverages from at least five out of the eight defined food groups (including breastmilk) during the previous day. Of note, the age range used for the various IYCF indicators varies. For example, exclusive breastfeeding was assessed in children <6 months of age, minimum dietary diversity was assessed in children 6-23 months of age, and early initiation of breastfeeding was assessed in children 0-23 months of age.

2.7.2. Anthropometric indicators

Children less than 5 years of age

In children 0-59 months of age, undernutrition (including wasting, stunting, and underweight) and overnutrition were calculated using WHO Child Growth Standards [65]. Children with z-scores below -2.0 for weight-for-height, height-for-age, or weight-for-age are defined as wasted, stunted, or underweight, respectively. Moderate wasting, stunting, and underweight are defined as a z-score less than -2.0 but greater than or equal to -3.0. Z-scores less than -3.0 define severe wasting, severe stunting, or severe underweight. Overnutrition is defined as a weight-for-height z-score greater than +2.0. Overweight is a weight-for-height z-score greater than +2.0 but less than or equal to +3.0. Obesity is defined as a weight-for-height z-score greater than +3.0. Children with z-scores below -2.0 for head circumference-for-age are defined as having a small head circumference. Z-scores were deemed as biologically implausible and therefore deleted if < -6.0 or > 6.0 for height-for-age, < -6.0 or > 5.0 for weight-for-age, and < -5.0 or > 5.0 for weight-for-height and for head circumference-for-age [65]. For children 6-59 months, a data quality assessment was conducted using the "ENA for SMART 2020" data analysis program (see Appendix 8.13).

Adolescent girls 10-18 years of age

In adolescent girls aged 10-18 years, undernutrition (including short stature and underweight) and overnutrition were calculated using WHO growth charts [66]. Girls with z-scores below -2.0 for height-for-age were defined as having a short stature; acute malnutrition (or thinness) was defined as girls having BMI-for-age z-score below -2.0.

Overweight was defined as a BMI-for-age z-score of greater than +1.0, while obesity was defined as a BMI-for-age z-score of greater than +2.0 [67].

Visceral/central obesity was assessed using an adolescent girl's waist circumference. The waist circumference was measured to the nearest 0.1 cm using a measuring tape placed around the survey subject's midriff midway between the iliac crest and the lower rib margin [68]. According to the International Diabetes Federation (IDF) recommendations, a waist circumference equal or greater than 80 cm defined central obesity [69] in non-pregnant women aged ≥ 18.0 years from a European ethnic group. For adolescent girls aged 10.0-17.9 years, age-specific waist circumference cutoffs were used to classify girls with visceral/central obesity [70].

Non-pregnant women

Chronic energy deficiency and overnutrition in non-pregnant women were assessed by using BMI. The most commonly used cut-off points for BMI to define levels of malnutrition in non-pregnant women have been applied: < 16.0 severe undernutrition, 16.0-16.9 moderate undernutrition, 17.0-18.4 at risk of undernutrition, 18.5-24.9 normal, 25.0-29.9 overweight and ≥ 30 obesity [71].

Visceral/central obesity was assessed using a non-pregnant woman's waist circumference. The waist circumference was measured to the nearest 0.1 cm using a measuring tape placed around the survey subject's midriff midway between the iliac crest and the lower rib margin [68]. According to the International Diabetes Federation (IDF) recommendations, a waist circumference equal or greater than 80 cm defined central obesity [69] in non-pregnant women aged ≥ 18.0 years from a European ethnic group. Of note, the IDF recommendations do not specify a waist circumference cutoff for "Eastern Mediterranean and Middle East (Arab) populations" but rather recommend that researchers use European cutoffs "... until more specific data are available" [69]. For non-pregnant women aged 15.0-17.9 years, age-specific waist circumference cutoffs were used to classify girls with visceral/central obesity [70].

Pregnant women and non-pregnant lactating women

Because body weight in pregnancy is increased by the products of conception and extra body fluid, BMI is not a valid indicator of nutritional status in pregnant women. Thus, MUAC was used instead to measure the nutritional status of pregnant women. A MUAC of less than 21.0 cm was used to define a pregnant woman as severely undernourished and a MUAC greater than or equal to 21.0 cm and lower than 23.0 cm was used to define a pregnant woman as moderately undernourished [72]. A MUAC < 23.0 cm was used to define all undernutrition.

The same MUAC cut-offs were used to define undernutrition in non-pregnant lactating women who delivered less than 6 months before the survey.

2.7.3. Blood pressure

Hypertension in adolescent girls and pregnant and non-pregnant women is defined as a systolic blood pressure equal to or above 140 mm Hg and/or diastolic blood pressure equal to or above 90 mm Hg [73].

2.7.4. Blood and urine specimens

The cut-off values for each biomarker indicator used to determine the nutritional status of each participant are presented in Table 4. For hemoglobin and urinary iodine concentrations, multiple cut-offs were used to classify the severity of anemia, vitamin D and iodine status. For other indicators, a single cut-off was used to identify deficiency or abnormality.

Table 4. Clinical cut-off points and classifications for biomarker indicators

Indicator*	Population group	Excess	Adequate	Mild	Insufficient Moderate	Severe
Urinary iodine ¹ [74]	NPNLW, AG	≥ 300 µg/L	100-299 µg/L	50-99 µg/L	20-49 µg/L	< 20 µg/L
	NPLW		≥ 100 µg/L	< 100 µg/L		
	Pregnant women	≥ 250 µg/L ²	150-249 µg/L	< 150 µg/L		
Hemoglobin [10] ³	PSC 6-23 months	--	≥ 105 g/L	95-104 g/L	70-94 g/L	< 70 g/L
	PSC 24-59 months	--	≥ 110 g/L	100-109 g/L	70-99 g/L	< 70 g/L
	AG 10-11 years	--	≥ 115 g/L	110-114 g/L	80-109 g/L	< 80 g/L
	AG >11 years and NPW	--	≥ 120 g/L	110-119 g/L	80-109 g/L	< 80 g/L
	Pregnant women					
	First trimester	--	≥ 110 g/L	100-109 g/L	70-99 g/L	< 70 g/L
	Second trimester	--	≥ 105 g/L	95-104 g/L	70-94 g/L	< 70 g/L
	Third trimester	--	≥ 110 g/L	100-109 g/L	70-99 g/L	< 70 g/L
Deficiency / excess cut-offs						
Retinol [75]	PSC, AG, NPW			< 0.7 µmol/L ^{4,5}		
Retinol-binding protein	PSC, AG, NPW			< 0.61667 µmol/L ^{4,5}		
Plasma ferritin [76]	PSC			< 12 µg/L ⁴		
	AG, NPW			< 15 µg/L ⁴		
α1-acid-glycoprotein [77]	PSC, AG, NPW			> 1 g/L		
C-reactive protein [77]	PSC, AG, NPW			> 5 mg/L		
Folate [78]	AG and NPW			< 10 nmol/L (< 4.4 ng/mL)		
Vitamin B12 [79]	AG and NPW			< 150 pmol/L (203 mg/L)		

Table continued on next page

Indicator*	Population group	Excess	Adequate	Insufficient		
				Mild	Moderate	Severe
Deficiency / excess cut-offs						
Zinc [80]	PSC		< 65 µg/dL morning sample (assuming non-fasting) < 57 µg/dL afternoon sample (assuming non-fasting)			
	AG and NPW		< 70 µg/dL morning sample in a fasting state < 66 µg/dL morning sample in a non-fasting state < 59 µg/dL afternoon sample in a non-fasting state			
25[OH]D [81] ⁶	PSC, AG and NPW		Insufficiency: 12 ng/mL (30 nmol/L) - 20 ng/mL (50 nmol/L) Deficiency: < 12 ng/mL (30 nmol/L)			
HbA1c [82]	AG, NPW, PW		Elevated HbA1c ≥ 5.7% (39 mmol/mol) Pre-diabetes 5.7-6.4% (39-47 mmol/mol) Diabetes ≥ 6.5% (48 mmol/mol)			
Triglycerides [83]	NPW[84,85], AG [86]		≥ 18 years: High (fasting): ≥ 150 mg/dL (1.69 mmol/L) High (non-fasting): ≥ 200 mg/dL (2.26 mmol/L) < 18 years: High (fasting): ≥ 90 mg/dL (1.02 mmol/L) High (non-fasting): ≥ 130 mg/dL (1.47 mmol/L)			
			≥ 18 years: High: ≥ 240 mg/dL (6.2 mmol/L) < 18 years: High: ≥ 200 mg/dL (5.17 mmol/L)			
Total cholesterol	NPW[87], AG [86]		≥ 18 years: High: ≥ 240 mg/dL (6.2 mmol/L) < 18 years: High: ≥ 200 mg/dL (5.17 mmol/L)			
HDL-cholesterol	NPW [85], AG [86]		≥ 18 years: Low: < 50 mg/dL (1.3 mmol/L) < 18 years: Low: < 40 mg/dL (1.03 mmol/L)			

Table continued on next page

Indicator*	Population group	Excess	Adequate	Insufficient		
				Mild	Moderate	Severe
Deficiency / excess cut-offs						
Urinary sodium	AG, NPW			Excess intake: ≥ 2000 mg/day		
Urinary potassium	AG, NPW			Low intake: < 3510 mg/day		

* AG, Adolescent girls 10-19 years; NPLW, non-pregnant lactating women 15-49 years; NPNLW, non-pregnant non lactating women 15-49 years; NPW, non-pregnant women 15-49 years; PSC, children 6-59 months of age; PW, pregnant women.

¹ Cut-offs are no individual cut-offs, but population group medians.

² ≥ 250 µg/L denotes an iodine status that is classified as more than adequate (250-499 µg/L) and excess (≥ 500 µg/L).

³ Because the normal hemoglobin differs by altitude and smoking, the cut-off for defining normal hemoglobin concentrations was adjusted for these factors, according to the WHO recommendations as shown in Table 5 and Table 6.

⁴ These indicators were adjusted for sub-clinical inflammation using appropriate algorithms [51,88].

⁵ No established deficiency cut-offs have been developed for RBP, and as such the linear correlation between RBP and plasma retinol was used to estimate a vitamin A deficiency cut-off of 0.61667 µmol/L (see Appendix 8.4). Further, for adult women no thresholds exist but in literature the same cut-off as for children is being used.

⁶ There is no consensus cut-off point for 25[OH]D to define vitamin D deficiency. The cut-off < 20 ng/mL is used by NHANES and many other surveys.

Anemia

Anemia, a condition characterized by an insufficient number of red blood cells in the circulation, remains a significant global health concern. It can lead to fatigue, weakness, impaired cognitive function, and other symptoms affecting individuals of all ages. Understanding the prevalence of anemia is crucial for public health interventions. In this survey, we aimed to assess the prevalence of anemia in the population groups, highlighting the importance of micronutrient status in promoting overall health and well-being.

Whole blood samples were analyzed for the complete blood count (CBC) at the AUBMC. Hemoglobin concentration was measured using COULTER UNICEL DxH SER. AUBMC successfully participates in the external quality control program for CBC of the College of American Pathologists.

Because hemoglobin concentration is affected by altitude, the World Health Organization recommends an altitude adjustment [10], as shown in Table 5. While all elevation adjustments are shown in Table 5, it is notable that highest elevation of a cluster surveyed by the LIMA was 1999 meters.

Table 5. Adjustments in cut-off defining anemia, by altitude of residence [10]

Altitude (meters)	Increase in cut-off point defining anemia (g/L)
1-499	No adjustment
500-999	+4
1000-1499	+8
1500-1999	+11
2000-2499	+14
2500-2999	+18
3000-3499	+21
3500-3999	+25
4000-4499	+29
4500-4999	+33

The LIMA adjusted the cut-off defining normal hemoglobin concentrations in adolescent girls and women based on the number of cigarettes smoked per day as per the WHO recommendations [10] (see Table 6).

Table 6. WHO adjustments in cut-off defining anemia, by smoking status

Cigarettes smoked per day	Increase in cut-off point defining anemia (g/L)
Smoker, quantity unknown	+3
< 10	+3
10-19	+5
≥ 20	+6

Plasma ferritin, RBP, retinol and acute phase proteins (CRP and AGP)

Plasma ferritin, retinol binding protein, CRP and AGP were analyzed by the VitMin Laboratory in Germany, which regularly participates in Center for Disease Control and Prevention (CDC)'s VITAL-EQA quality program. The laboratory used a combined and optimized sandwich ELISA technique using a single small-volume plasma sample [89], which has recently been validated against the methods used by United States NHANES [90].

Ferritin is recommended by the World Health Organization for population-based assessment of iron status because it is responsive to iron interventions over time [91]. RBP was used to assess the vitamin A status of all individuals in the survey. RBP can be analyzed with small quantities of plasma. It is highly correlated with plasma retinol [92], the biomarker of vitamin A status recommended by the World Health Organization [93]. Because RBP is not a WHO-recommended biomarker for assessment of vitamin A status, the correlation between the RBP results and plasma retinol measured by high-performance liquid chromatography (HPLC) was checked by testing a subset of plasma specimens from children, adolescent girls and non-pregnant women at the VitMin Laboratory, Germany and Khatib Micronutrient Laboratory, Jordan. The laboratories have repeatedly participated and performed well in this analysis in the CDC external quality assurance program Vital-EQA. Comparisons of retinol and RBP values are presented in more detail in Appendix 8.4. There was a strong correlation between retinol and RBP values when compared as continuous values, yet the RBP values were consistently lower than their respective retinol counterparts. As such, the regression equation was used to estimate the RBP cut-off for defining vitamin A deficiency, resulting in a cut-off of 0.61667 $\mu\text{mol/L}$; this cut-off value was subsequently used to define vitamin A deficiency throughout this report.

However, both ferritin and RBP concentrations are affected by inflammation; ferritin concentrations are elevated and RBP concentrations are suppressed in the presence of acute phase proteins AGP and CRP. Due to this inflammatory response, ferritin and RBP concentrations were adjusted for inflammation using the correction algorithm developed by the *Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia* (BRINDA) [50,51].

Specifically, the BRINDA equation and correction factors were used to adjust ferritin concentrations in children 6-59 months of age and non-pregnant women 15-49 years of age, and RBP concentrations in children 6-59 months of age. The BRINDA project does not recommend adjusting RBP in non-pregnant women 15-49 years of age.

For ferritin, pairwise correlations showed a significant continuous positive association between ferritin and CRP, and between ferritin and AGP in children 6-59 months of age, adolescent girls 10-19 years of age, and non-pregnant women 15-49 years of age. As such, internal correction factors were calculated and used in tandem with the BRINDA equation to adjust ferritin concentrations for inflammation.

As with ferritin, internal correction factors were calculated and used with the BRINDA equation to adjust RBP concentrations. Pairwise correlations showed a significant continuous negative association between RBP and CRP, and between RBP and AGP in children 6-59 months of age. RBP was not adjusted for adolescent girls, as the age range of this population group — 10 to 19 years of age — overlaps with age range of non-pregnant women.

HbA1c (glycated hemoglobin)

Whole blood HbA1c levels were analyzed using the CAPILLARYS at AUBMC, an automated capillary electrophoresis system, which is considered an intermediate technique between classical zone electrophoresis and liquid chromatography. HbA1c serves as a key indicator of long-term blood sugar control, offering valuable insights into the risk and management of diabetes. Values of 6.5% and above were considered diabetic, irrespective of the age group.

Serum folate

Serum folate is used to assess short-term folate status and is highly responsive to increased intakes of folate naturally present in foods and folic acid added during fortification [94]. Serum folate concentrations were measured at AUBMC using Electrochemiluminescent Immunoassay (ECLIA) on Cobas 8000 (e801) (Roche Diagnostics GmbH, Germany). Since no folate cut-offs using macrocytic anaemia as the threshold have been defined for protein-binding assays, we defined folate deficiency as the folate concentration (< 10 nmol/L) at which homocysteine levels begin to increase, as recommended by WHO [95].

Serum vitamin B12

Vitamin B12 levels in serum are accurately quantified using the highly sensitive Electrochemiluminescent Immunoassay (ECLIA) method performed on Cobas 8000 (e801) (Roche Diagnostics GmbH, Germany) at AUBMC that successfully engages in the external quality assurance program offered by the College of American Pathologists. Serum B12 levels reflect both intake and stores and work well in large-scale assessments of B12 status.

Serum vitamin D

Serum 25(OH)D concentrations were analyzed at AUBMC by Electrochemiluminescent Immunoassay (ECLIA) using the Cobas 8000 (e801) (Roche Diagnostics GmbH, Germany). For serum 25(OH)D the laboratory successfully participates in the external quality control program of the College of American Pathologists.

Serum zinc

Zinc levels in serum samples are determined using the advanced technique of Inductively Coupled Plasma Mass Spectrometry (ICP-MS) at the Laboratories for the Environment, Agriculture and Food (LEAF) of AUB.

Lipid profile

Serum triglyceride, total cholesterol, and HDL-cholesterol were assessed at AUBMC photometrically using established methods/kits on the Cobas 8000 (C702) from Roche Diagnostics GmbH, Germany.

Urinary iodine

The WHO recommends measuring iodine in urine for population-based surveys [96]. Urinary iodine results serve as an approximate reflection of recent iodine intake, but substantial intra-individual diurnal variation is a major limitation of this biomarker for clinical diagnosis.

Urinary iodine was analyzed at the Regional Reference Iodine Lab at the Nutrition and Food Sciences Department of AUB, which regularly participates in CDCs Ensuring the Quality of Urinary Iodine Procedures (EQUIP) quality program. The iodine in the urine was then measured by a modification of the traditional colorimetric method of Sandell-Kolthoff, as proposed by Pino *et al.* [97].

Urinary sodium and potassium

An indirect approach was used to assess sodium and potassium intake by analyzing spot urine after adjusting concentration to creatinine levels. In a national study on Lebanese children [98], total 24-hour creatinine excretion was estimated based on an equation from Remer *et al.* [99], which reported a strong positive correlation with children's heights. This method provides a valuable means to estimate individual sodium and potassium consumption, offering insights into dietary patterns and nutritional imbalances.

2.7.5. Public health significance levels

The assessment of public health significance in the context of any survey plays a pivotal role in understanding the overall health and nutritional well-being of a population. The following prevalence levels will be used as reference points for the assessment, providing a clear framework for understanding the significance of each indicator in the context of public health. Table 7 summarizes the level of public health significance of several key nutritional indicators.

Table 7. Public health significance level of different indicators

Nutrition problem	Indicator	Prevalence (%)	Public health significance
Stunting [6]	Low height for age z-score (< -2.0 SD)	< 2.5	Very low
		2.5 – 10	Low
		10 – 20	Medium
		20 – 30	High
		≥ 30	Very high
Global Acute Malnutrition (GAM) /Wasting	Low weight for length/height z-score (< -2.0 SD)	< 2.5	Very low
		2.5 – 5	Low
		5 – 10	Medium
		10 – 15	High
		≥ 15	Very high
Underweight [6]	Low weight for age z-score (< -2.0 SD)	5 – 9	Low
		10 – 19	Medium
	Low BMI (BMI < 18.5)	20 – 39	High
		≥ 40	Very high
Overweight [6,100]	High weight for height z-scores (≥ +2.0 SD)	< 2.5	Very low
		2.5 – 5	Low
		5 – 10	Medium
		10 – 15	High
		≥ 15	Very high
	High BMI for age (≥ +1.0 SD)	< 10	Very low
		10 – 15	Low
		15 – 25	Medium
		25 – 35	High
		≥ 35	Very high
	High BMI (≥ 25.0)	< 20	Very low
		20 – 29	Low
		30 – 49	Medium
		50 – 70	High
		> 70	Very high
Vitamin A [101]	Low serum retinol level	2 – 9	Mild
		10 – 19	Moderate
		≥ 20	Severe
Anemia [10]	Low hemoglobin level	5 – 20	Mild
		20 – 40	Moderate
		≥ 40	Severe
Iron deficiency [102]	Low serum ferritin	5 – 19.9	Mild
		20 – 39.9	Moderate
		≥ 40	High
Iodine deficiency	Median urinary iodine concentration (µg/L)	50 – 99	Mild
		20 – 49	Moderate
		< 20	Severe
Zinc deficiency [103]	Low serum zinc	> 25	High

2.7.6. Food samples

Analysis of salt samples

The LIMA survey aimed to assess the performance of Lebanon's salt iodization program. Refined salt samples were collected from half the selected households of each PSU. Iodine content of salt, in the form of potassium iodate, was analyzed at the Regional Reference Iodine Lab of AUB using the iodometric titration method with thiosulfate [104].

2.8. Data management and analysis

2.8.1. Data entry

Direct electronic data entry was done using KoboCollect during the household, child, and adolescent girls/ women interviews. For the parts of the individual questionnaires (biological form) that were completed by the anthropometrist/phlebotomist using a paper form, the interviewers entered the data into KoboCollect on the same or the following day. Completed questionnaires were cross-checked on a daily basis by the team leaders prior to data uploading to a cloud-based secure server.

2.8.2. Data monitoring

Interview data and data from the biological forms uploaded from the tablets to the cloud were monitored continuously and a weekly monitoring report was prepared. In case of systematic and sporadic errors made by one or several teams, all team leaders were immediately informed about the problem, so the problem was not repeated. For errors that could be immediately addressed, team members were requested to do so while still in a given PSU. For some variables, such data quality checks could not be performed immediately (e.g., composite anthropometric indicators), hence took place during data analysis.

2.8.3. Calculations of composite variables

Wealth index: Using data on each household's dwelling, water and sanitation conditions and facilities, and ownership of durable goods, a wealth index was calculated using the World Bank method [105]. Calculation of weighted wealth index quintiles was used to categorize the continuous wealth index and permit the cross-tabulation and the subsequent presentation of key indicators by wealth.

Household sanitation: Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation was defined as flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation was defined as open pit, bucket latrine, hanging toilet/latrine, no facility, bush, or field.

Safe drinking water: Composite variable of main source of drinking water and treating water to make it safe for drinking. Improved source of drinking water was defined as water from a piped system, tube well or borehole, protected well, protected spring, rainwater collection, bottled water, or sachet water. Unimproved source was defined as water from an unprotected well, unprotected spring, tanker truck or cart, surface water or other. Water treatments

deemed as effective to make water safe for drinking were boiling, adding bleach, chlorine, or purification tablet, using a water filter (ceramic, sand, composite, etc.), using solar disinfection.

Minimum dietary diversity: For women and adolescent girls, a minimum dietary diversity was calculated using the Food and Nutrition Technical Assistance (FANTA) W-MDD method [62]. For the calculation of the IYCF complementary feeding indicator for children 6-23 months of age, the 2021 updated WHO/UNICEF guideline on indicators for assessing IYCF practices was used, which defines minimum diversity as consuming foods and beverages from at least five out of eight defined food groups (including breast milk) during the previous day [59].

Minimum meal frequency: For children 6-23 months of age, minimum meal frequency was calculated according to the 2021 updated WHO/UNICEF IYCF guidelines day [59]. While the calculations stipulated in the guidelines were used to categorize the majority of children 6-23 months of age as having minimum meal frequency or not, one modification was made to the calculation. Specifically, caretakers of nearly 20% (n=90) of children reported “don’t know” to the questions “How many times did [NAME] eat any solid, semi-solid or soft foods yesterday during the day or night?”. Despite the high frequency of this “don’t know” response, complete data on the number of food groups consumed the previous day was available for these same children. Thus, for the 90 children with “don’t know” responses for the number on solid/semi-solid/soft food feeds in previous day, we added 1 feed if the children consumed 1-3 food groups and 2 feeds if they consumed ≥ 4 food groups. The number of feeds for corresponding number of food groups was based on a tabulation of number of solid/semi-solid/soft food feeds and number of food groups for children with complete data. Nonetheless, this approach is still conservative as only children consuming 1 food group had mean number of feeds < 2 . As such, our estimated prevalence of minimum meal frequency prevalence may be a slight underestimate of the actual meal frequency practices in children 6-23 months of age in Lebanon.

Food insecurity access: To determine each household’s access for food in the past 30 days, household questionnaires included the Household Food Insecurity Access Scale (HFIAS) module. Specifically, nine separate yes/no questions were asked to gauge if different aspects of food insecurity (access component) existed in the past 30 days, and if so, a follow-up question was asked to determine the frequency of the occurrence. Responses were summed up to produce a household food insecurity access scale score for each household, which in turn was classified into a food insecurity access category (page 20 of the HFIAS indicator guide, version 3) according to guidelines developed by the FANTA project [106].

Clean/solid fuel: Solid fuels include coal/lignite, charcoal, wood, straw/shrub/grass, agricultural crops, and animal dung. Clean fuels include electricity, liquefied petroleum gas (LPG), natural gas, and biogas [107].

Sun exposure index: As the quantity of vitamin D synthesized by the body is related to sun exposure, the average sun exposure that children, adolescent girls, and women received on a

daily basis was estimated as the number of hours spent outside daily, while accounting for the frequency of use of sun protection and sunscreen, based on an approach developed by Gannage-Yared et al. [108]. The number of minutes of sun exposure was multiplied by the following factors depending on the frequency of use of sun protection and sunscreen:

Consistency	Multiplication factor
Never/rarely	1.0
Sometimes	0.8
Most of the time	0.2
Always	0

The index was then multiplied by the percentage of the body exposed to sunlight (9 per cent for the adult head and 16 per cent for the child head, 1 per cent for each hand, and 9 per cent for each arm). A lower score of the sun-exposure index denotes little sun exposure. The sun exposure index was then separated into three categories (i.e., < 10.0, 10-19, ≥ 20) when describing the sun exposure of each population group and when presented as a characteristic in the association tables.

Metabolic syndrome: The International Diabetes Federation (IDF) definitions for metabolic syndrome in adolescents [109] and adult women [110] were used to estimate the prevalence of metabolic syndrome among adolescent girls and non-pregnant women participating in the LIMA. In this report, the IDF reference values for adults were used for 15-year-old girls. According to the definition of metabolic syndrome by the IDF [85], there are five independent indicators that are used to assess metabolic syndrome: central/visceral obesity measured by waist circumference, elevated serum triglycerides, elevated blood glucose, elevated blood pressure, and low HDL cholesterol. The presence of central/ visceral obesity plus two out of the four aforementioned conditions constitute a clinical diagnosis of metabolic syndrome. While the measure of glucose cited by the IDF is fasting plasma glucose, the LIMA utilized HbA1c. This biomarker is a more long-term measure of elevated blood glucose (diabetes and insulin resistance) and does not require participants to fast prior to providing a blood sample, which would have been impractical for a national cross-sectional survey such as the LIMA. Moreover, HbA1c is one of the biomarkers recommended by the WHO to diagnose diabetes mellitus [82].

Metabolic syndrome was not measured in pregnant women, as the measurement of central/visceral obesity cannot be used as a cardiometabolic risk factor during pregnancy.

Early Childhood Development: The Household Form of Global Scales for Early Development (HF-GSED), developed by the World Health Organization (WHO), was used to measure the development status of children below the age of 24 months [111]. The suite of GSED instruments is designed for global use, and the items included in the HF-GSED were drawn from a global review of development assessments and data, and have been tested in multiple sites. Specifically, the items used in the HF-GSED underwent content validity review with WHO

team in the region (Oman) to reflect cultural and linguistic nuances for use in the Middle East and North African (MENA) region. The D-score is a unit of measurement with an interval scale representing child development by a single number calculated as the mean of the posterior distribution conditional on the responses, the items' difficulty and the child's age. Development-for-age Z scores (DAZ) were calculated to show development as a continuum adjusted for age and describes how well children are doing relative to a reference population as described by the WHO (the distribution of scores is normally distributed with a mean of 0 and a variance of 1). A binary score using data from the LIMA sample was calculated to provide an estimate of the percentage of children developmentally 'on track' in this age group. Using the LIMA sample, children were considered developmentally 'on track' if their age-adjusted developmental z-scores were within 1.0 standard deviation below the mean. A score between 1.0 and 1.5 standard deviations below the mean was categorized as 'slightly off track,' between 1.5 and 2.0 standard deviations below the mean were categorized as 'moderately off track,' and scores exceeding 2.0 standard deviations below the mean were classified as 'severely off track'; the WHO is currently undertaking work to set preliminary global benchmarks for what children under the age of 24 months should be able to do in order to be considered "on track" developmentally. The Early Childhood Development Index 2030 (ECDI2030), developed by UNICEF, was used to measure the development status of children 24 months or older [112]. The ECDI2030 age-specific cut-scores to identify children developmentally 'on track' were: 24-29 months: 7 of the 20 items; 30-35 months: 9 of the 20 items; 36-41 months: 11 of the 20 items; 42-47 months: 13 of the 20 items; 48-59 months: 15 of the 20 items. The ECDI2030 is intended for global use and the instrument has undergone rigorous multi-country testing. Minor accommodations were integrated to ensure cultural and language relevance for the Lebanese population as guided by the ECDI2030 implementation guidance.

2.8.4. Data analysis

Data analysis was done using Stata/IC version 18. All analyses of questionnaire data, biomarkers and salt samples were conducted using a weighted analysis. Specifically, the weighting used for stratum-level analyses accounts for inaccurate probability of selection in the primary sampling unit, whereas the weighting used for the remaining household, child, adolescent girl, or woman analyses accounts for unequal probability of selection by stratum, unequal household, child or woman response rates by stratum, and inaccurate probability of selection in the primary sampling unit.

For continuous variables, weighted means with standard deviations and weighted medians with interquartile ranges were calculated for normally distributed and skewed data, respectively. Regarding urinary iodine concentrations (UIC), median UICs were calculated for each target group overall and for subgroups in order to judge population iodine status against WHO criteria [96]. However, in order to evaluate the statistical precision of apparent differences among subgroups, a box-cox transformation of the UIC values created a variable

which was normally distributed [113]. Linear regression was then used to calculate p-values for the apparent association between the Box-Cox UIC means and each characteristic.

For categorical variables, weighted proportions were calculated to derive the prevalence of various outcomes. The statistical precisions of all prevalence estimates were assessed by using 95% confidence intervals, which were calculated accounting for the complex sampling used in this survey, including the cluster and stratified sampling. Chi-square p-values for differences were calculated accounting for the complex cluster and stratified sampling used by the LIMA 2023.

Descriptive statistics were calculated for children 0-59 months of age, adolescent girls, and non-pregnant women (i.e., across all strata), for each stratum separately and by sex (for children). Results are also presented by specific age subgroups for children, adolescent girls, and non-pregnant women. For example, results are presented for children 0-5 months, 6-11 months, 12-23 months, 24-35 months, 36-47 months, and 48-59 months of age. Age subgroups for adolescent girls are 10-12 years, 13-15 years, and 16-19 years, whereas for non-pregnant women are 15-19 years, 20-29 years, 30-39 years, and 40-49 years. For adolescent girls, subgroups include pre-menarche and menarche. For pregnant women, only national estimates for all ages have been generated since little subgroup analysis was not possible due to the small sample size.

Females aged 15-19 years belonged to 2 different groups: a) adolescent girls and b) non-pregnant women. All females aged 15-19 years were included in the adolescent girl data analyses. For the non-pregnant women analyses, females aged 15-19 years were only included from every second household following the same selection procedure as for non-pregnant women 20-49 years of age.

3. RESULTS

3.1. Study participation of households, children, and women

Figure 2 summarizes the number of respondents and response rates at the different stages of the survey. Regarding the random selection of households, the teams listed 8613 dwellings in the selected PSUs. Approximately 6% (n=561) of the listed dwellings were ineligible as the households within the dwelling were absent during data collection. In total, three visits were made within 2 days before dismissing a household as absent. Of the 8052 eligible households recruited by the listing teams, 6409 households (80%) were successfully recruited to participate in the survey.

The LIMA identified 2306 eligible children 0-59 months. Complete interview and anthropometric data are available for 90% and 83% of children, respectively. Regarding the collection of blood samples, children < 6 months of age were ineligible, and blood samples were collected from 78% of the eligible children 6-59 months.

In total, the LIMA identified 2551 eligible adolescent girls. Interview and anthropometric data are available for 88% and 83% of these anthropometric girls, respectively. Blood samples were collected from 81% of the eligible adolescent girls.

Among the participating households, 3542 non-pregnant women 15-49 years of age were eligible to participate in the LIMA. Interview and anthropometric data were collected from 87% and 82% of non-pregnant women. Blood samples were successfully collected from 81% of non-pregnant women. The LIMA identified 224 pregnant women, of whom only one refused to provide interview data. Of the consenting pregnant women, 83% provided MUAC data and 90% provided a blood sample.

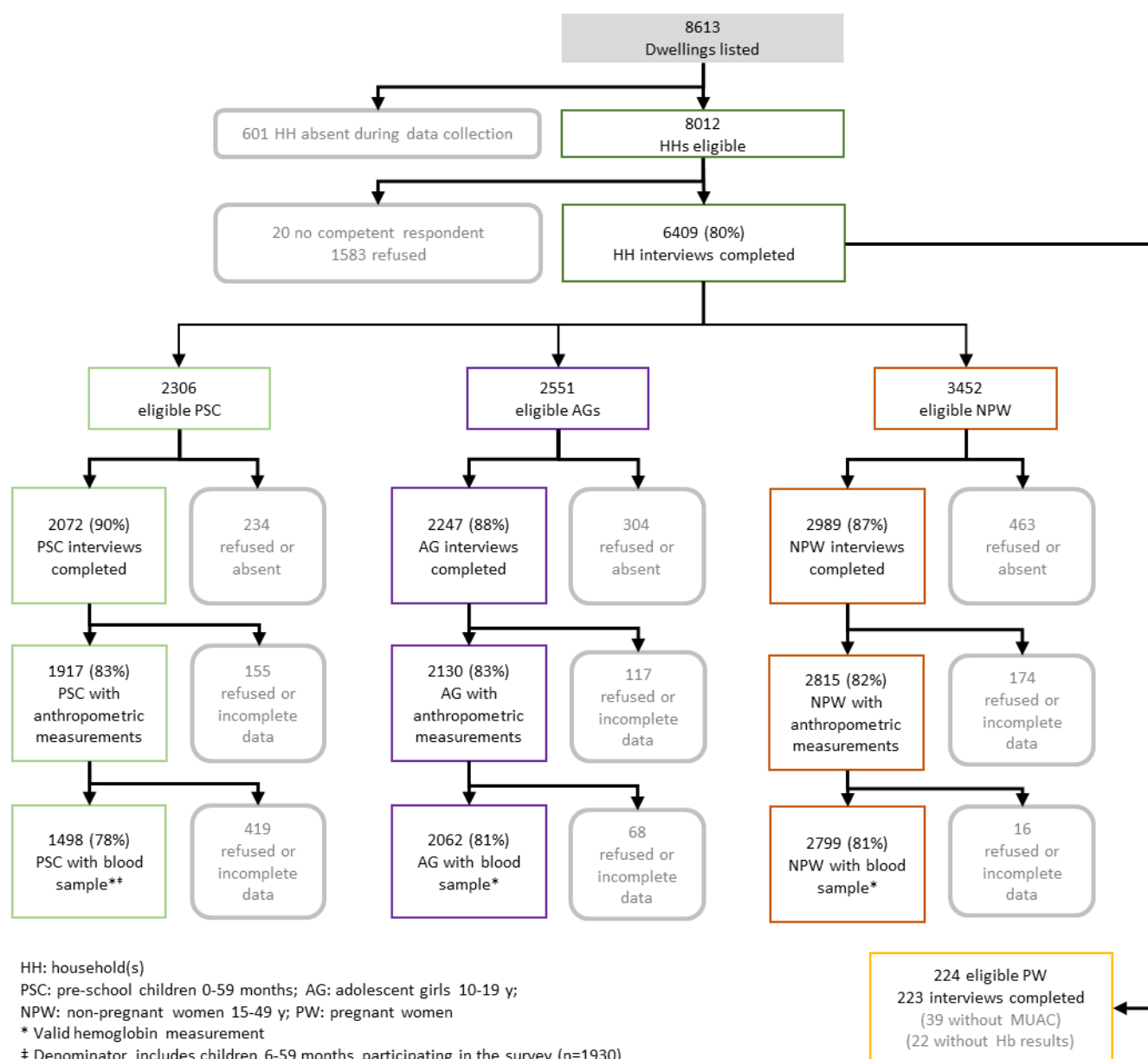


Figure 2. Participation flow diagram for households, women, adolescent girls and children, Lebanon 2023

3.2. Household characteristics

3.2.1. Demographic characteristics

Table 8 shows the weighted distribution of characteristics of participating households. Overall, 6409 households participated in the survey. Approximately equal numbers of households were allocated to the different wealth quintiles with the exception of the lowest quintile. Approximately 80% of the households are Lebanese and 20% are Syrian, only about 2% of the households are of Palestinian nationality. Close to 75% of the household heads are male and the vast majority married.

Table 8. Characteristics of participating households, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Nationality of household head			
Lebanese	4740	79.2	[75.9,82.1]
Syrian	1280	17.8	[15.1,20.8]
Palestinian	336	2.1	[1.4,3.1]
Other	53	0.9	[0.5,1.6]
Stratum			
Akkar	547	4.7	[3.9,5.7]
Baalbek-Hermel	610	4.5	[3.4,6.1]
Beirut	989	6.5	[5.3,8.0]
Bekaa	690	8.5	[6.5,11.2]
El Nabatieh	555	5.6	[4.6,6.8]
Mount Lebanon	817	41.1	[36.0,46.3]
North	693	13.9	[11.0,17.5]
South	735	10.5	[8.0,13.6]
Palestinian camps	410	1.4	[1.0,1.9]
Syrian ITS	363	3.2	[2.5,4.2]
Wealth quintile			
Lowest	1543	20.0	[17.8,22.4]
Second	1241	20.0	[17.9,22.3]
Middle	1230	20.0	[18.1,22.1]
Fourth	1214	19.9	[18.3,21.7]
Highest	1181	20.0	[17.2,23.2]
Sex of household head			
Male	4661	72.5	[70.2,74.8]
Female	1748	27.5	[25.2,29.8]
Marital status of the household head			
Never married	285	7.7	[6.1,9.6]
Married	3242	85.0	[82.3,87.3]
Divorced/ separated/ widowed	241	7.4	[6.0,9.0]
TOTAL SAMPLE	6409	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

On average, households participating in the LIMA have 3.8 members, which is similar to the household size reported by the SMART 2021 [4]. Approximately 60% of households have 2-4 household members (Table 9). About 4 out of 5 household heads ever attended school, the majority primary or middle school (Table 10). Almost one sixth of those attending school completed tertiary education, with Syrians having the lowest proportion. For all nationalities, the highest level of education obtained by heads of households who had attended schools is for the middle school (Figure 3). Disaggregating household wealth quintiles by nationality shows that the majority of households in the lowest wealth quintile are Syrians while almost all wealthy households are of Lebanese nationality (see Figure 4).

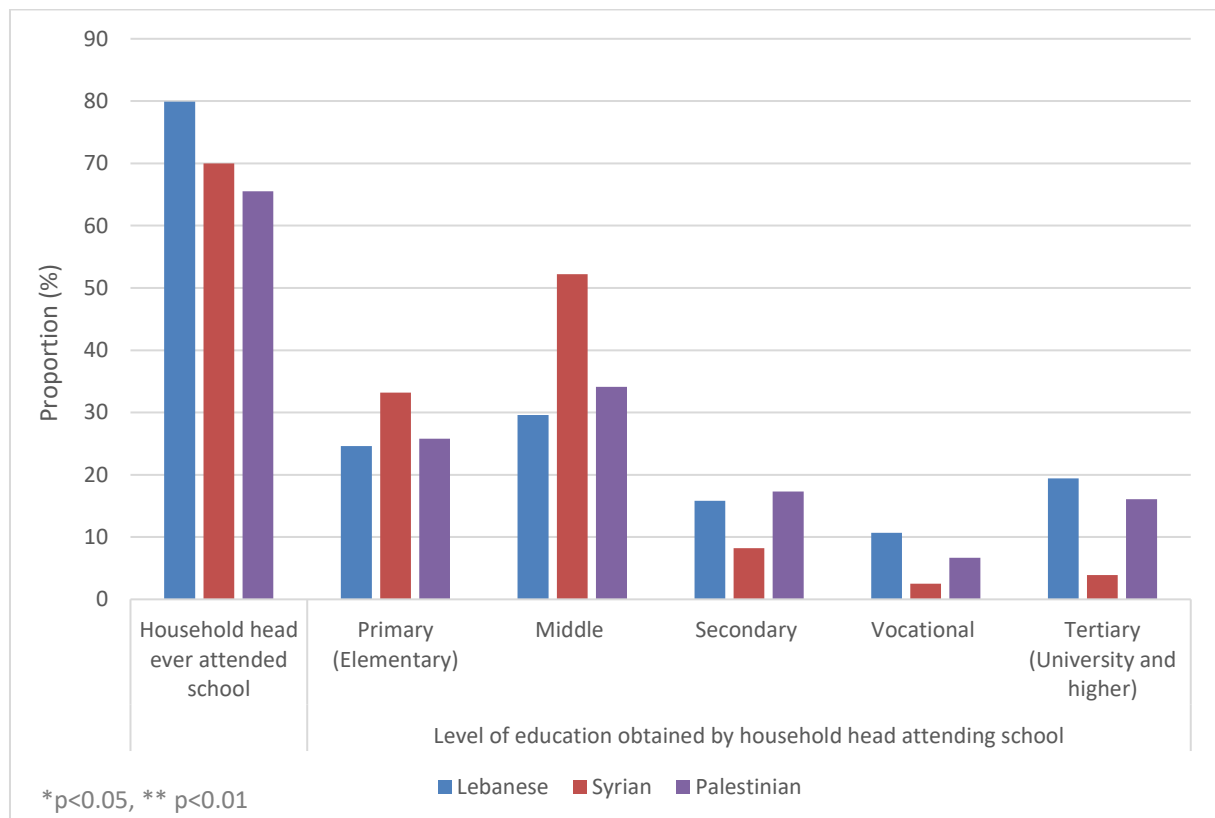


Figure 3. Proportion of households attending school by nationality, Lebanon 2023

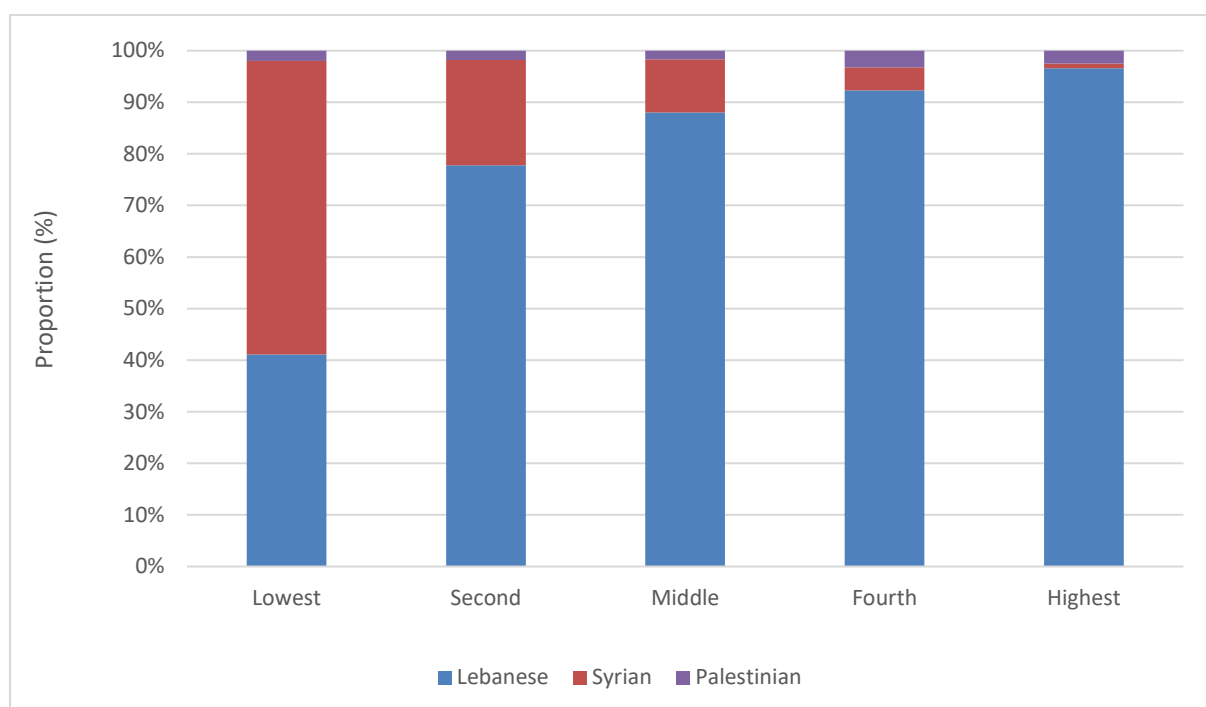


Figure 4. Distribution of household nationality within each wealth quintile, Lebanon 2023

Table 9. Household composition of participating households, Lebanon 2023

Characteristic	N	% or mean ^a	[95% CI] ^b
Average household size			
Mean	6409	3.8	[3.6,3.9]
Number of members in the household			
1	590	9.8	[8.3,11.5]
2	1177	19.6	[18.0,21.3]
3	1127	19.5	[17.5,21.6]
4	1215	19.8	[17.9,21.8]
5	1015	14.1	[12.8,15.6]
6	646	8.8	[7.7,10.1]
7	320	4.0	[3.2,5.0]
≥8	319	4.4	[3.5,5.4]
TOTAL SAMPLE	6409	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

Table 10. Educational level of household head for participating households, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Head of household ever attended school or preschool			
Yes	5094	77.9	[74.6,80.8]
No	1307	22.0	[19.0,25.2]
Don't know	8	0.2	[0.1,0.6]
Highest level of school attended by household head			
Primary (elementary school)	1464	26.0	[23.9,28.2]
Middle (intermediate school)	1671	33.0	[30.8,35.3]
Secondary (general secondary school)	745	14.6	[13.0,16.3]
Vocational (technical secondary school)	378	9.2	[7.9,10.7]
Tertiary (university and higher)	816	16.8	[14.6,19.2]
Don't know	20	0.5	[0.2,1.2]
TOTAL SAMPLE	6409	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

3.2.2. Cooking fuel and household lighting

As shown in Table 11, nearly all participating households use clean fuel for cooking, and around three quarter of households use electricity to light their house. Regarding home heating, almost one third of households rely on an electric or gas portable heater and about one quarter use a manufactured fireplace to heat their house. Nearly 20% of households do not have any heating.

Table 11. Type of energy used for cooking, lighting and heating in participating households, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Type of fuel used for cooking			
Clean fuel ^c	6241	97.6	[96.6,98.3]
Solid fuel ^c	140	2.0	[1.4,3.0]
No food cooked in household / Don't know / Other	28	0.4	[0.2,0.8]
How household is lit at night			
Electricity (from the grid/ off the grid)	4532	73.1	[69.8,76.1]
Solar energy	1293	19.1	[16.6,21.8]
Kerosene/ paraffin lamp	95	1.1	[0.8,1.5]
Battery powered torch, flashlight, lamp	309	4.5	[3.4,5.9]
Biogas lamp	3	0.0	[0.0,0.1]
Candle	26	0.3	[0.2,0.4]
No lighting in house	143	1.9	[1.4,2.5]
Don't know/ Other	8	0.1	[0.0,0.2]
Type of fuel or energy used to heat the house			
Electric/gas portable room heater	2024	31.9	[28.7,35.4]
Central heating	177	2.9	[2.2,3.8]
Manufactured fireplace	1444	23.2	[20.0,26.9]
Traditional fireplace	1292	19.8	[17.2,22.7]
Factory cooking stove/ cooking stove	74	0.9	[0.6,1.3]
Triple stone stove/ on fire	102	1.5	[1.1,2.2]
Household does not have heating	1156	18.8	[15.5,22.5]
Don't know	140	0.9	[0.6,1.3]
TOTAL SAMPLE	6409	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Clean fuels include electricity, liquefied petroleum gas (LPG), natural gas, and biogas. Solid fuels include coal/lignite, charcoal, wood, straw/shrub/grass, and animal dung.

3.2.3. Household income

As shown in Table 12, more than 75% of households have at least one household member that was employed and earned money at the time of the survey. A large proportion of Syrian households have at least one employed member who earned money (see Figure 5). Only about 10% of households have a member with a bank account. Relatively few households receive cash remittances from outside Lebanon. Of the households that receive remittances, the average amount received was 350 USD in the three months prior to the survey. No association was found between the proportion of households receiving cash remittance and the nationality of the household (Figure 5).

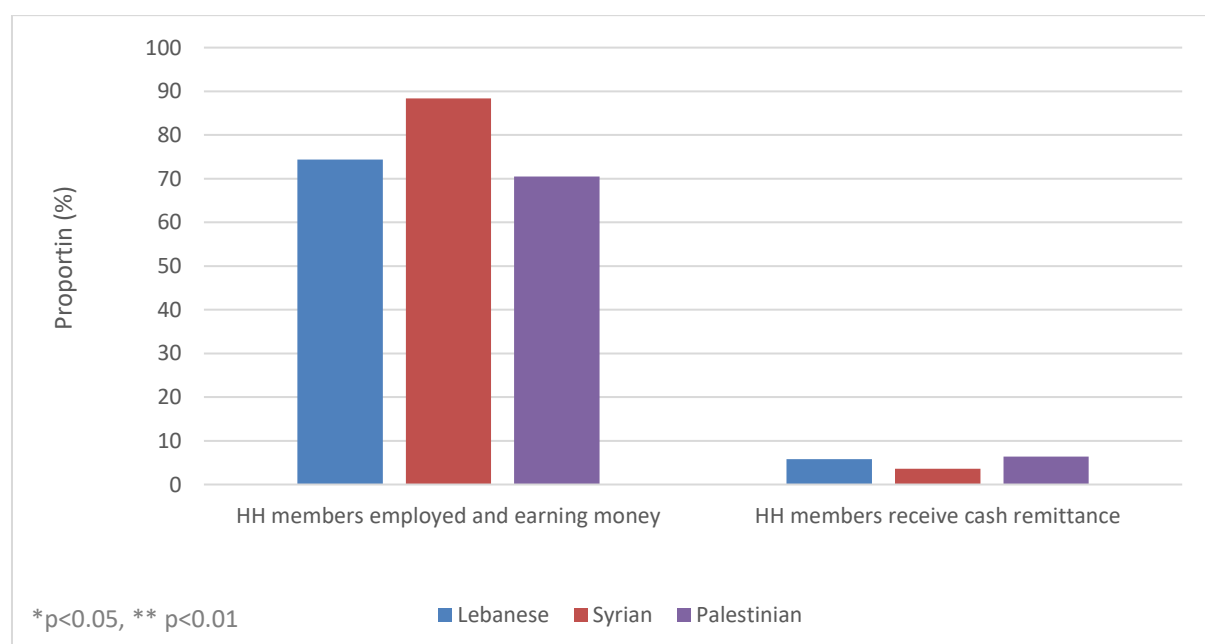
Table 12. Household income and cash remittance, Lebanon 2023

Characteristic	N	% or mean ^a	[95% CI] ^b
Household members employed and earning money			
Yes	4923	76.8	[74.5,78.9]
No	1477	23.1	[21.0,25.4]
Don't know	9	0.2	[0.1,0.3]
Number of household members employed or earning income			
0	1486	23.2	[21.1,25.5]
1	3629	55.4	[53.0,57.8]
2	1001	16.6	[15.0,18.3]
≥3	293	4.8	[3.9,5.9]
Any household member with a bank account			
Yes	595	9.9	[8.6,11.4]
No	5784	89.5	[88.0,90.9]
Don't know	30	0.5	[0.3,0.9]
Household received cash remittance from outside Lebanon in past 3 months			
Yes	313	5.4	[4.4,6.6]
No	6072	94.3	[93.1,95.4]
Don't know	24	0.3	[0.1,0.5]
Amount of money received in past 3 months			
Mean	244	350.6	[276.3,425.0]
TOTAL SAMPLE	6409	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

**Figure 5. Household employment and cash remittance by nationality, Lebanon 2023**

3.2.4. Household food security

Table 13 presents the household food insecurity access status for stratum, wealth quintile, nationality and sex of the household head. Nationally, almost 60% of households in Lebanon are classified with insecure food access. Food insecurity access status is significantly associated with stratum, nationality, and wealth quintile. In Akkar and the Syrian ITS strata, almost all households are with insecure food access, and 46% of households in Akkar and 60% of households in the Syrian ITS strata are with severely insecure food access. In contrast, less than half of the households in South, Mount Lebanon, and the Palestinian Camp strata are food insecure based on access component. More than five out of six households in the lowest wealth quintile are food insecure (access), with prevalence decreasing as household wealth increases. Regarding nationality, a significantly larger proportion of Syrian households are food insecure (access) compared to Lebanese and Palestinian households.

A significant association was also found between the severity of household food insecurity and the nationality of the household. About half of the Syrian households are severely food insecure (access), compared to only 20% of Lebanese and 14% of Palestinian households (Figure 6).

Table 13. Household food insecurity access by various demographic characteristics, Lebanon 2023

		Food insecure access								
Characteristic	N	Severe, % ^a	[95% CI] ^b	Moderate, % ^a	[95% CI] ^b	Mild, % ^a	[95% CI] ^b	Total, % ^a	[95% CI] ^b	p-value ^c
Nationality										
Lebanese	4740	20.0	[17.9,22.2]	24.8	[22.7,27.0]	9.5	[8.3,10.9]	54.2	[51.3,57.2]	<0.001
Syrian	1280	48.3	[42.6,54.1]	30.9	[25.7,36.6]	5.7	[4.2,7.6]	84.9	[81.2,88.0]	
Palestinian	336	14.4	[7.3,26.3]	13.4	[8.2,21.1]	13.5	[9.4,19.0]	41.3	[32.5,50.6]	
Other	53	59.2	[35.0,79.6]	13.2	[6.1,26.3]	10.5	[2.0,39.9]	82.9	[66.2,92.3]	
Stratum										
Akkar	547	45.5	[39.4,51.7]	44.2	[39.3,49.2]	3.8	[2.3,6.4]	93.5	[91.3,95.1]	<0.001
Baalbek-Hermel	610	31.6	[26.7,37.0]	33.5	[29.4,37.8]	4.9	[3.3,7.2]	70.0	[64.7,74.8]	
Beirut	989	28.5	[24.5,32.8]	27.3	[23.4,31.5]	7.7	[5.8,10.3]	63.5	[58.1,68.6]	
Bekaa	690	16.6	[12.4,21.8]	37.3	[29.7,45.6]	12.6	[9.7,16.3]	66.5	[57.5,74.5]	
El Nabatieh	555	16.7	[12.3,22.3]	38.1	[31.6,45.2]	16.8	[12.3,22.6]	71.7	[62.7,79.2]	
Mount Lebanon	817	24.9	[20.0,30.5]	16.9	[14.0,20.3]	6.2	[4.6,8.3]	48.0	[42.8,53.2]	
North	693	29.4	[23.9,35.5]	35.1	[31.1,39.4]	11.4	[8.7,14.8]	75.9	[69.2,81.6]	
South	735	11.1	[6.3,18.8]	17.2	[13.3,22.0]	13.3	[10.0,17.4]	41.6	[34.3,49.4]	
Palestinian camps	410	4.9	[2.9,8.0]	14.8	[10.1,21.2]	16.9	[13.4,21.1]	36.6	[29.1,44.7]	
Syrian ITS	363	59.9	[53.0,66.5]	29.5	[22.4,37.8]	6.7	[3.9,11.3]	96.2	[93.0,97.9]	
Wealth quintile										
Lowest	1543	51.4	[46.4,56.4]	28.9	[24.9,33.3]	4.4	[3.3,5.9]	84.8	[80.6,88.2]	<0.001
Second	1241	34.2	[28.5,40.3]	27.0	[23.0,31.3]	6.6	[4.6,9.5]	67.8	[62.8,72.4]	
Middle	1230	19.7	[16.6,23.2]	26.1	[22.3,30.2]	10.0	[7.5,13.2]	55.7	[51.2,60.1]	
Fourth	1214	15.5	[12.2,19.5]	24.8	[21.4,28.5]	10.7	[8.4,13.4]	51.0	[45.6,56.3]	
Highest	1181	5.5	[3.7,8.0]	20.8	[17.6,24.3]	12.9	[10.8,15.4]	39.2	[34.7,43.8]	
Sex of household head										
Male	4661	24.8	[21.9,27.9]	25.2	[23.2,27.2]	9.3	[8.1,10.6]	59.2	[56.1,62.3]	0.423
Female	1748	26.6	[23.1,30.4]	26.4	[22.9,30.1]	8.0	[6.0,10.5]	60.9	[57.1,64.7]	
TOTAL SAMPLE	6409	25.3	[22.8,27.9]	25.5	[23.7,27.4]	8.9	[7.9,10.1]	59.7	[56.9,62.4]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. // ^a Percentages weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

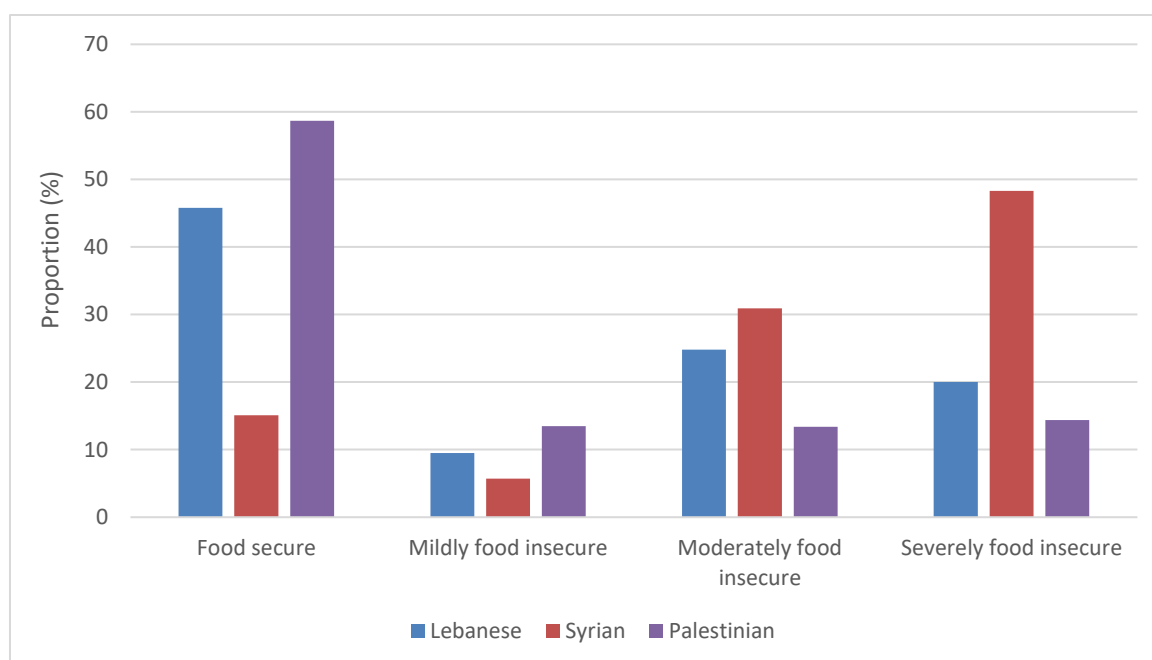


Figure 6. Severity of household food insecurity access by nationality, Lebanon 2023

3.2.5. Water and sanitation

Almost all of the households have a fixed sink or basin for handwashing, and almost all households had water and some kind of soap (bar soap, liquid soap, detergent) available at the handwashing site at the time of the survey (Table 14).

About 9 out of 10 households reported having enough water to meet all their needs. As shown in Table 15, approximately 93% of households have an improved source of water for drinking. Only a small proportion of the households reported treating their water to make it safe to drink, resulting in nearly 94% of households with access to safe drinking water. No significant differences in the coverage of safe drinking water were found by nationality of the household head (Figure 7).

Regarding sanitation, more than 90% households nationally have improved sanitation facilities; however, the coverage (89%) of improved sanitation facilities is significantly lower Syrian households (Figure 7).

Table 14. Indicators of handwashing, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Location of handwashing site			
Fixed place (observed)	6129	97.0	[96.2,97.6]
Mobile (observed)	119	1.5	[1.1,2.0]
Not observed, not in dwelling	129	1.1	[0.8,1.4]
Not observed, permission to see not given	7	0.3	[0.1,0.9]
Not observed, other reason	25	0.2	[0.1,0.4]
Water is available at observed handwashing place^c			
Yes	6031	96.2	[94.8,97.2]
No	217	3.8	[2.8,5.2]
Soap seen at handwashing site^c			
Bar soap, liquid soap, detergent	6187	98.0	[97.1,98.6]
Ash, mud, sand	133	6.9	[4.8,9.9]
No soap	21	0.3	[0.2,0.7]
TOTAL SAMPLE	6409	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Results based on households where handwashing site was observed (N=6248), but N's to not sum to total as multiple responses permitted.

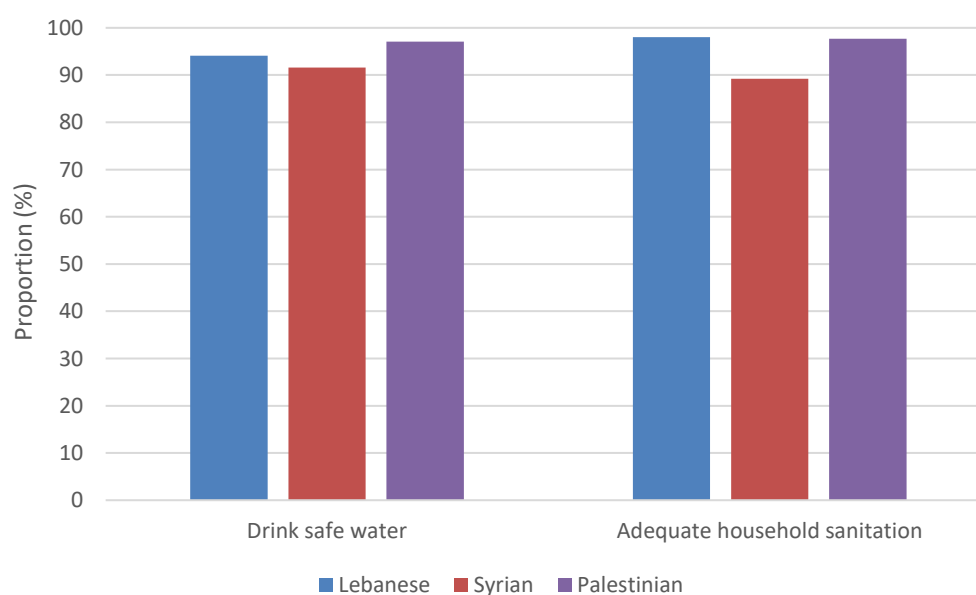
**Figure 7. Proportion of households with adequate sanitation facilities and safe drinking water by nationality, Lebanon 2023**

Table 15. Indicators of household water and sanitation, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Main source of water for drinking^c			
Improved source	5836	93.2	[92.0,94.2]
Unimproved source	560	6.6	[5.5,7.8]
Don't know	13	0.3	[0.1,0.6]
Treat water to make safe to drink			
Yes	280	6.1	[4.6,8.1]
No	6113	93.6	[91.7,95.1]
Don't know	16	0.3	[0.1,0.6]
Treatment method^d			
Boil	47	18.3	[12.9,25.4]
Add bleach	27	8.8	[4.8,15.7]
Strain through cloth	26	10.6	[6.5,16.9]
Water filter	197	64.7	[53.3,74.7]
Solar disinfection	17	7.6	[3.8,14.4]
Let it stand	17	3.2	[1.7,6.3]
Enough water to meet the following needs			
Drinking	5822	88.1	[85.0,90.6]
Cooking	5862	88.6	[85.3,91.2]
Handwashing	5940	91.4	[87.6,94.1]
Personal hygiene	5705	88.3	[84.7,91.2]
Other domestic purposes (e.g. cleaning)	5556	86.5	[82.8,89.5]
Drink safe water^e			
Yes	5860	93.6	[92.4,94.5]
No	537	6.2	[5.2,7.3]
Don't know	12	0.2	[0.1,0.6]
Household sanitation^f			
Inadequate	232	3.5	[2.7,4.5]
Adequate	6072	94.6	[93.3,95.7]
Don't know	105	1.9	[1.4,2.7]
TOTAL SAMPLE	6409	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Improved source = water from piped system, tube well or borehole, protected well, protected spring, rainwater collection, bottled water or sachet water. Unimproved source = water from unprotected well, unprotected spring, tanker truck or cart, surface water or other.

^d Water treatment methods asked to households reporting that some type of water treatment was done (N=280, and multiple responses to water treatment method were permitted).

^e Composite variable of main source of drinking water and treating water to make safe for drinking.

^f Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate Sanitation = flush or pour flush toilet or pit latrine with slab or ventilated improved pit latrine not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

3.2.6. Salt iodization

As shown in Table 16, more than 95% of participating households use fine salt and almost all of them had fine salt in the house at the time of the survey, most of it stored away from sunlight. Only about 14% of the salt was in the original packaging, with the original packaging almost exclusively stating that the salt was iodized.

Fine salt was collected from half of the participating households for quantitative analysis of iodine content. Nationally, the median iodine concentration is 13.8 ppm. About two thirds of the salt is iodized and about half of the salt is adequately iodized according to international standards (≥ 15 ppm; see Figure 8).

According to Lebanon's 2011 legislation (178/2011)¹, 60-80 mg/kg of potassium iodate (KIO₃) should be added to table salt, which corresponds to 35.5-47.4 ppm of iodine². Applying this threshold, less than 10% of the salt is classified as adequately iodized according to national standards (Figure 8). Moreover, only a small proportion of the salt is over iodized (> 47.4 ppm).

Table 16. Availability and packaging of fine salt in the household, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Household uses fine salt			
Yes	6155	96.3	[95.3,97.1]
No	254	3.7	[2.9,4.7]
Have fine salt in house			
Yes	6047	98.9	[98.5,99.2]
No	108	1.1	[0.8,1.5]
Interviewer able to observe salt storage			
Yes	5970	98.2	[97.3,98.8]
No	77	1.8	[1.2,2.7]
Salt exposure to light^c			
Exposed to sunlight	183	3.6	[2.7,4.8]
Sheltered from sunlight	5787	96.4	[95.2,97.3]
Salt labelling^c			
Original packaging stating salt is iodized	639	13.6	[12.0,15.4]
Original packaging without mention of iodization	72	0.8	[0.5,1.3]
Undetermined, not in original package	5133	82.7	[80.6,84.5]
Undetermined, salt package not observed	126	2.9	[2.0,4.2]
TOTAL SAMPLE	6409	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Results based on households where salt storage was observed (N=5970).

¹ Law 178/2011 was implemented via a decree published in June 2014 in the national gazette.

² Potassium iodate (KIO₃) contains 59.3% iodine.

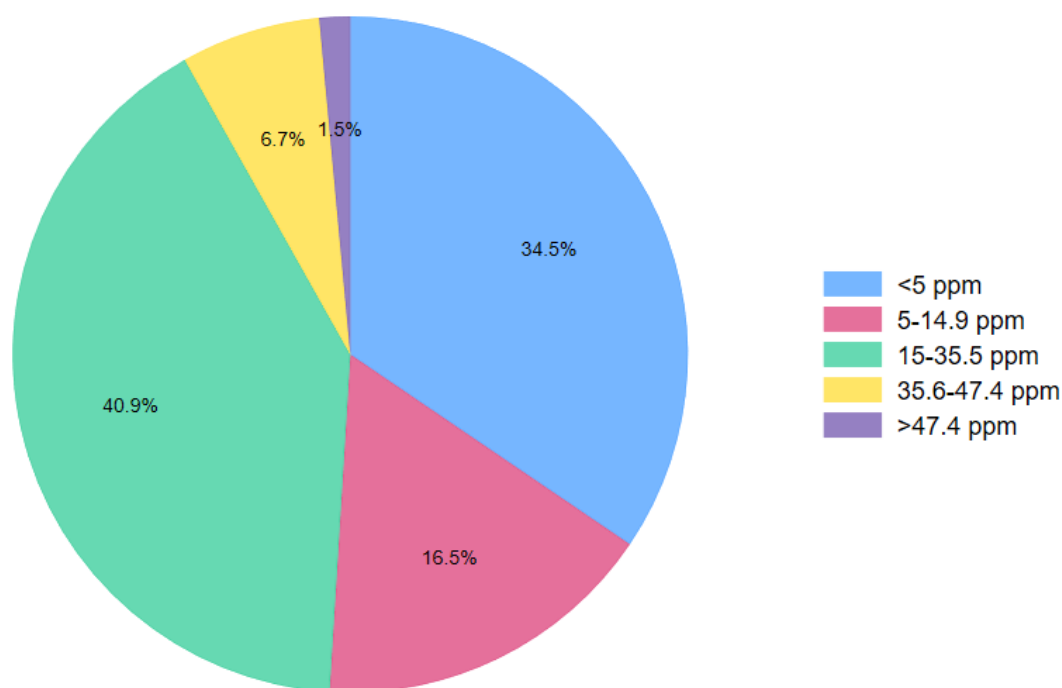


Figure 8. Salt iodine concentration by categories, Lebanon 2023

According to international standards, significant differences in adequately iodized salt were found by stratum (Table 17). Almost 80% of households in Akkar have adequately iodized salt, whereas adequately iodized salt was found in only about 30% of households in El Nabatieh and 40% of households in Bekaa and Mount Lebanon (Figure 9). Significant differences were also found by household nationality, with a smaller proportion of Lebanese households using adequately iodized salt. A significant association was also found between adequately iodized salt and household food security, with fewer food secure households consuming adequately iodized salt.

Salt packaging is not associated with the proportion of iodized nor adequately iodized salt using international or national thresholds. Importantly, only a small proportion of salt was in the original packaging at the time salt samples were collected. In addition, no significant associations were found between demographic characteristics and salt iodization adequacy when Lebanon's national standards (≥ 35.6 ppm) were used to define salt adequacy.

When examining the results by nationality within each governorate, the LIMA found that the coverage of adequately iodized salt is similar in Lebanese and Syrian households in all strata except for the Bekaa and South (see Figure 10)³.

³ Figure 10 excludes the Palestinian nationality because of the small number of Palestinian households in each governorate.

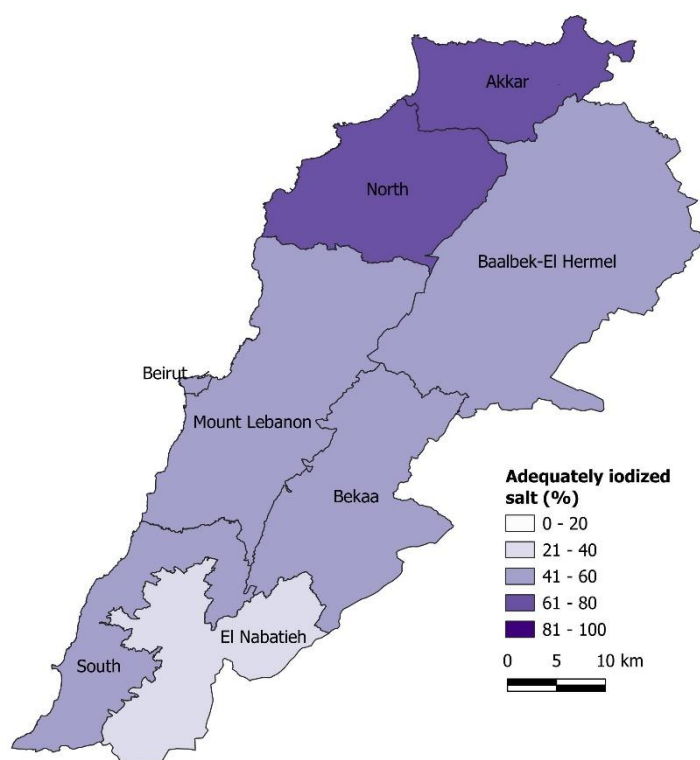


Figure 9. Coverage of adequately iodized (≥ 15 ppm) salt by governorate, Lebanon 2023

Table 17. Proportion of households in which salt was iodized and adequately iodized by various demographic and salt packaging characteristics, Lebanon 2023

Characteristic	N	Median iodine concentration (ppm) ^b	Iodized (≥ 5 ppm) ^a			Adequately iodized (≥ 15 ppm) ^a			Adequately iodized (≥ 35.6 ppm) ^a		
			% ^b	[95% CI] ^c	p-value ^d	% ^b	[95% CI] ^c	p-value ^d	% ^b	[95% CI] ^c	p-value ^d
Nationality					0.212			0.002			0.721
Lebanese	2291	11.6	64.5	[60.9,67.9]		46.6	[43.3,49.9]		8.1	[6.5,10.0]	
Syrian	598	21.2	67.7	[59.2,75.2]		56.9	[48.8,64.6]		8.0	[4.4,13.8]	
Palestinian	123	21.2	77.8	[63.8,87.5]		57.6	[42.3,71.7]		14.1	[4.7,35.3]	
Other	19	19.0	86.5	[53.3,97.3]		84.5	[52.1,96.5]		5.3	[0.7,30.9]	
Stratum					<0.001			<0.001			0.525
Akkar	269	25.4	85.8	[77.9,91.2]		77.9	[70.7,83.8]		9.7	[5.7,15.9]	
Baalbek-Hermel	289	20.1	74.1	[66.4,80.5]		56.6	[48.4,64.5]		4.9	[2.5,9.6]	
Beirut	469	18.0	71.3	[65.5,76.5]		53.7	[46.4,60.8]		11.1	[7.2,16.9]	
Bekaa	337	10.6	70.9	[64.0,77.0]		43.0	[36.6,49.6]		6.8	[3.6,12.7]	
El Nabatieh	283	5.3	56.8	[47.3,65.9]		29.3	[21.7,38.1]		4.5	[2.1,9.6]	
Mount Lebanon	392	8.5	56.3	[49.3,63.1]		41.8	[35.2,48.6]		8.3	[5.5,12.4]	
North	342	23.3	73.7	[63.7,81.7]		61.3	[53.8,68.4]		7.8	[4.5,13.1]	
South	349	18.0	69.8	[61.2,77.2]		52.8	[41.4,63.9]		9.1	[4.2,18.6]	
Palestinian camps	153	19.0	75.9	[69.0,81.7]		53.4	[43.8,62.7]		8.6	[4.9,14.7]	
Syrian ITS	148	23.3	74.7	[62.5,84.0]		63.3	[53.8,71.8]		11.5	[7.1,18.2]	
Wealth quintile					0.212			0.278			0.658
Lowest	665	19.0	68.7	[61.4,75.3]		53.9	[47.2,60.3]		8.4	[5.5,12.7]	
Second	575	13.8	62.4	[55.0,69.2]		47.7	[40.2,55.4]		8.9	[5.2,14.8]	
Middle	605	16.9	69.4	[63.4,74.9]		51.4	[45.1,57.6]		6.0	[3.9,9.1]	
Fourth	605	9.5	60.4	[53.7,66.8]		44.0	[37.8,50.3]		8.4	[5.7,12.1]	
Highest	581	12.7	66.6	[59.3,73.2]		48.3	[41.8,54.8]		9.2	[6.4,13.0]	

Table continued on next page

Characteristic	N	Median iodine concentration (ppm) ^b	Iodized (≥ 5 ppm) ^a			Adequately iodized (≥ 15 ppm) ^a			Adequately iodized (≥ 35.6 ppm) ^a		
			% ^b	[95% CI] ^c	p-value ^d	% ^b	[95% CI] ^c	p-value ^d	% ^b	[95% CI] ^c	p-value ^d
Household food insecurity access					0.126			0.04			0.359
Secure	1102	9.5	62.0	[56.6,67.1]		44.5	[39.3,49.8]		7.6	[5.6,10.2]	
Mild	299	13.8	67.8	[59.5,75.1]		48.0	[39.4,56.7]		5.0	[3.0,8.3]	
Moderate	851	15.9	65.6	[60.6,70.3]		51.0	[45.9,56.0]		8.8	[6.1,12.5]	
Severe	779	19.0	70.2	[63.4,76.2]		54.7	[48.2,61.0]		9.6	[6.2,14.5]	
Packaging of salt					0.076			0.409			0.472
Original packaging stating salt is iodized	355	12.7	61.2	[52.3,69.4]		45.5	[36.3,55.1]		10.2	[6.3,16.3]	
Original packaging without mention of iodization	26	5.3	51.7	[19.4,82.6]		24.2	[7.9,54.5]		0.0		
Undetermined, not in original package	2546	14.8	65.9	[62.4,69.2]		49.9	[46.5,53.3]		7.8	[6.1,9.8]	
Undetermined, salt package not observed	55	19.0	84.6	[69.6,92.9]		52.3	[32.3,71.6]		12.6	[4.3,31.9]	
TOTAL SAMPLE	3031	13.8	65.5	[61.9,69.0]		49.0	[45.6,52.4]		8.2	[6.5,10.1]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Iodized salt: ≥ 5 ppm; adequately iodized salt: ≥ 15 ppm (international cut-off); adequately iodized salt: ≥ 35.6 ppm (national cut-off).

^b Percentages and medians weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

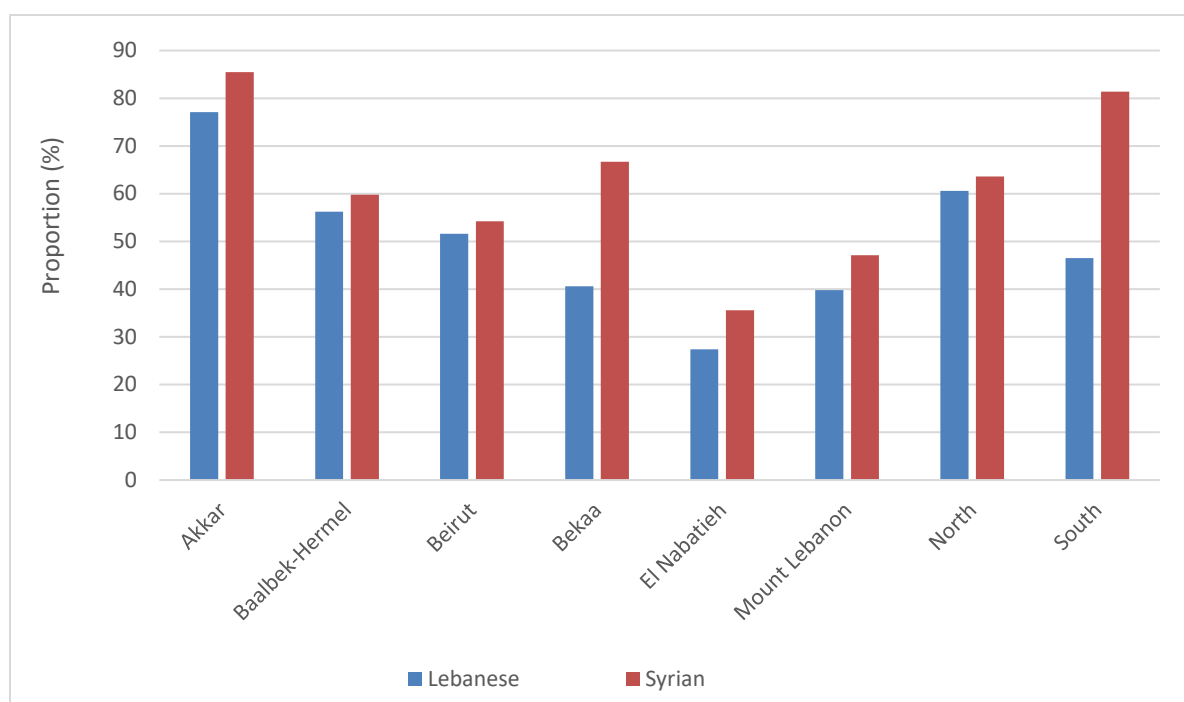


Figure 10. Proportion of households with adequate salt iodization (≥ 15 ppm) by governorate strata (excluding Syrian ITS and Palestinian camps strata) and nationality, Lebanon 2023

3.3. Children 0-59 months of age

3.3.1. Characteristics

Data were collected from 2072 children (Table 18), and the sample contained slightly more boys than girls. Nearly half of the children are Lebanese and half are Syrian, and < 2% of the sampled children are Palestinian. Due to the small sample size, the Palestinian children's results should be interpreted with caution. Only four children have a nationality that was not either Lebanese, Syrian, or Palestinian, and these four children are not included in any of the nationality-specific analyses in this chapter.

Table 18. Description of children 0-59 months of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Nationality			
Lebanese	1009	46.8	[40.3,53.5]
Syrian	988	50.9	[44.2,57.5]
Palestinian	71	1.6	[0.8,3.1]
Other	4	0.7	[0.1,3.9]
Age group (in months)			
0-5	142	8.1	[5.9,11.2]
6-11	155	7.0	[5.1,9.4]
12-23	373	19.2	[16.6,22.2]
24-35	375	18.4	[16.1,20.8]
36-47	489	23.6	[20.8,26.5]
48-59	538	23.7	[20.2,27.6]
Sex			
Male	1080	52.3	[48.8,55.7]
Female	992	47.7	[44.3,51.2]
Stratum			
Akkar	227	6.3	[4.6,8.6]
Baalbek-Hermel	201	4.9	[3.2,7.4]
Beirut	222	6.0	[4.1,8.6]
Bekaa	176	6.0	[4.2,8.4]
El Nabatieh	140	6.0	[4.2,8.6]
Mount Lebanon	157	29.5	[20.4,40.6]
North	292	18.3	[12.7,25.7]
South	176	11.3	[6.6,18.5]
Palestinian camps	140	1.9	[1.3,2.9]
Syrian ITS	341	9.8	[7.2,13.1]
Wealth quintile			
Lowest	881	41.2	[35.7,46.9]
Second	382	18.6	[14.2,23.9]
Middle	307	12.6	[10.2,15.5]
Fourth	270	14.3	[11.4,17.7]
Highest	232	13.3	[10.3,17.1]
TOTAL SAMPLE	2072	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. //

^a Percentages weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design.

The proportion of children <1 year of age (15%) is smaller than the proportions (i.e., 19-24%) found in the older age groups (Table 18). The LIMA recruited the largest number of children from the Syrian ITS and North strata. More than 40% of the sampled children live in households of the lowest wealth quintile.

The breakdown of the wealth quintiles by nationality shows that the vast majority of children in the lowest wealth quintile are of Syrian nationality, and the highest wealth quintile consists mainly of Lebanese children (Figure 11).

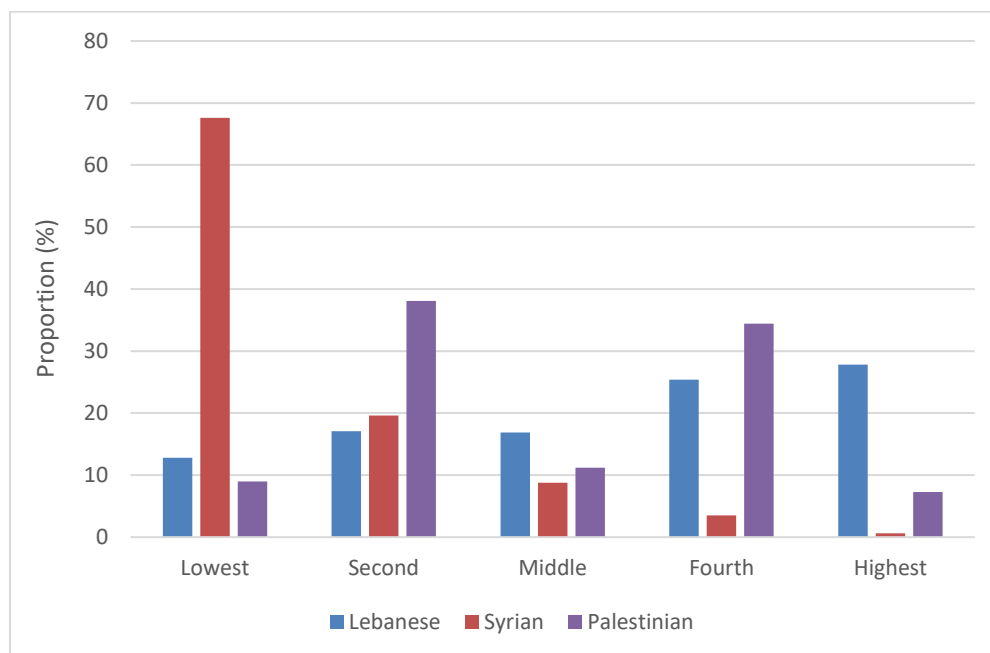


Figure 11. Child wealth quintile distribution by nationality, Lebanon 2023

3.3.2. Recent illness and health indicators

Table 19 presents key birth weight and illness indicators. Approximately 85% of children participating in the survey were weighed at birth. Of the children weighted at birth, birth weight was primarily provided from recall, and 20% of these children had a low birth weight (i.e., < 2500 grams). The prevalence of low birth weight is highest among Palestinian children and lowest in Lebanese children (Figure 12).

Lower acute respiratory infection (LRI) was uncommon, and the caregivers reported that almost 20% of children had diarrhea and 25% had fever in the 2 weeks prior to the survey.

Approximately 35% of children have any type of inflammation. Convalescent inflammation (normal CRP, high AGP) is the most common, affecting one-quarter of the children participating in the LIMA.

Table 19. Health indicators in children 0-59 months of age, Lebanon 2023

Characteristic	N	% or mean ^a	[95% CI] ^b
Child weighed at birth			
Yes	1815	84.5	[80.3,88.0]
No	102	6.6	[3.8,11.2]
Don't know	155	8.9	[6.9,11.4]
Birth weight in kilograms^c			
Mean	1815	2.9	[2.8,2.9]
Low birth weight^c			
<2500 grams	331	19.7	[16.3,23.7]
>2500 grams	1484	80.3	[76.3,83.7]
Birth weight source			
Birth certificate	377	19.4	[15.7,23.7]
Medical card	220	13.0	[9.9,16.9]
Recall	1209	67.3	[62.7,71.5]
Other	9	0.4	[0.1,1.1]
Had lower acute respiratory infection in past 2			
Yes	116	4.6	[3.5,5.9]
No	1956	95.4	[94.1,96.5]
Had diarrhea in past 2 weeks			
Yes	365	18.6	[15.2,22.5]
No	1707	81.4	[77.5,84.8]
When child had diarrhea, ORS/zinc given^e			
Yes	87	23.6	[15.7,33.9]
No	278	76.4	[66.1,84.3]
Had fever in past 2 weeks			
Yes	500	24.3	[20.7,28.3]
No	1572	75.7	[71.7,79.3]
Inflammation^f			
None	960	65.2	[61.3,69.0]
Early (High CRP, Normal AGP)	18	1.1	[0.6,1.9]
Acute (High CRP, High AGP)	151	8.7	[6.9,10.9]
Convalescent (Normal CRP, High AGP)	368	25.0	[21.7,28.7]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Only includes those children weighed at birth.

^d Questions on recent illness were phrased according to the MICS manual [114].

^e Only including respondents whose children had diarrhea in preceding 2 weeks.

^f Elevated CRP defined as > 5 mg/L and elevated AGP defined as > 1 g/L according to Thurnham *et al.* [115].

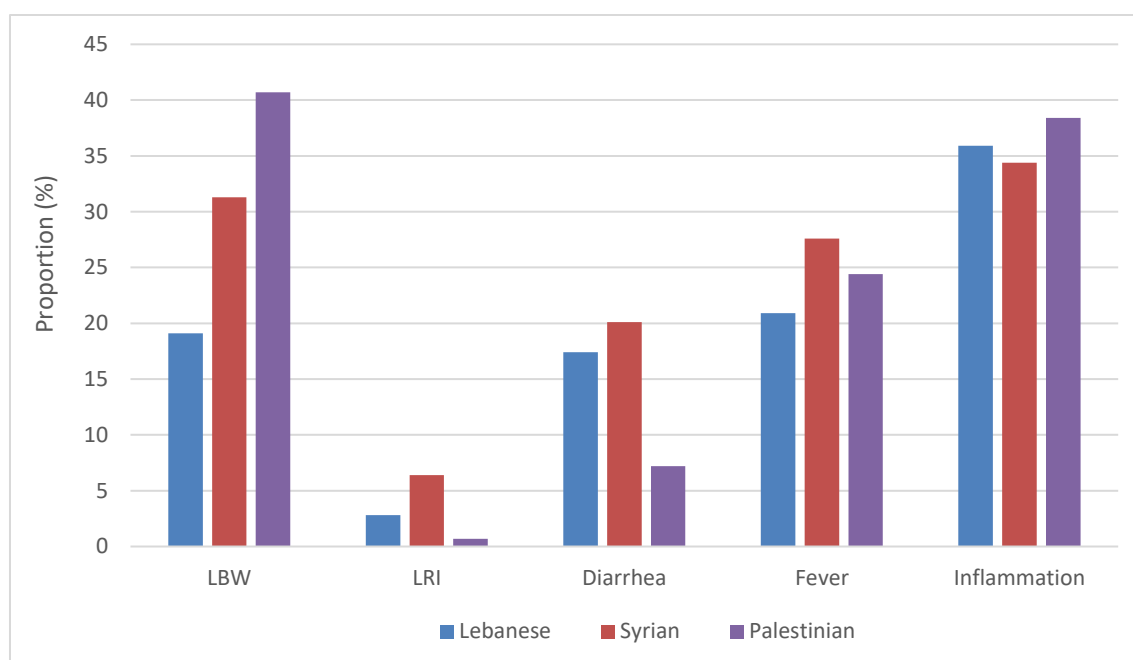


Figure 12. Prevalence of low birth weight (LBW), illness in the past 2 weeks (lower respiratory infection (LRI), diarrhea, fever) and inflammation (elevated AGP and/or CRP) by nationality, children 0-59 months, Lebanon 2023

3.3.3. Infant and young child feeding indicators

Table 20 and Table 21 present several standard infant and young child feeding (IYCF) indicators recommended by the WHO and UNICEF [59].

More than 85% of the surveyed children 0-23 months of age had ever been breastfed. Almost 60% of children were breastfed immediately after birth, and about 45% of children were exclusively breastfed for the first two days after birth. Only about 20% of children < 6 months of age were exclusively breastfed and continued breastfeeding was reported in less than 30% of children 12-23 months of age (Table 20).

Disaggregating the IYCF indicators by nationality revealed that the proportion of children ever breastfed and exclusively breastfed for the first two days after birth is highest in Syrian children compared to other nationalities (Figure 13).

Table 20. IYCF breast feeding indicators in children 0-23 months of age (unless stated otherwise), Lebanon 2023

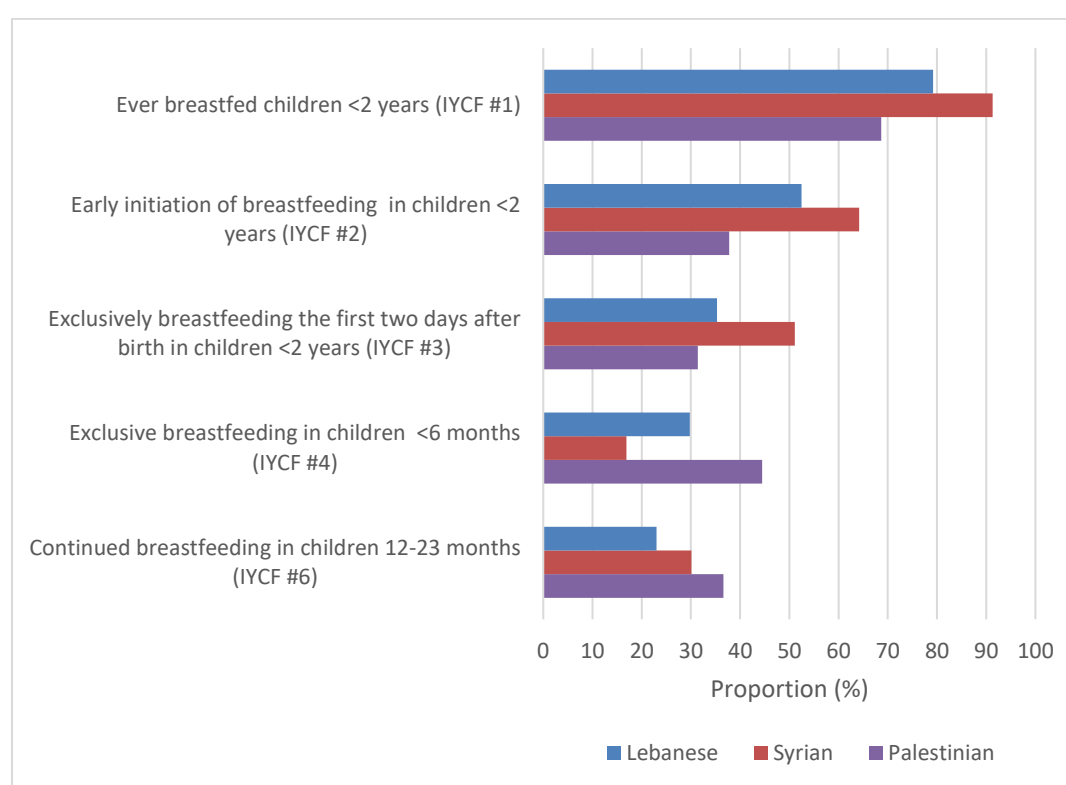
Characteristic	N	% ^a	[95% CI] ^b
Ever breastfed (Indicator #1)			
Yes	568	86.0	[80.8,90.0]
No	103	14.0	[10.0,19.2]
Early initiation of breastfeeding (Indicator #2)			
Yes	441	58.8	[52.4,64.9]
No	230	41.2	[35.1,47.6]
Exclusively breastfed for the first two days after birth (Indicator #3)			
Yes	319	44.4	[38.1,50.9]
No	352	55.6	[49.1,61.9]
Exclusive breastfeeding under six months (0-5 months of age; Indicator #4)			
Yes	39	22.7	[14.6,33.4]
No	102	77.3	[66.6,85.4] ^c
Continued breastfeeding at 1 year (12-23 months of age; Indicator #6)			
Yes	114	27.2	[19.5,36.7]
No	259	72.8	[63.3,80.5]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Data from El Nabatieh (1 observation) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup.

**Figure 13. IYCF breast feeding indicators by nationality, Lebanon 2023**

Regarding complementary feeding, less than two-third of children 6-8 months of age receive complementary foods. Among non-breastfed children 6-23 months of age, nearly half the children receive the minimum number of milk feedings for their age. Among the same age group, about one-quarter of children reach the minimum dietary diversity and half achieve the minimum meal frequency. Consequently, only a small proportion of children achieve the minimum acceptable diet - a composite of minimum dietary diversity and minimum meal frequency. Moreover, about one-third of surveyed children consume eggs or flesh foods and less than two-thirds consume any vegetables. Approximately 40% of children 6-23 months of age consume at least one sweet beverage and/ or unhealthy food.

Table 21. IYCF complementary and bottle-feeding indicators in children 6-23 months of age (unless stated otherwise), Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Introduction of solid foods (6-8 months; Indicator #7)			
Yes	38	60.0	[42.6,75.2] ^c
No	23	40.0	[24.8,57.4] ^d
Minimum dietary diversity (Indicator #8)			
Yes	100	25.8	[19.1,33.9]
No	428	74.2	[66.1,80.9]
Minimum meal frequency (Indicator #9)			
Yes	233	47.1	[40.8,53.4]
No	295	52.9	[46.6,59.2]
Minimum milk feeding frequency for non-breastfed children (Indicator #10)			
Yes	122	52.0	[42.8,61.1]
No	106	48.0	[38.9,57.2]
Minimum acceptable diet (Indicator #11)			
Yes	48	10.7	[7.4,15.2]
No	480	89.3	[84.8,92.6]
Egg and/or flesh food consumption (Indicator #12)			
Yes	166	38.3	[31.9,45.1]
No	362	61.7	[54.9,68.1]
Sweet beverage consumption (Indicator #13)			
Yes	193	39.7	[32.6,47.4]
No	335	60.3	[52.6,67.4]
Unhealthy food consumption (Indicator #14)			
Yes	193	40.5	[33.7,47.8]
No	335	59.5	[52.2,66.3]
Vegetable or fruit consumption (Indicator #15)			
Zero vegetable or fruits	229	36.3	[30.5,42.5]
Any vegetable or fruits	299	63.7	[57.5,69.5]
Bottle fed in past 24 hours (Indicator #16)			
Yes	290	43.9	[37.9,50.2]
No	380	56.1	[49.8,62.1]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Data from Akkar (4 observations), El Nabathie (3 observations), and Mount Lebanon (1 observation) were excluded from analysis since the small N's in these strata caused instability in the estimation of the confidence interval for this subgroup.

^d Data from Mount Lebanon (1 observation) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup.

3.3.4. Minimum dietary diversity, meal frequency and acceptable diet in children 6-23 months of age

As shown in Table 22, only about 25% of children have minimum dietary diversity, while almost half of the children live in moderate food poverty (i.e., 3-4 food groups) and almost one third in severe food poverty (i.e., 0-2 food groups). Children living in the Palestinian Camp and the Syrian ITS strata are less likely to achieve minimum dietary diversity compared to children living in other strata. Minimum dietary diversity is also significantly associated with wealth quintile, with a significantly larger proportion of the children residing in wealthier households achieving minimum dietary diversity. Dietary diversity is also significantly associated with nationality, with the highest proportion of Lebanese children achieving minimum dietary diversity and the highest proportion of Palestinian children living in severe food poverty. Moreover, significant differences were found by household food security, with the proportion of children achieving minimum dietary diversity being significantly higher among those living in food secure households than among those living in food insecure households. Severe food poverty, but not minimum dietary diversity, is associated with age groups, with the highest prevalence found in children 6-11 months of age.

Table 23 presents minimum meal frequency and minimum acceptable diet by various factors. Overall, about half of the surveyed children achieve minimum meal frequency and only about 10% of children have the minimum acceptable diet. Both indicators are significantly associated with stratum, nationality, wealth quintile, and household food security. The lowest proportion of children with minimum meal frequency and minimum acceptable diet was found in the Palestinian Camp stratum. A higher proportion of Lebanese children have minimum meal frequency and minimum acceptable diet compared to Syrian and Palestinian children. Further, a larger proportion of children living in wealthy and food secure households reach minimum meal frequency and a minimum acceptable diet compared to children living in poor and food insecure households.

Table 22. Dietary diversity in children 6-23 months, Lebanon 2023

Characteristic	Mean dietary score ^a		Minimum dietary diversity (consumed ≥5 food groups)			Moderate food poverty (consumed 3-4 food groups)		Severe food poverty (consumed 0-2 food groups)		
	N		% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	% ^a	[95% CI] ^b	p-value ^c
Nationality					0.001					0.007
Lebanese	234	3.8	39.4	[28.8,51.2]		38.2	[29.8,47.4]	22.4	[16.6,29.4]	
Syrian	276	3.2	16.1	[9.2,26.6]		49.0	[39.0,59.0]	34.9	[27.8,42.7]	
Palestinian	16	2.6	9.5	[2.0,34.8]		21.6	[5.2,58.0]	68.8	[27.5,92.8]	
Age group (in months)					0.402					0.040
6-11	155	3.1	20.0	[11.7,32.1]		38.3	[25.2,53.3]	41.7	[30.2,54.2]	
12-17	162	3.5	31.3	[19.4,46.3]		38.2	[26.5,51.4]	30.5	[21.1,41.9]	
18-23	211	3.6	25.1	[16.0,37.2]		52.5	[41.2,63.6]	22.3	[15.5,31.0]	
Sex					0.059					0.510
Male	272	3.4	31.5	[21.7,43.3]		36.0	[28.3,44.5]	32.5	[23.9,42.5]	
Female	256	3.4	19.9	[13.3,28.8]		52.3	[42.0,62.5]	27.8	[20.3,36.7]	
Stratum					0.036					<0.001
Akkar	46	3.2	20.1	[11.8,32.1]		52.7	[37.2,67.6]	27.2	[15.2,43.9]	
Baalbek-Hermel	49	2.8	12.4	[4.7,29.0]		42.0	[25.6,60.4]	45.6	[26.8,65.8]	
Beirut	59	3.8	20.5	[8.1,43.0]		67.1	[48.1,81.7]	12.5	[6.1,23.7]	
Bekaa	41	3.7	28.8	[12.4,53.6]		42.8	[24.8,62.9]	28.4	[14.4,48.5]	
El Nabatieh	36	3.7	25.4	[10.6,49.3]		58.8	[37.8,77.1]	15.8	[6.5,33.5]	
Mount Lebanon	39	3.9	38.2	[21.4,58.3]		39.6	[23.2,58.8]	22.3	[12.4,36.8]	
North	74	3.5	29.6	[16.2,47.7]		45.2	[29.3,62.1]	25.3	[16.9,36.0]	
South	41	2.9	18.2	[8.4,35.0]		33.6	[23.0,46.2]	48.1	[31.5,65.2]	
Palestinian camps	40	2.4	4.3	[1.2,14.8]		45.4	[29.4,62.5]	50.3	[34.6,65.9]	
Syrian ITS	103	2.5	6.2	[2.4,15.2]		42.7	[34.2,51.7]	51.1	[40.4,61.8]	
Wealth quintile					0.007					0.016
Lowest	230	3.0	15.0	[7.2,28.7]		46.7	[36.0,57.7]	38.3	[29.0,48.6]	
Second	112	3.5	27.9	[15.5,44.8]		44.6	[28.6,61.9]	27.5	[18.0,39.5]	
Middle	68	3.0	16.8	[7.5,33.4]		42.3	[25.2,61.4]	41.0	[24.2,60.1]	
Fourth	67	4.2	46.9	[27.8,66.9]		34.1	[19.2,53.1]	19.0	[9.1,35.7]	
Highest	51	4.0	40.8	[25.4,58.2]		48.4	[32.8,64.3]	10.8	[4.6,23.3]	

Table continued on next page

Characteristic	Mean dietary score ^a		Minimum dietary diversity (consumed ≥5 food groups)			Moderate food poverty (consumed 3-4 food groups)		Severe food poverty (consumed 0-2 food groups)		
	N		% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	% ^a	[95% CI] ^b	p-value ^c
Household food insecurity access					0.026					0.051
Secure	100	4.1	47.4	[31.5,63.8]		37.3	[23.9,53.0]	15.3	[8.6,25.8]	
Mild	53	3.8	25.6	[10.6,50.1]		53.3	[39.9,66.2]	21.1	[8.2,44.4]	
Moderate	161	3.2	19.0	[10.9,31.0]		43.4	[32.7,54.7]	37.6	[27.2,49.2]	
Severe	214	3.2	21.3	[12.0,35.0]		45.1	[33.7,57.1]	33.6	[25.2,43.1]	
TOTAL SAMPLE	528	3.4	25.8	[19.1,33.9]		44.0	[36.8,51.5]	30.2	[25.2,35.7]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

Table 23. Minimum meal frequency and minimum acceptable diet in children 6-23 months, Lebanon 2023

Characteristic	Minimum meal frequency ^a				Minimum acceptable diet ^b		
	N	% ^c	[95% CI] ^d	p-value ^e	% ^c	[95% CI] ^d	p-value ^e
Nationality				0.008			0.007
Lebanese	234	58.8	[49.7,67.4]		19.0	[12.8,27.4]	
Syrian	276	39.1	[29.8,49.1]		5.0	[2.2,11.1]	
Palestinian	16	41.7	[28.7,56.0]		0.0		
Age group (in months)				0.887			0.817
6-11	155	44.2	[32.4,56.8]		12.2	[6.2,22.8]	
12-17	162	47.7	[35.8,59.9]		11.3	[5.3,22.5]	
18-23	211	48.4	[38.1,58.8]		9.1	[4.8,16.6]	
Sex				0.223			0.994
Male	272	50.9	[41.7,60.1]		10.7	[6.2,17.7]	
Female	256	43.0	[34.8,51.7]		10.6	[5.8,18.8]	
Stratum				0.038			0.014
Akkar	46	37.8	[27.6,49.2]		10.8	[5.1,21.3]	
Baalbek-Hermel	49	45.8	[31.6,60.7]		3.4	[1.0,11.1]	
Beirut	59	54.1	[32.8,73.9]		15.8	[4.9,40.5]	
Bekaa	41	52.4	[36.6,67.7]		10.2	[4.4,21.9]	
El Nabatieh	36	65.0	[46.3,80.0]		17.8	[6.8,39.3]	
Mount Lebanon	39	41.8	[27.4,57.7]		12.1	[5.7,24.0]	
North	74	55.0	[44.9,64.8]		19.2	[10.6,32.1]	
South	41	52.3	[38.9,65.3]		1.5	[0.2,11.5]	
Palestinian camps	40	18.3	[8.8,34.0]		0.0		
Syrian ITS	103	38.3	[27.5,50.4]		1.5	[0.3,7.4]	
Wealth quintile				0.002			<0.001
Lowest	230	33.4	[25.7,42.3]		3.5	[1.2,9.6]	
Second	112	53.0	[36.9,68.5]		7.6	[2.7,19.3]	
Middle	68	36.7	[21.6,54.9]		7.0	[2.7,17.1]	
Fourth	67	66.8	[47.6,81.7]		25.0	[13.2,42.1]	
Highest	51	68.0	[51.8,80.8]		27.1	[12.7,48.8]	
Household food insecurity access				0.015			0.078
Secure	100	61.5	[47.2,74.0]		20.7	[10.1,37.8]	
Mild	53	71.7	[47.8,87.6]		7.7	[2.7,19.6]	
Moderate	161	42.3	[30.4,55.1]		11.4	[6.1,20.4]	
Severe	214	38.4	[28.8,49.0]		6.5	[2.9,13.8]	
TOTAL SAMPLE	528	47.1	[40.8,53.4]		10.7	[7.4,15.2]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Minimum meal frequency indicates that at least two feedings of solid, semi-solid or soft foods were consumed for breastfed infants aged 6–8 months; at least three feedings of solid, semi-solid or soft foods were consumed for breastfed children aged 9–23 months; and at least four feedings of solid, semi-solid or soft foods or milk feeds were consumed for non-breastfed children aged 6–23 months whereby at least one of the four feeds must be a solid, semi-solid or soft feed.

^b Minimum acceptable diet indicates that breastfed children received at least the minimum dietary diversity and minimum meal frequency for their age during the previous day; that non-breastfed children received at least the minimum dietary diversity and minimum meal frequency for their age during the previous day, as well as at least two milk feeds.

^c Percentages weighted for unequal probability of selection.

^d CI = confidence interval, calculated taking into account the complex sampling design.

^e Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.3.5. Consumption of vitamins, minerals, supplements, and fortified foods

As shown in Table 24, a relatively small proportion (< 10%) of children 0-59 months of age consumed fortified infant formula, fortified baby cereal, or micronutrient powders the day before the survey. About 10% of children took iron tablets/ syrup or multivitamin supplements, and nearly 14% took vitamin D tablets in the 6 months before the survey. Only a small proportion of the children consumed fish oil supplements or took drugs against intestinal worms in the past six months. Looking at supplement and fortified food consumption by nationality, Figure 14 shows that a large proportion of Syrian children consumed fortified baby foods and micronutrient powder the day before the survey.

Table 24. Consumption of iron-fortified food, vitamin A and vitamin D supplements in children 0-59 months of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Consumed commercially fortified baby food			
Yes	207	7.4	[5.9,9.3]
No	1849	92.2	[90.2,93.8]
Consumed micronutrient powder			
Yes	137	5.5	[3.9,7.7]
No	1918	94.0	[91.8,95.6]
Consumed infant formula with added iron			
Yes	170	6.3	[5.0,8.1]
No	1881	92.9	[91.1,94.4]
Took iron tablet or syrup in past six months			
Yes	223	10.4	[8.6,12.5]
No	1830	88.9	[86.8,90.8]
Took multivitamin supplement in past six			
Yes	190	9.6	[7.0,13.1]
No	1859	89.7	[86.2,92.3]
Took vitamin D tablet or syrup in past six			
Yes	263	13.8	[11.5,16.4]
No	1786	85.3	[82.7,87.6]
Is still taking vitamin D tablets or syrup^c			
Yes	148	60.6	[49.8,70.5]
No	115	39.4	[29.5,50.2]
Took fish oil supplements in past six months			
Yes	60	1.9	[1.2,3.0]
No	1989	97.3	[96.1,98.1]
Is still taking fish oil supplements^c			
Yes	11	18.0	[9.2,32.3] ^d
No	41	82.0	[67.7,90.8] ^e
Took drug for intestinal worms in past six			
Yes	56	3.0	[1.9,4.8]
No	1993	96.3	[94.5,97.5]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Only includes those children reported to take supplement in the past six months.

^d Data from Beirut (2 observations) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup.

^e Data from Baalbek-Hermel (1 observation), Bekaa (2 observations), Mount Lebanon (1 observation), and Palestinian camps (2 observations) were excluded from analysis since the small N's in these strata caused instability in the estimation of the confidence interval for this subgroup.

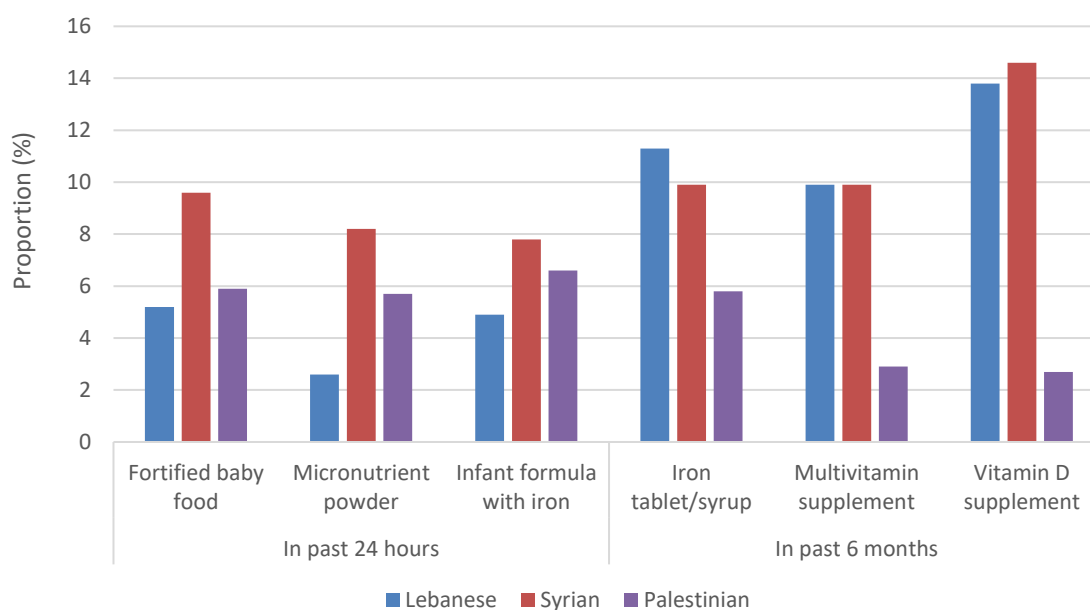


Figure 14. Iron fortified food and supplement consumption by nationality, Lebanon 2023

3.3.6. Sun exposure

When outside, only 20% of children have their heads protected from the sun “most of the time” or “all the time”. Protecting children’s arms and hands from the sun is also rarely practiced, with only 10% and 7% of children having their arms or hands covered, respectively. Also, sunscreen usage is very uncommon. More than half of the children spend less than two hours outside per day. About half of children have a sun index of ≥ 20 , indicating a large amount of sun exposure, and about 30% have a low amount sun exposure (sun index < 10). Only 3% ($n = 47$; 95% CI: 1.8, 5.0) of children have a sun exposure index score of 0 indicating no sun exposure.

Table 25. Sun exposure patterns in children 0-59 months of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Usually protects head from sun when outside			
Never/rarely	1233	56.8	[53.0,60.5]
Sometimes	481	23.2	[20.2,26.4]
Most of the time	216	12.2	[10.1,14.7]
All the time	142	7.8	[6.0,10.0]
Usually covers arms when outside			
Never/rarely	1452	69.2	[65.0,73.2]
Sometimes	417	20.5	[17.4,24.0]
Most of the time	131	7.0	[5.4,9.1]
All the time	72	3.2	[2.3,4.4]
Usually covers hands when outside			
Never/rarely	1598	77.8	[73.2,81.8]
Sometimes	320	14.7	[11.7,18.1]
Most of the time	97	5.3	[3.8,7.3]
All the time	57	2.3	[1.5,3.5]
Approx. time on weekdays spent under the sun			
1-29 minutes	292	20.4	[16.5,24.9]
30-59 minutes	273	22.1	[18.8,25.7]
1-2 hours	346	15.8	[12.9,19.1]
2-3 hours	274	13.8	[11.6,16.3]
>3 hours	551	28.0	[24.3,32.1]
Approx. time on weekends spent under the sun			
1-29 minutes	394	27.3	[23.2,31.7]
30-59 minutes	285	20.8	[18.0,24.0]
1-2 hours	306	15.1	[12.0,18.7]
2-3 hours	357	19.1	[15.4,23.5]
>3 hours	343	17.8	[14.8,21.1]
Usually uses sunscreen			
Never/rarely	1811	88.2	[84.5,91.0]
Sometimes	175	7.6	[5.6,10.3]
Most of the time	57	2.8	[1.8,4.4]
All the time	29	1.4	[0.7,2.9]
Respondent skin color			
Very white	69	4.7	[3.2,6.9]
White	796	39.4	[35.2,43.7]
Olive	1126	51.7	[46.8,56.5]
Dark	79	3.6	[2.5,5.0]
Very dark	2	0.6	[0.1,4.3]
Sun exposure index			
< 10	479	32.6	[28.4,37.1]
10-19	320	21.3	[18.0,25.0]
≥ 20	879	46.1	[41.2,51.1]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection among regions.

^b CI = confidence interval, calculated taking into account the complex sampling design.

3.3.7. Stunting

Figure 15 shows the distribution of the height-for-age z-score in the surveyed population of children 0-59 months of age and shows that the z-score is shifted slightly towards the left of the standard growth curve. The weighted mean height-for-age z-score is -0.72 (95% CI; -0.82, -0.61), and the weighted median height-for-age z-score is -0.77 (IQR; -1.74, 0.08).

The national prevalence of stunting in Lebanon is 13.9% (Table 26) and has “medium” public health significance according to WHO guidelines [116]. However, the prevalence is classified as “severe” (i.e., $\geq 20\%$) in multiple subgroups, including children 12-23 months of age, children living in the ITS stratum, and children living in households of the lowest wealth quintile. When examining the prevalence by strata, Beirut, El Nabatieh, North and Palestinian camps have a “low” public health significance, and Akkar, Baalbek-Hermel, Mount Lebanon, Bekaa and South have a “medium” public health significance. The ITS stratum is the only stratum where stunting is considered a “severe” public health problem.

The majority of the stunted children in Lebanon are moderately stunted, while severe stunting is relatively rare. Nonetheless, severe stunting is most prevalent among children in the Syrian ITS stratum and in children in the lowest wealth quintile.

Stunting significantly differs by nationality, with the prevalence among Syrian children two times higher than in Lebanese children. The prevalence of stunting also significantly differs by age, sex, and birth weight, with the highest prevalences found in children 12-23 months of age, male children, and children born with a low birth weight. Stunting is significantly higher in children residing in the lowest wealth quintile households and in households with moderate or severe food insecurity.

When examining stunting by nationality within each governorate, stunting is consistently higher among Syrian children (Figure 16)⁴. The sole exception is the South governorate where the stunting prevalence is highest in Lebanese children.

The prevalence of stunting by nationality within each wealth quintile shows that the stunting prevalence is high among children living in poor households, independent of the nationality (Figure 17).

⁴ Figure 16 excludes the Palestinian nationality because of the small number of subjects in each governorate.

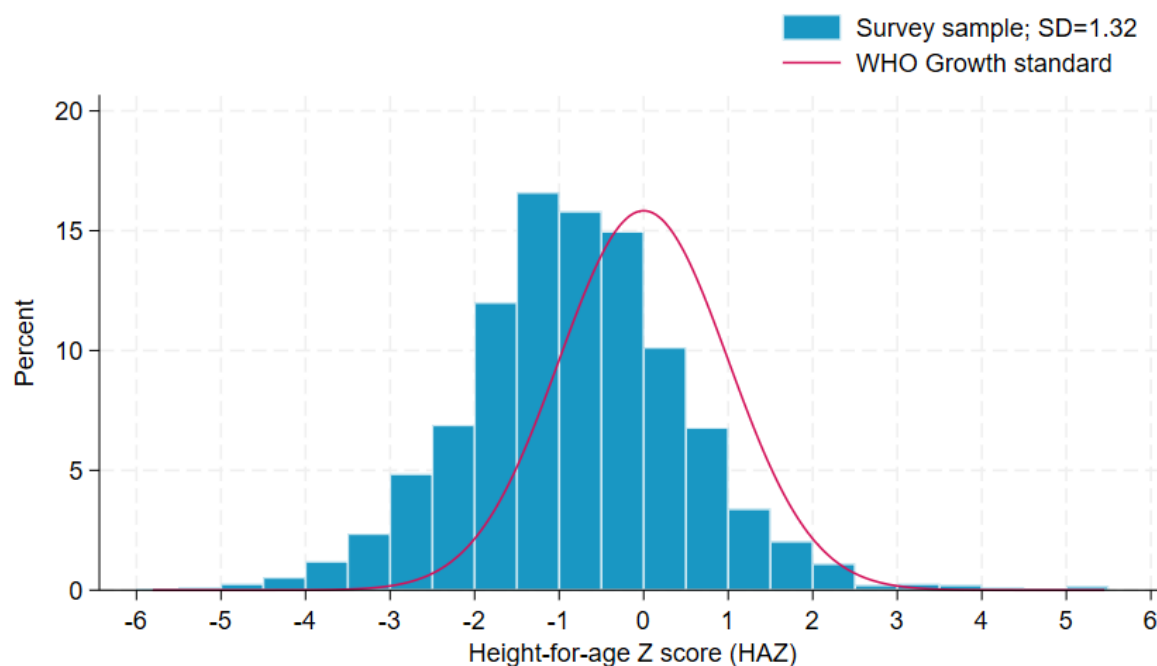


Figure 15. Distribution of height-for-age z-scores in children 0-59 months of age, Lebanon 2023

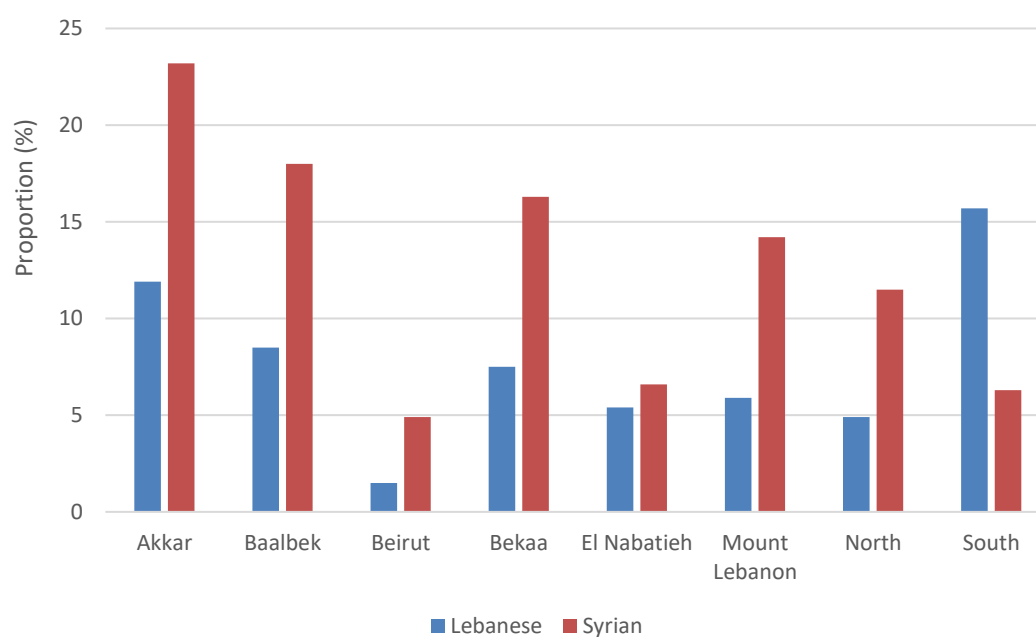


Figure 16. Stunting by nationality in the different governorates (excluding Syrian ITS and Palestinian camps strata), Lebanon 2023

Table 26. Percentage of children (0-59 months) with stunting by various demographic characteristics, Lebanon 2023

Characteristic	N	Severe stunting ^a		Moderate stunting ^b		Any stunting ^c		p-value ^f
		% ^d	[95% CI] ^e	% ^d	[95% CI] ^e	% ^d	[95% CI] ^e	
Nationality								<0.001
Lebanese	945	1.2	[0.7,2.1]	8.0	[5.6,11.3]	9.2	[6.8,12.5]	
Syrian	911	4.2	[2.9,6.1]	14.5	[10.9,19.0]	18.7	[14.5,23.7]	
Palestinian	56	1.4	[0.3,6.7]	0.4	[0.1,3.2]	1.9	[0.4,7.8]	
Age group (in months)								0.030
0-5	119	2.9	[0.8,9.4]	7.6	[3.4,15.9]	10.5	[5.1,20.1]	
6-11	147	1.5	[0.5,4.2]	8.7	[4.0,17.7]	10.2	[5.2,18.9]	
12-23	339	4.5	[2.8,7.1]	16.9	[11.5,24.0]	21.4	[15.8,28.3]	
24-35	353	3.2	[2.0,5.1]	11.7	[7.0,18.7]	14.8	[9.8,21.8]	
36-47	461	3.2	[1.7,5.9]	10.5	[6.5,16.4]	13.6	[9.1,20.0]	
48-59	497	0.9	[0.4,2.1]	8.7	[5.8,12.8]	9.6	[6.6,13.7]	
Low birth weight								0.031
Yes	306	3.4	[1.8,6.3]	15.0	[10.3,21.5]	18.4	[13.2,25.1]	
No	1369	2.4	[1.8,3.4]	9.7	[7.7,12.2]	12.1	[9.9,14.8]	
Sex								0.002
Male	1000	3.2	[2.3,4.4]	14.0	[10.8,18.0]	17.2	[13.8,21.2]	
Female	916	2.3	[1.4,3.7]	8.0	[5.9,10.8]	10.3	[7.9,13.4]	
Stratum								<0.001
Akkar	220	4.5	[2.6,7.7]	11.1	[5.5,21.3]	15.7	[9.5,24.8]	
Baalbek-Hermel	193	1.1	[0.3,3.9]	11.2	[7.0,17.6]	12.4	[7.9,18.8]	
Beirut	193	2.2	[0.8,6.1]	7.9	[2.9,19.8]	10.1	[4.7,20.4]	
Bekaa	164	1.0	[0.2,6.0]	9.1	[4.7,16.8]	10.1	[5.5,17.8]	
El Nabatieh	137	2.9	[1.2,7.0]	4.5	[2.0,9.6]	7.4	[4.4,12.2]	
Mount Lebanon	152	0.6	[0.1,4.4]	11.1	[6.8,17.6]	11.6	[7.2,18.2]	
North	284	2.0	[0.9,4.6]	8.2	[5.2,12.6]	10.2	[6.7,15.1]	
South	153	0.9	[0.3,3.2]	10.4	[4.2,23.4]	11.3	[4.8,24.3]	
Palestinian camps	99	5.9	[3.1,10.8]	6.8	[3.5,12.9]	12.7	[8.0,19.7]	
Syrian ITS	321	13.1	[9.3,18.2]	26.0	[19.0,34.6]	39.2	[30.2,49.0]	

Table continued on next page

Characteristic	N	Severe stunting ^a % ^d [95% CI] ^e	Moderate stunting ^b % ^d [95% CI] ^e	Any stunting ^c % ^d [95% CI] ^e	p-value ^f
Wealth quintile					<0.001
Lowest	832	5.2 [3.7,7.3]	17.2 [13.4,21.7]	22.4 [18.0,27.4]	
Second	356	1.7 [0.7,4.0]	6.9 [3.9,12.1]	8.6 [5.2,14.0]	
Middle	274	0.9 [0.3,2.5]	5.3 [2.7,10.3]	6.2 [3.4,11.1]	
Fourth	246	0.7 [0.2,2.2]	9.0 [4.8,16.3]	9.8 [5.5,16.8]	
Highest	208	0.4 [0.1,2.7]	5.4 [2.6,11.1]	5.8 [2.9,11.5]	
Household food insecurity access					0.017
Secure	397	1.9 [1.0,3.4]	6.3 [3.7,10.5]	8.2 [5.4,12.5]	
Mild	180	1.0 [0.3,3.8]	7.7 [3.5,16.0]	8.7 [4.3,16.7]	
Moderate	608	2.8 [1.8,4.2]	13.5 [9.5,19.0]	16.3 [12.0,21.8]	
Severe	731	3.5 [2.2,5.6]	12.6 [9.4,16.7]	16.1 [12.7,20.2]	
Household sanitation^g					0.947
Inadequate	161	5.4 [2.9,9.9]	8.6 [4.7,15.2]	14.0 [8.5,22.3]	
Adequate	1710	2.5 [1.8,3.5]	11.3 [9.0,14.1]	13.8 [11.4,16.7]	
Safe drinking water^h					0.827
Yes	1666	2.6 [1.9,3.6]	11.3 [9.0,13.9]	13.8 [11.5,16.6]	
No	244	4.3 [2.3,7.9]	10.3 [5.9,17.4]	14.6 [8.9,23.2]	
TOTAL SAMPLE	1916	2.8 [2.1,3.7]	11.1 [9.0,13.7]	13.9 [11.6,16.6]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Severe stunting includes children who are below -3 standard deviations (SD; z-scores) from the WHO Child Growth Standards population median.

^b Moderate stunting includes children who are equal to or above -3 SD and below -2 SD from the WHO Child Growth Standards population median.

^c Any stunting includes both severely and moderately stunted children.

^d Percentages weighted for unequal probability of selection.

^e CI = confidence interval, calculated taking into account the complex sampling design.

^f Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. Results are based on any stunting.

^g Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate Sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^h Composite variable of main source of drinking water and treating water to make safe for drinking.

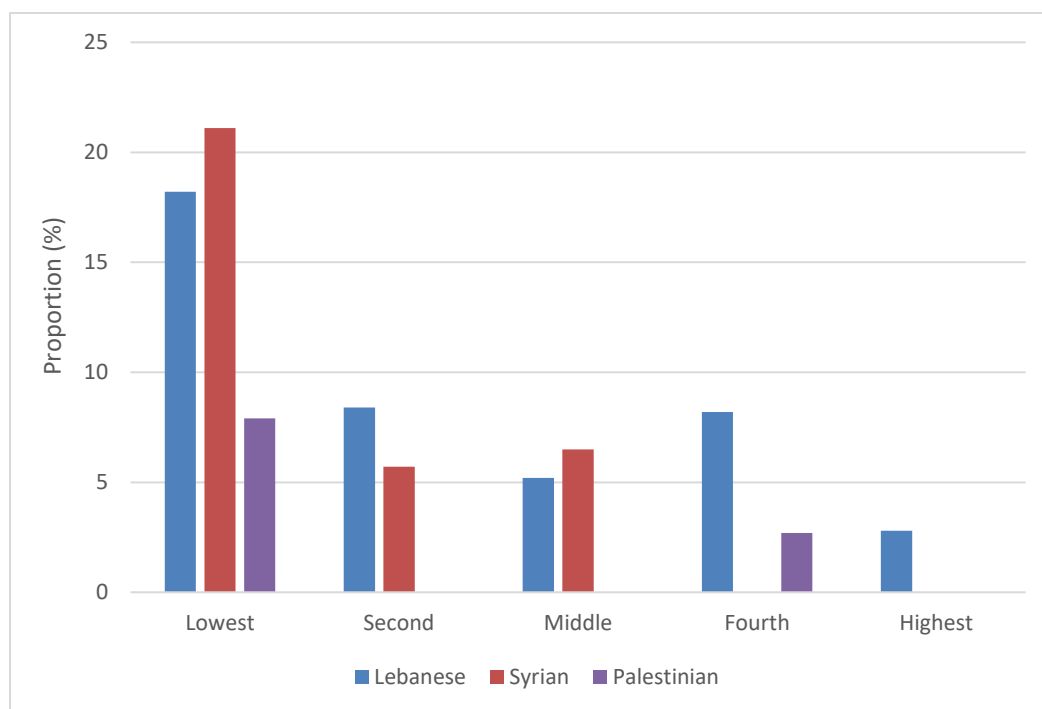


Figure 17. Stunting prevalence by nationality and household wealth, Lebanon 2023

3.3.8. Wasting, overweight and obesity

Weight-for-height z-score was used to estimate both the prevalence of wasting (defined as a z-score < -2) and overweight and obesity defined as a z-score $> +1$ SD and $> +2$ SD, respectively.

Figure 18 shows the distribution of the weight-for-height z-score in the surveyed population of children 0-59 months of age and shows that the distribution of the z-score is shifted slightly to the right of the WHO standard growth curve. The weighted mean weight-for-height z-score is 0.19 (95% CI; 0.09, 0.29), and the weighted median weight-for-height z-score is 0.16 (IQR; -0.51, 0.81).

Overall, 1.3% of children 0-59 months of age in Lebanon are wasted, with about equal proportions of moderate and severe wasting. Nationally, this prevalence can be classified as “very low” ($< 2.5\%$) according to WHO classifications [116]. However, a “medium” public health relevance (5.0 – 9.9%) was observed in children 0-5 months of age, and “low” public health relevance (2.5 – 4.9%) was found in children a) 6-11 months of age, b) living in the Syrian ITS stratum, and c) residing in households without safe drinking water (Table 27).

The survey found significant differences in wasting by age, stratum and household wealth quintile, with highest prevalences found in children < 6 months of age children living in Akkar or Syrian ITS, or in households of the lowest wealth quintile. No significant differences were detected in the other demographic subgroups (Table 27).

Less than 0.1% of children 6-59 months can be classified with SAM based on low MUAC (< 11.5 cm) and overall, only 0.3% of children 6-59 months in Lebanon have SAM based on low MUAC and/ or WHZ (data not shown).

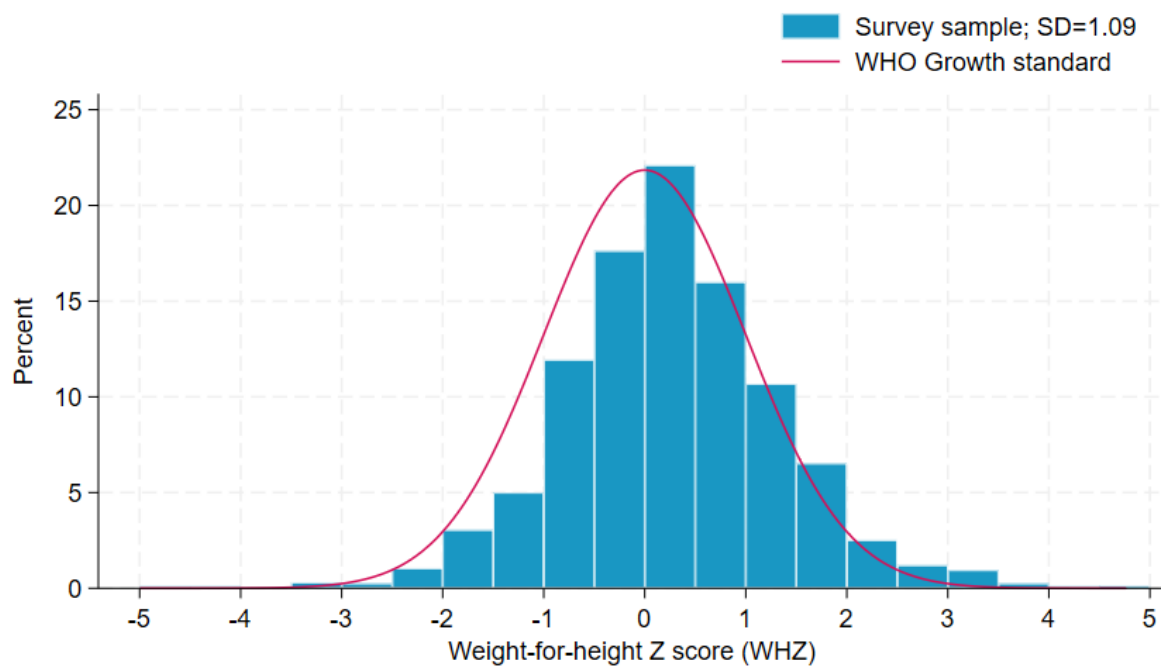


Figure 18. Distribution of weight-for-height z-scores in children 0-59 months of age, Lebanon 2023

Table 27. Percentage of children (0-59 months) with wasting by various demographic characteristics, Lebanon 2023

Characteristic	N	Severe Wasting ^a		Moderate Wasting ^b		Any Wasting ^c		p-value ^f
		% ^d	[95% CI] ^e	% ^d	[95% CI] ^e	% ^d	[95% CI] ^e	
Nationality								0.217
Lebanese	930	0.1	[0.0,0.5]	0.6	[0.2,1.5]	0.7	[0.3,1.6]	
Syrian	910	0.9	[0.3,2.6]	1.0	[0.6,1.6]	1.9	[1.1,3.2]	
Palestinian	55	0.0		0.0		0.0		
Age group (in months)								<0.001
0-5	118	3.8	[0.9,14.6]	2.2	[0.5,8.6]	6.0	[2.4,14.3]	
6-11	146	0.5	[0.1,3.8]	2.4	[1.0,6.0]	3.0	[1.3,6.8]	
12-23	335	0.7	[0.2,2.4]	0.9	[0.4,2.2]	1.6	[0.8,3.4]	
24-35	348	0.1	[0.0,1.0]	0.1	[0.0,1.0]	0.3	[0.0,1.9]	
36-47	459	0.2	[0.0,1.2]	0.7	[0.2,1.9]	0.8	[0.3,2.1]	
48-59	493	0.1	[0.0,0.6]	0.2	[0.1,0.8]	0.3	[0.1,0.9]	
Low birth weight								0.782
Yes	303	0.5	[0.1,1.6]	0.7	[0.2,1.8]	1.1	[0.5,2.5]	
No	1357	0.6	[0.2,2.0]	0.7	[0.3,1.3]	1.3	[0.7,2.4]	
Sex								0.651
Male	989	0.3	[0.1,0.9]	0.8	[0.4,1.6]	1.2	[0.6,2.1]	
Female	910	0.8	[0.2,2.9]	0.7	[0.4,1.3]	1.5	[0.7,2.9]	
Stratum								0.024
Akkar	218	0.9	[0.2,3.7]	1.4	[0.5,3.8]	2.3	[1.1,5.0]	
Baalbek-Hermel	191	0.7	[0.1,5.2]	0.2	[0.0,1.6]	0.9	[0.2,4.6]	
Beirut	193	0.2	[0.0,1.1]	0.3	[0.0,1.9]	0.4	[0.1,1.8]	
Bekaa	164	0.3	[0.0,2.4]	1.1	[0.2,5.9]	1.4	[0.4,5.7]	
El Nabatieh	134	0.0		1.6	[0.5,5.3]	1.6	[0.5,5.3]	
Mount Lebanon	151	0.9	[0.2,4.3]	0.4	[0.0,2.8]	1.2	[0.4,4.0]	
North	278	0.4	[0.1,2.6]	0.3	[0.1,1.1]	0.6	[0.2,2.3]	
South	151	0.0		0.2	[0.0,1.9]	0.2	[0.0,1.9]	
Palestinian camps	97	0.0		1.4	[0.2,10.0]	1.4	[0.2,10.0]	
Syrian ITS	322	0.9	[0.3,3.0]	2.7	[1.5,4.8]	3.6	[2.1,6.2]	

Table continued on next page

Characteristic	N	Severe Wasting ^a		Moderate Wasting ^b		Any Wasting ^c		p-value ^f
		% ^d	[95% CI] ^e	% ^d	[95% CI] ^e	% ^d	[95% CI] ^e	
Wealth quintile								0.034
Lowest	827	1.1	[0.4,3.2]	1.2	[0.7,2.0]	2.3	[1.4,3.9]	
Second	352	0.2	[0.0,1.3]	0.8	[0.2,3.7]	1.0	[0.3,3.6]	
Middle	273	0.2	[0.0,1.1]	0.6	[0.2,2.3]	0.8	[0.2,2.4]	
Fourth	243	0.0		0.2	[0.0,1.4]	0.2	[0.0,1.4]	
Highest	204	0.0		0.0		0.0		
Household food insecurity access								0.158
Secure	393	0.1	[0.0,1.0]	0.3	[0.1,1.1]	0.5	[0.2,1.3]	
Mild	178	0.0		0.0		0.0		
Moderate	602	0.3	[0.1,1.1]	1.5	[0.7,3.1]	1.7	[0.9,3.4]	
Severe	726	1.1	[0.4,3.1]	0.6	[0.3,1.2]	1.7	[0.8,3.3]	
Household sanitation ^g								0.723
Inadequate	159	1.2	[0.3,5.3]	0.4	[0.1,1.6]	1.7	[0.5,5.2]	
Adequate	1695	0.5	[0.2,1.5]	0.8	[0.5,1.4]	1.3	[0.8,2.2]	
Safe drinking water ^h								0.079
Yes	1651	0.6	[0.2,1.5]	0.6	[0.3,1.1]	1.2	[0.7,1.9]	
No	242	0.3	[0.0,2.3]	2.3	[1.0,5.3]	2.6	[1.2,5.7]	
TOTAL SAMPLE	1899	0.5	[0.2,1.4]	0.8	[0.5,1.2]	1.3	[0.8,2.0]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Severe wasting includes children who are below -3 standard deviations (SD; z-scores) from the WHO Child Growth Standards population median.

^b Moderate wasting includes children who are equal to or above -3 SD and below -2 SD from the WHO Child Growth Standards population median.

^c Any wasting includes both severely and moderately wasted children.

^d Percentages weighted for unequal probability of selection.

^e CI = confidence interval, calculated taking into account the complex sampling design.

^f Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. Results are based on any wasting.

^g Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate Sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^h Composite variable of main source of drinking water and treating water to make safe for drinking.

As shown in Table 28 overweight and obesity affect almost 5% of children aged 0-59 months, and the overweight prevalence is classified as “low” by WHO classifications [116] The overweight or obesity prevalence is significantly higher in Palestinian children and poses a problem of “high” public health relevance in this group. In addition to nationality, significant differences were found by birth weight status, household wealth quintile, household food insecurity (access), and inflammation. Children with low birth weight are less likely to be overweight or obese compared to normal birth weight children. In contrast, children residing in wealthier, and food secure households have a higher prevalence of overnutrition than children in poor and food insecure households. The prevalence of overweight and obesity is also significantly higher among children with inflammation compared to those without. No significant differences were detected by age, sex, stratum, household sanitation, and access to safe drinking water.

Table 28. Percentage of children (0-59 months) with overweight and obesity by various demographic characteristics, Lebanon 2023

Characteristic	N	Overweight ^a		Obesity ^a		Overweight or obesity ^a		p-value ^d
		% ^b	[95% CI] ^c	% ^b	[95% CI] ^c	% ^b	[95% CI] ^c	
Nationality								<0.001
Lebanese	930	4.7	[3.1,7.1]	2.1	[1.2,3.6]	6.8	[4.8,9.5]	
Syrian	910	1.7	[0.8,3.5]	0.3	[0.1,1.0]	2.0	[1.0,3.8]	
Palestinian	55	12.1	[3.0,37.8]	2.0	[0.4,10.5]	14.1	[4.3,37.8]	
Age group (in months)								0.088
0-5	118	5.6	[1.3,20.9]	1.5	[0.4,5.3]	7.1	[2.1,21.1]	
6-11	146	8.8	[3.9,19.0]	2.0	[0.3,11.1]	10.8	[5.1,21.4]	
12-23	335	1.5	[0.8,3.0]	0.9	[0.3,2.5]	2.4	[1.3,4.3]	
24-35	348	3.7	[1.6,8.5]	1.0	[0.2,4.7]	4.7	[2.2,9.7]	
36-47	459	2.4	[1.1,5.0]	0.6	[0.2,1.7]	3.0	[1.5,5.7]	
48-59	493	2.7	[1.5,4.7]	1.9	[0.9,3.9]	4.5	[2.6,7.6]	
Low birth weight								0.003
Yes	303	1.4	[0.6,3.3]	0.2	[0.0,1.1]	1.5	[0.6,3.6]	
No	1357	3.9	[2.6,5.8]	1.6	[0.9,2.7]	5.5	[3.9,7.6]	
Sex								0.407
Male	989	2.9	[1.7,4.7]	1.0	[0.5,1.9]	3.9	[2.6,5.9]	
Female	910	3.6	[2.2,5.7]	1.3	[0.6,2.8]	4.9	[3.2,7.3]	
Stratum								0.188
Akkar	218	7.1	[3.2,15.1]	0.4	[0.1,2.8]	7.5	[3.5,15.2]	
Baalbek-Hermel	191	5.8	[2.3,13.7]	0.2	[0.0,1.8]	6.0	[2.5,13.8]	
Beirut	193	2.4	[1.1,5.4]	2.4	[0.8,7.2]	4.8	[2.3,10.0]	
Bekaa	164	2.3	[0.9,5.8]	3.9	[1.1,12.6]	6.2	[2.4,14.9]	
El Nabatieh	134	2.9	[0.8,9.9]	3.2	[0.9,10.3]	6.0	[1.7,19.0]	
Mount Lebanon	151	1.7	[0.4,6.4]	0.5	[0.1,3.6]	2.2	[0.7,6.8]	
North	278	6.4	[3.8,10.5]	1.5	[0.5,4.0]	7.9	[5.1,11.9]	
South	151	2.0	[0.6,5.8]	0.2	[0.0,1.5]	2.2	[0.8,6.0]	
Palestinian camps	97	1.5	[0.3,6.6]	1.9	[0.4,8.4]	3.3	[1.1,9.5]	
Syrian ITS	322	1.2	[0.4,3.1]	1.0	[0.2,3.8]	2.1	[1.0,4.5]	

Table continued on next page

Characteristic	N	Overweight ^a		Obesity ^a		Overweight or obesity ^a		p-value ^d
		% ^b	[95% CI] ^c	% ^b	[95% CI] ^c	% ^b	[95% CI] ^c	
Wealth quintile								0.014
Lowest	827	1.9	[0.9,4.0]	0.4	[0.2,1.0]	2.3	[1.2,4.3]	
Second	352	4.6	[2.0,10.2]	0.4	[0.1,1.8]	5.0	[2.3,10.5]	
Middle	273	2.5	[1.0,5.6]	0.7	[0.1,3.0]	3.1	[1.5,6.5]	
Fourth	243	4.4	[2.1,9.1]	3.7	[1.7,7.5]	8.1	[4.7,13.5]	
Highest	204	4.8	[2.3,9.9]	2.5	[0.9,7.2]	7.4	[4.0,13.0]	
Household food insecurity access								
Secure	393	5.1	[2.4,10.3]	2.5	[1.2,5.5]	7.6	[4.4,12.8]	
Mild	178	3.6	[1.6,7.9]	1.1	[0.3,4.1]	4.8	[2.2,9.8]	
Moderate	602	4.4	[2.4,7.8]	0.9	[0.4,2.1]	5.3	[3.2,8.7]	
Severe	726	1.4	[0.7,2.6]	0.7	[0.2,2.0]	2.1	[1.2,3.7]	
Household sanitation ^e								0.126
Inadequate	159	0.8	[0.2,3.6]	1.0	[0.1,6.8]	1.8	[0.5,6.3]	
Adequate	1695	3.6	[2.5,5.2]	1.2	[0.7,2.1]	4.8	[3.5,6.6]	
Safe drinking water ^f								0.780
Yes	1651	3.1	[2.0,4.6]	1.3	[0.8,2.1]	4.3	[3.1,6.1]	
No	242	4.6	[2.1,9.8]	0.3	[0.0,1.9]	4.9	[2.3,9.9]	
Inflammation ^g								0.013
Yes	520	5.3	[3.1,9.0]	1.2	[0.5,2.8]	6.5	[4.2,10.2]	
No	946	1.7	[1.0,3.0]	1.3	[0.6,2.7]	3.0	[1.9,4.8]	
TOTAL SAMPLE	1899	3.2	[2.2,4.6]	1.2	[0.7,1.9]	4.4	[3.2,6.0]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Overweight is defined as having a weight-for-height z-score greater than +2 but less than or equal to +3 standard deviations (SD; z-scores) from the WHO Child Growth Standards population median; obesity is defined as having a weight-for-height z-score greater than +3 SD from the WHO Child Growth Standards population median.

^b Percentages weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate Sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

^g Inflammation defined as elevated CRP (> 5 mg/L) and/or elevated AGP (> 1 g/L) according to Thurnham *et al.* [115].

3.3.9. Underweight

Figure 19 shows the distribution of the weight-for-age z-score in the surveyed population of children 0-59 months of age and shows that the z-score is shifted slightly towards the left of the WHO standard growth curve. The weighted mean weight-for-age z-score is -0.27 (95% CI; -0.36, -0.17), and the weighted median weight-for-age z-score is -0.28 (IQR; -0.97, 0.43).

As shown in Table 29, the national underweight prevalence is approximately 5%, and the majority of underweight is classified as “moderate”. Significant differences were found by nationality and stratum, with the highest prevalences found in the Syrian children and children in the Syrian ITS stratum. Underweight is also significantly associated with sex and low birth weight status, with male children and those born with a low birth weight more likely to be underweight. Lastly, underweight is also associated with wealth quintile and household food insecurity (access), the highest prevalences found in children residing in lowest wealth quintile households and in severely food insecure households.

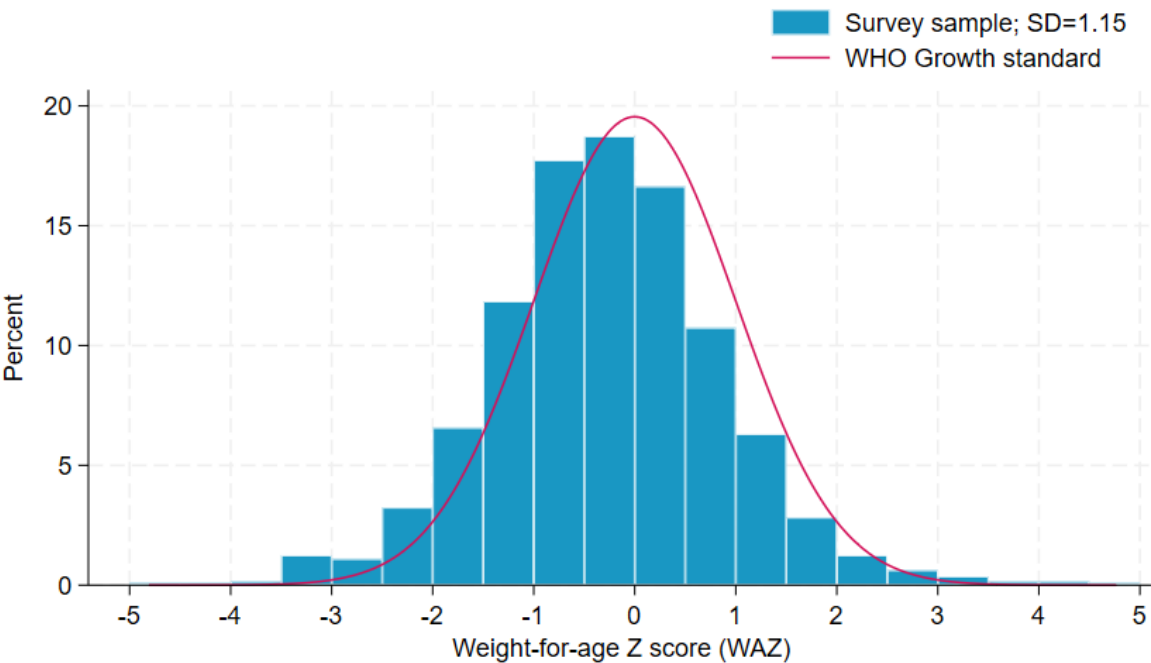


Figure 19. Distribution of weight-for-age z-scores in children 0-59 months of age, Lebanon 2023

Table 29. Percentage of children (0-59 months) with underweight by various demographic characteristics, Lebanon 2023

Characteristic	Severe Underweight ^c			Moderate Underweight ^d		Any underweight ^e		p-value ^f
	N	% ^a	[95% CI] ^b	% ^a	[95% CI] ^b	% ^a	[95% CI] ^b	
Nationality								<0.001
Lebanese	939	0.2	[0.1,0.6]	1.8	[0.8,3.8]	2.0	[1.0,4.0]	
Syrian	917	2.0	[1.1,3.5]	6.0	[3.9,9.1]	8.0	[5.7,11.1]	
Palestinian	56	0.0		4.2	[0.9,17.7]	4.2	[0.9,17.7]	
Age group (in months)								0.397
0-5	119	2.3	[0.7,7.7]	1.6	[0.5,5.5]	3.9	[1.5,9.7]	
6-11	147	0.1	[0.0,0.8]	5.5	[1.8,15.9]	5.6	[1.8,15.8]	
12-23	335	1.2	[0.5,2.9]	6.2	[3.5,10.8]	7.4	[4.5,11.9]	
24-35	356	1.1	[0.5,2.4]	3.1	[1.4,6.6]	4.2	[2.3,7.6]	
36-47	462	1.6	[0.6,4.3]	4.3	[2.5,7.1]	5.9	[3.8,9.1]	
48-59	497	0.4	[0.1,1.1]	3.1	[1.4,6.8]	3.5	[1.7,7.1]	
Low birth weight								0.037
Yes	303	1.5	[0.6,3.5]	6.8	[3.4,13.1]	8.3	[4.5,14.9]	
No	1374	0.8	[0.4,1.3]	3.1	[2.0,4.8]	3.9	[2.7,5.5]	
Sex								0.032
Male	998	0.9	[0.5,1.7]	5.5	[3.5,8.5]	6.4	[4.4,9.4]	
Female	918	1.3	[0.6,2.6]	2.3	[1.4,3.9]	3.7	[2.4,5.4]	
Stratum								<0.001
Akkar	219	1.2	[0.3,4.2]	2.0	[0.8,4.8]	3.1	[1.4,7.1]	
Baalbek-Hermel	193	0.2	[0.0,1.7]	2.3	[0.6,8.2]	2.5	[0.8,7.9]	
Beirut	197	1.1	[0.2,5.1]	1.7	[0.6,4.9]	2.7	[1.1,6.6]	
Bekaa	165	0.9	[0.1,6.6]	2.8	[0.9,8.8]	3.7	[1.4,9.8]	
El Nabatieh	136	0.7	[0.1,4.7]	3.1	[0.9,10.2]	3.8	[1.4,10.1]	
Mount Lebanon	151	0.6	[0.1,4.4]	4.5	[1.9,10.3]	5.1	[2.4,10.6]	
North	279	0.9	[0.2,4.6]	2.7	[0.9,8.3]	3.7	[1.3,9.7]	
South	153	0.3	[0.0,2.4]	2.4	[0.9,6.3]	2.7	[1.0,7.1]	
Palestinian camps	99	1.6	[0.2,9.8]	3.4	[1.4,8.3]	5.0	[2.4,10.0]	
Syrian ITS	324	4.6	[2.5,8.5]	11.5	[7.1,18.0]	16.1	[10.6,23.7]	

Table continued on next page

Characteristic	Severe Underweight ^c			Moderate Underweight ^d		Any underweight ^e		p-value ^f
	N	% ^a	[95% CI] ^b	% ^a	[95% CI] ^b	% ^a	[95% CI] ^b	
Wealth quintile								<0.001
Lowest	831	2.3	[1.3,4.0]	6.8	[4.6,9.9]	9.1	[6.7,12.3]	
Second	356	0.5	[0.1,2.3]	2.4	[0.9,6.4]	2.9	[1.2,6.8]	
Middle	275	0.0		1.6	[0.7,4.0]	1.6	[0.7,4.0]	
Fourth	245	0.3	[0.0,1.8]	2.4	[0.5,10.8]	2.7	[0.6,10.5]	
Highest	209	0.0		1.1	[0.2,5.1]	1.1	[0.2,5.1]	
Household food insecurity access								
Secure	397	0.6	[0.2,1.7]	1.2	[0.4,3.5]	1.8	[0.8,4.0]	
Mild	182	0.0		0.9	[0.3,3.0]	0.9	[0.3,3.0]	
Moderate	604	1.3	[0.6,2.5]	3.3	[2.0,5.2]	4.5	[3.0,6.7]	
Severe	733	1.5	[0.7,3.1]	6.5	[4.1,10.4]	8.0	[5.4,11.8]	
Household sanitation ^g								0.915
Inadequate	162	2.6	[1.0,6.5]	2.3	[0.8,6.4]	4.9	[2.3,10.2]	
Adequate	1709	1.0	[0.6,1.8]	3.7	[2.4,5.7]	4.7	[3.3,6.8]	
Safe drinking water ^h								0.645
Yes	1665	1.1	[0.6,1.9]	4.0	[2.6,5.9]	5.0	[3.6,7.0]	
No	245	1.4	[0.5,4.2]	4.4	[2.1,9.4]	5.9	[3.1,10.8]	
TOTAL SAMPLE	1916	1.1	[0.7,1.9]	4.0	[2.7,5.8]	5.1	[3.8,6.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Severe underweight includes children who are below -3 standard deviations (SD; z-scores) from the WHO Child Growth Standards population median.

^d Moderate underweight includes children who are equal to or above -3 SD and below -2 SD from the WHO Child Growth Standards population median.

^e Any underweight includes both severely and moderately underweight children.

^f Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^g Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate Sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household.

Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^h Composite variable of main source of drinking water and treating water to make safe for drinking.

3.3.10. Small head circumference

The distribution of head circumference-for-age z-score is shown in Figure 20, and is shifted slightly to the left of the reference distribution.

The prevalence of small head circumference in children 0-59 months of age is 3.6%. Significant differences were found by stratum, with the highest prevalence in children living in the ITS stratum. Moreover, small head circumference is highly associated with stunting; 13% of stunted children also have a small head circumference, while 2% of non-stunted children have a small head circumference. None of the other variables is significantly associated with small head circumference.

Table 30. Percentage of children (0-59 months) with small head circumference by various demographic characteristics, Lebanon 2023

Characteristic	N	Small head circumference ^a		
		% ^b	[95% CI] ^c	p-value ^d
Nationality				0.519
Lebanese	941	3.4	[2.0,5.7]	
Syrian	911	3.9	[2.5,6.0]	
Palestinian	56	0.4	[0.1,3.2]	
Age group (in months)				0.779
0-5	119	3.3	[1.2,9.0]	
6-11	147	2.9	[1.2,7.0]	
12-23	338	4.0	[2.0,7.9]	
24-35	357	2.4	[1.3,4.4]	
36-47	460	3.5	[2.0,6.2]	
48-59	491	4.5	[2.4,8.2]	
Low birth weight				0.158
Yes	306	5.5	[2.8,10.8]	
No	1367	3.2	[2.3,4.6]	
Sex				0.239
Male	994	4.2	[2.8,6.4]	
Female	918	2.9	[1.8,4.5]	
Stratum				<0.001
Akkar	221	2.1	[0.9,4.6]	
Baalbek-Hermel	193	1.8	[0.6,5.5]	
Beirut	187	3.1	[1.4,7.1]	
Bekaa	164	1.3	[0.3,5.9]	
El Nabatieh	137	3.9	[1.6,9.0]	
Mount Lebanon	151	1.8	[0.7,4.7]	
North	285	5.1	[2.3,11.0]	
South	150	2.0	[0.7,5.3]	
Palestinian camps	99	7.1	[3.5,14.1]	
Syrian ITS	325	10.3	[6.6,15.7]	

Table continued on next page

Small head circumference ^a				
Characteristic	N	% ^b	[95% CI] ^c	p-value ^d
Wealth quintile				0.037
Lowest	835	5.0	[3.3,7.4]	
Second	357	2.0	[1.0,4.0]	
Middle	270	0.9	[0.3,2.7]	
Fourth	245	5.7	[2.4,12.9]	
Highest	205	1.5	[0.4,5.9]	
Household food insecurity access				0.389
Secure	396	4.1	[2.1,8.0]	
Mild	178	1.2	[0.4,3.9]	
Moderate	604	4.5	[2.9,7.0]	
Severe	734	3.2	[1.8,5.9]	
Child stunted				<0.001
Yes	310	12.8	[8.4,19.1]	
No	1590	2.0	[1.3,3.0]	
TOTAL SAMPLE	1912	3.6	[2.6,4.8]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Small head circumference includes children with head circumference below -2 standard deviations (SD; z-scores) from the WHO Child Growth Standards population median.

^b Percentages weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into interval account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

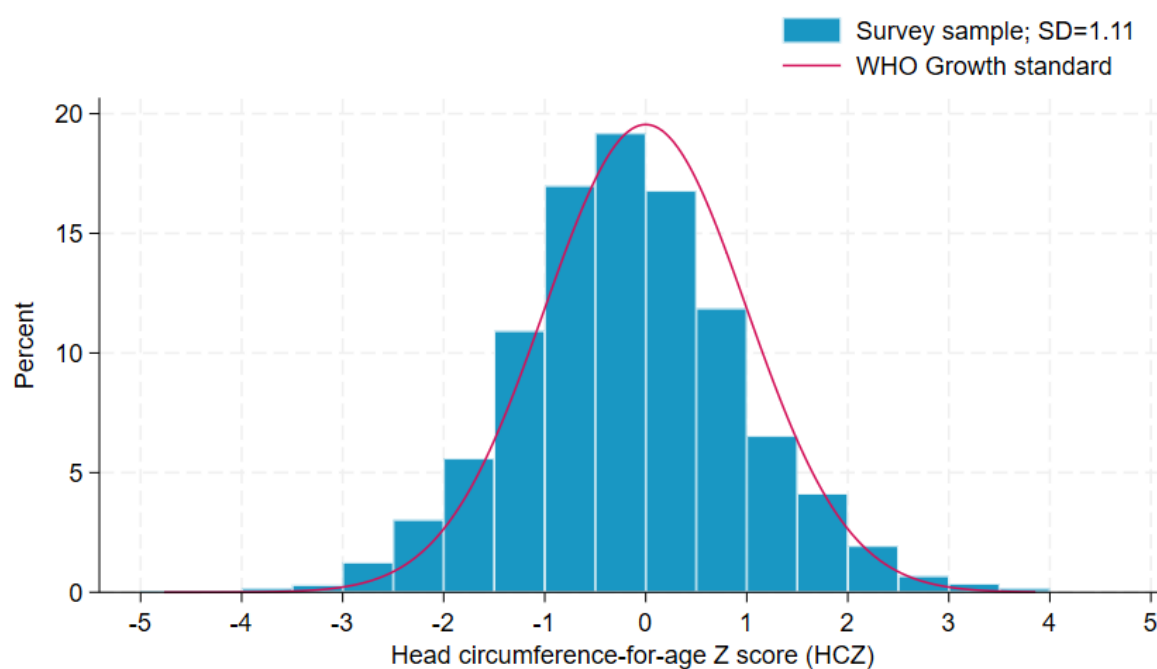


Figure 20. Distribution of head circumference-for-age z-scores in children 0-59 months of age, Lebanon 2023

3.3.11. Early childhood development

The Household Form of Global Scales for Early Development (HF-GSED), developed by the World Health Organization (WHO), was used to measure development status for children below the age of 24 months. Overall, the mean development-for-age z-scores (DAZ) for children under the age of 24 months in Lebanon is -0.41 (95% CI: -0.58, -0.25), indicating that 65.3% of these children are developmentally on-track based on cut-offs determined by the research team (footnote e, Table 31). Lebanese children have an average DAZ of -0.20 with 72.7% considered on-track, whereas Syrian children have a lower DAZ of -0.51 with 61.4% on-track. Palestinian children have the lowest development scores, with a DAZ of -2.11 and only 13.4% on-track. However, due to the relatively small sample size for Palestinian children, the point estimates are accompanied by large confidence intervals, suggesting caution in interpreting results.

Geographic disparities within Lebanon were pronounced; the lowest DAZ scores were found in Palestinian Camps at -2.41 with only 12.2% on-track (in this survey sample, 67.9% of children living in Palestinian Camps are Syrian nationals) and in the South at -1.12 with 43.3% on-track. In contrast, children in Baalbek-Hermel have a DAZ of 0.17 and those in Bekaa a DAZ of -0.01, with 77.6% and 80.9% on-track, respectively. There are significant subgroups differences in child development status based on food insecurity (access) levels, with DAZ scores ranging from -0.09 in food-secure households to -0.82 in moderately insecure households. There are no significant differences in developmental status associated with low birth weight or gender for this age group.

Child development outcomes were found to be different based on some feeding practices (Table 32). No significant differences in development were found for children who were exclusively breastfed for the first six months. Children who were not exclusively breastfed in the first six months displayed trends toward lower development-for-age z-scores, but these differences are not statistically significant. Significant positive subgroups differences in development outcomes were observed for children with minimum dietary diversity (DAZ of 0.06 compared to -0.63) and those with a minimum acceptable diet (DAZ of 0.15 compared to -0.52), with markedly higher percentages of children on track.

Table 31. Early childhood development using the Household Form of the Global Scales for Early Development (GSED) in children 0-23 months by various demographic characteristics, Lebanon 2023

Characteristic	Development-for-age z-score ^a				Developmentally on-track ^e	
	N	z-score ^b	[95% CI] ^c	p-value ^d	% ^b	p-value ^d
Nationality				<0.001		<0.001
Lebanese	286	-0.20	[-0.37,-0.04]		72.7	
Syrian	338	-0.51	[-0.76,-0.27]		61.4	
Palestinian	21	-2.11	[-2.62,-1.60]		13.4	
Low birth weight				0.32		0.70
Yes	98	-0.48	[-0.89,-0.07]		64.9	
No	480	-0.25	[-0.44,-0.06]		67.7	
Sex				0.78		0.52
Male	328	-0.39	[-0.64,-0.14]		66.9	
Female	319	-0.43	[-0.65,-0.22]		63.7	
Stratum				<0.001		<0.001
Akkar	65	-0.29	[-0.60,0.02]		76.0	
Baalbek-Hermel	62	0.17	[-0.49,0.83]		77.6	
Beirut	76	-0.41	[-0.75,-0.08]		68.8	
Bekaa	50	-0.01	[-0.39,0.36]		80.9	
El Nabatieh	37	-0.23	[-0.82,0.37]		73.5	
Mount Lebanon	49	-0.38	[-0.76,0.00]		69.1	
North	91	-0.12	[-0.46,0.22]		71.3	
South	48	-1.14	[-1.49,-0.78]		43.3	
Palestinian camps	51	-2.41	[-2.73,-2.10]		12.2	
Syrian ITS	118	-0.34	[-0.72,0.05]		55.3	
Wealth quintile				0.007		0.05
Lowest	287	-0.40	[-0.72,-0.08]		63.6	
Second	130	-0.29	[-0.62,0.36]		73.3	
Middle	89	-1.02	[-1.45,-0.60]		40.7	
Fourth	80	-0.52	[-0.87,-0.16]		73.5	
Highest	61	0.11	[-0.34,0.56]		70.5	
Household food insecurity access				0.03		0.07
Secure	129	-0.09	[-0.46,0.29]		74.0	
Mild	58	-0.59	[-1.06,-0.11]		49.8	
Moderate	196	-0.82	[-1.15,-0.48]		58.6	
Severe	264	-0.23	[-0.52,0.07]		69.7	
TOTAL	647	-0.41	[-0.58,-0.25]		65.3	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a D-score is a unit of measurement with an interval scale representing child development by a single number calculated as the mean of the posterior distribution conditional on the responses, the items' difficulty and the child's age; Development-for-Age z-score (DAZ) is age-independent and is scaled such that at each age, the distribution of scores is normally distributed with a mean of 0 and a variance of 1, and calculated relative to a reference population; source: World Health Organization (WHO).

^b Weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d P-value <0.05 indicates that the variation in the values of the subgroup is significantly different from all other subgroups.

^e Children were considered developmentally 'on track' if their age-adjusted developmental z-scores were within 1 standard deviation below the mean. Using the LIMA sample, a score between 1 and 1.5 standard deviations below the mean was categorized as 'slightly off track,' between 1.5 and 2 standard deviations below the mean were categorized as 'moderately off track,' and scores exceeding 2 standard deviations below the mean were classified as 'severely off track'; the WHO is currently undertaking work to set preliminary global benchmarks for what children under the age of 24 months should be able to do in order to be considered "on track" developmentally (source: Personal Communication, 18th March 2024); percentage weighted for unequal probability of selection.

Table 32. Early childhood development using the Household Form of the Global Scales for Early Development (GSED) in children 0-23 months, by feeding characteristics, Lebanon 2023

Characteristic	Development-for-age z-score ^a			Developmentally on-track ^e	
	N	z-score ^b	[95% CI] ^c	p-value ^d	% ^b
Exclusive breastfeeding under six months (0-5 months of age; Indicator #4)				0.49	0.52
Yes	32	0.00	[-0.70,0.70]		76.9
No	91	-0.32	[-0.77,0.14]		66.8
Continued breastfeeding at 1 year (12-23 months of age; Indicator #6)				0.32	0.75
Yes	114	-0.29	[-0.96,0.37]		59.6
No	255	-0.64	[-0.85,-0.44]		62.5
Minimum dietary diversity (Indicator #8)				0.007	0.003
Yes	101	0.06	[-0.41,0.53]		84.8
No	422	-0.63	[-0.83,-0.44]		57.4
Minimum meal frequency (Indicator #9)				0.64	0.47
Yes	232	-0.39	[-0.63,-0.16]		67.3
No	291	-0.50	[-0.86,-0.14]		62.2
Minimum milk feeding frequency for non-breastfed children (Indicator #10)				0.03	0.10
Yes	122	-0.26	[-0.60,0.08]		72.0
No	106	-0.97	[-1.40,-0.54]		55.0

Table continued on next page

Characteristic	Development-for-age z-score ^a			Developmentally on-track ^e	
	N	z-score ^b	[95% CI] ^c	p-value ^d	% ^b
Minimum acceptable diet (Indicator #11)				0.002	0.03
Yes	49	0.15	[-0.23,0.52]		86.8
No	474	-0.52	[-0.74,-0.30]		61.9

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a D-score is a unit of measurement with an interval scale representing child development by a single number calculated as the mean of the posterior distribution conditional on the responses, the items' difficulty and the child's age; Development-for-Age z-score (DAZ) is age-independent and is scaled such that at each age, the distribution of scores is normally distributed with a mean of 0 and a variance of 1, and calculated relative to a reference population; source: World Health Organization (WHO).

^b Weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d P-value <0.05 indicates that the variation in the values of the subgroup is significantly different from all other subgroups.

^e Children were considered developmentally 'on track' if their age-adjusted developmental z-scores were within 1 standard deviation below the mean. Using the LIMA sample, a score between 1 and 1.5 standard deviations below the mean was categorized as 'slightly off track,' between 1.5 and 2 standard deviations below the mean were categorized as 'moderately off track,' and scores exceeding 2 standard deviations below the mean were classified as 'severely off track'; the WHO is currently undertaking work to set preliminary global benchmarks for what children under the age of 24 months should be able to do in order to be considered "on track" developmentally (source: Personal Communication, 18th March 2024); percentage weighted for unequal probability of selection.

Children who are stunted have a significantly lower development-for-age z-score (DAZ) of -0.77 compared to non-stunted children (-0.33), with only 52.5% being developmentally on-track (Table 33). No significant differences were found in the DAZ of children with wasting, underweight, or small head circumference, although data indicates that a smaller proportion of underweight children are developmentally on track compared to children who are not underweight ($p=0.05$). Children with Severe Acute Malnutrition (SAM) have a surprisingly higher mean DAZ of 0.22, but this result should be interpreted cautiously given the wide confidence interval (-0.18, 0.62) and small sample size, indicating poor precision estimates. There are no significant differences in DAZ or developmental status for children with obesity or with overweight or obesity.

Table 33. Early childhood development using the Household Form of the Global Scales for Early Development (GSED) in children 0-23 months, by anthropometric characteristics, Lebanon 2023

Characteristic	Development-for-age z-score ^a				Developmentally on-track ^e	
	N	z-score ^b	[95% CI] ^c	p-value ^d	% ^b	p-value ^d
Stunting				0.03		0.04
Yes	101	-0.77	[-1.12,-0.42]		52.5	
No	484	-0.33	[-0.51,-0.15]		68.4	
Wasting				0.67		0.56
Yes	23	-0.53	[-1.19,0.13]		57.7	
No	557	-0.38	[-0.55,-0.21]		66.6	
Underweight				0.41		0.05
Yes	37	-0.67	[-1.35,0.02]		43.1	
No	543	-0.37	[-0.54,-0.19]		67.6	
SAM (MUAC)				0.007		0.14
Yes	6	0.22	[-0.18,0.62]		88.7	
No	579	-0.39	[-0.56,-0.22]		66.1	
Small head circumference				0.50		0.99
Yes	22	-0.15	[-0.79,0.48]		66.8	
No	560	-0.38	[-0.55,-0.21]		67.0	
Obesity				0.86		0.46
Yes	11	-0.32	[-1.02,0.38]		78.9	
No	569	-0.38	[-0.55,-0.21]		66.2	
Overweight or obesity				0.11		0.48
Yes	40	0.38	[-0.58,1.35]		74.5	
No	540	-0.42	[-0.60,-0.25]		65.9	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a D-score is a unit of measurement with an interval scale representing child development by a single number calculated as the mean of the posterior distribution conditional on the responses, the items' difficulty and the child's age; Development-for-Age z-score (DAZ) is age-independent and is scaled such that at each age, the distribution of scores is normally distributed with a mean of 0 and a variance of 1, and calculated relative to a reference population; source: World Health Organization (WHO).

^b Weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d P-value <0.05 indicates that the variation in the values of the subgroup is significantly different from all other subgroups.

^e Children were considered developmentally 'on track' if their age-adjusted developmental z-scores were within 1 standard deviation below the mean. Using the LIMA sample, a score between 1 and 1.5 standard deviations below the mean was categorized as 'slightly off track,' between 1.5 and 2 standard deviations below the mean were categorized as 'moderately off track,' and scores exceeding 2 standard deviations below the mean were classified as 'severely off track'; the WHO is currently undertaking work to set preliminary global benchmarks for what children under the age of 24 months should be able to do in order to be considered "on track" developmentally (source: Personal Communication, 18th March 2024); percentage weighted for unequal probability of selection.

The Early Childhood Development Index 2030 (ECDI2030), developed by UNICEF, was used to measure the development status of children 24 months or older. The percentage of children developmentally on-track is presented following the ECDI2030 guidance. Lebanese children are most likely to be developmentally on track at 83.5%, whereas Syrian and Palestinian children have lower rates, 54.6% and 69.9%, respectively (Table 34). There are statistically significant subgroups differences between children who were low birth weight, with 64.4% of low birthweight children on track, significantly less than the 75.7% for those with normal birth weight. There are also significant subgroups gender differences, with 73.3% of females on track compared to 65.9% of males. Children from Akkar and Baalbek-Hermel are most likely to be on track, with over 85% in both strata, while those in the North and Syrian ITS show much lower percentages, 57.3% and 55.2%, respectively. Children belonging to the highest wealth quintile show a significantly greater proportion of being on track (91.7%) compared to only 53.8% in the lowest quintile. There are also significant subgroups differences in food insecurity levels, with 79.8% of children from food-secure households on track, in contrast to only 60.2% from severely insecure households.

As shown in Table 35, there are no significant differences in the developmental status of children between the ages of 24-59 months who are stunted, wasted, underweight, or with Severe Acute Malnutrition (SAM). Children with small head circumference are notably less likely to be developmentally on track, with only 45.5% on track compared to 68.8% for those who do not have small head circumference. For children identified as obese or overweight and obese, no significant subgroup differences in development status were found. It's important to note the wide confidence intervals in some of the subgroups, such as for children with SAM (30% on track, CI: 3.4, 83.9), which indicate a high degree of uncertainty around these estimates, due to small sample sizes. Results for wasting, SAM, and obesity must be interpreted with caution given the small sample size and subsequent large variability in estimates.

Table 34. Early childhood development using the Early Childhood Development Index 2030 (ECDI2030) in children 24-59 months, Lebanon 2023

Characteristic	Developmentally on-track ^a			
	N	% ^b	[95% CI] ^c	p-value ^d
Nationality				<0.001
Lebanese	584	83.5	[78.8,87.3]	
Syrian	373	54.6	[48.0,61.0]	
Palestinian	34	69.9	[52.8,82.8]	
Low birth weight				0.04
Yes	152	64.4	[52.6,74.6]	
No	744	75.7	[71.2,79.7]	
Sex				0.05
Male	509	65.9	[58.9,72.2]	
Female	483	73.3	[67.9,78.1]	
Stratum				<0.001
Akkar	132	85.0	[77.0,90.5]	
Baalbek-Hermel	121	88.6	[81.3,93.2]	
Beirut	101	69.1	[55.0,80.4]	
Bekaa	107	80.5	[63.3,90.8]	
El Nabatieh	79	79.1	[67.2,87.5]	
Mount Lebanon	74	67.9	[54.4,79.0]	
North	109	57.3	[48.0,66.2]	
South	94	74.9	[56.5,87.2]	
Palestinian camps	50	61.9	[49.1,73.3]	
Syrian ITS	125	55.2	[49.4,60.8]	
Wealth quintile				<0.001
Lowest	341	53.8	[45.7,61.6]	
Second	174	63.0	[48.1,75.8]	
Middle	174	84.3	[76.7,89.8]	
Fourth	153	82.6	[73.4,89.1]	
Highest	150	91.7	[84.2,95.9]	
Household food insecurity access				<0.001
Secure	236	79.8	[72.8,85.3]	
Mild	121	81.8	[70.7,89.4]	
Moderate	310	68.4	[60.1,75.7]	
Severe	325	60.2	[51.8,68.1]	
TOTAL	922	69.3		

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a ECDI2030 age-specific cut-scores to identify children developmentally on track were: 24–29 months: 7 of the 20 items; 30–35 months: 9 of the 20 items; 36–41 months: 11 of the 20 items; 42–47 months: 13 of the 20 items; 48–59 months: 15 of the 20 items.

^b Percentages weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

Table 35. Early childhood development and anthropometric indicators using the Early Childhood Development Index 2030 (ECDI2030) in children 24-59 months, Lebanon 2023

Characteristic	Developmentally on-track ^a			
	N	% ^b	[95% CI] ^c	p-value ^d
Stunting				0.31
Yes	104	64.1	[52.5,74.2]	
No	816	69.9	[64.5,74.7]	
Wasting				0.09
Yes	4	41.1	[14.4,74.3]	
No	904	69.0	[63.8,73.7]	
Underweight				0.23
Yes	37	59.0	[43.4,73.0]	
No	881	69.2	[63.8,74.2]	
SAM (MUAC)				0.15
Yes	1	30.0	[3.4,83.9]	
No	918	68.8	[63.7,73.5]	
Small head circumference				<0.001
Yes	29	45.5	[31.6,60.0]	
No	884	69.6	[64.3,74.4]	
Obesity				0.33
Yes	8	55.5	[27.4,80.5]	
No	900	69.0	[63.8,73.7]	
Overweight and obesity				0.55
Yes	40	63.3	[43.4,79.5]	
No	868	69.0	[63.7,73.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a ECDI2030 age-specific cut-scores to identify children developmentally on track were: 24–29 months: 7 of the 20 items; 30–35 months: 9 of the 20 items; 36–41 months: 11 of the 20 items; 42–47 months: 13 of the 20 items; 48–59 months: 15 of the 20 items.

^b Percentages weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.3.12. *Anemia, iron deficiency, and iron deficiency anemia*

The distribution of hemoglobin values for children 6-59 months of age is shown in Figure 21. It is roughly symmetric with the majority of values above the cut-off point of 105 g/L or 110 g/L for children aged 6-23 months or 24-59 months, respectively. Median hemoglobin concentration among all children 6-59 months old is 118 g/L. Approximately 17% of children are anemic (Table 36). A small proportion of child anemia is classified as severe (0.1%), and 5.5% and 11.3% of children have moderate and mild anemia, respectively (see Appendix 8.1). The WHO classifies the public health severity of anemia as mild for prevalence rates of 5.0 – 19.9 [117]. Therefore, the prevalence in Lebanon is on the higher end of the mild range.

Iron deficiency (ID) and iron deficiency anemia (IDA) affect about 36% and 11% of children, respectively and ID poses a moderate public health problem (20-39.9%) according to WHO classification [102].

As shown by Figure 22, the prevalence of children with concomitant anemia and ID is nearly 11%. About 6% of children have anemia without ID and the prevalence of non-anemic iron deficient children is about 25%. Approximately 63% of anemic children are iron deficient (data not shown).

Anemia is significantly associated with age group, wealth quintile, and sanitation, with the highest prevalences found in children 24-35 months of age, children living in households in the lowest and second wealth quintiles, and children in households with inadequate sanitation. ID is associated with age group and is highest amongst children 12-23 months of age. ID is also significantly associated with stratum and sanitation, with the highest prevalences found in Beirut and Mount Lebanon governorates, and in children with inadequate sanitation. IDA is also significantly associated with age group and is highest in children aged 24 to 35 months. The highest IDA prevalence was found in children from the Syrian ITS stratum, followed by those residing in Mount Lebanon and Beirut. The prevalence of IDA is significantly higher in children residing in poor households and declines with increasing household wealth. In addition, the IDA prevalence is highest among Syrian children, children in households with severe food insecurity, and children in households with inadequate sanitation.

Figure 23 presents the prevalence of anemia and ID by nationality within each governorate⁵. In Baalbek-El Hermel, the anemia prevalence is significantly higher in Syrian children, and in Beirut the ID prevalence is also significantly higher in Syrian children. All other associations are not statistically significant.

⁵ Figure 23 excludes Palestinian nationality because of the small number of Palestinian children in each governorate.

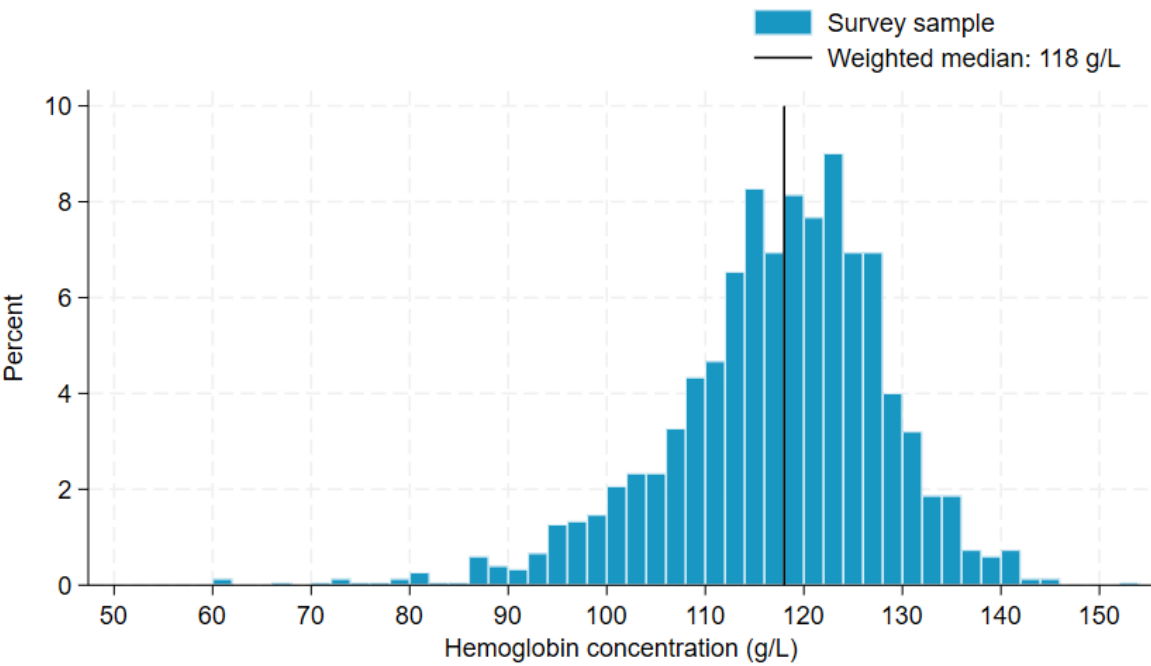


Figure 21. Distribution of adjusted hemoglobin (g/L) in children 6-59 months, Lebanon 2023

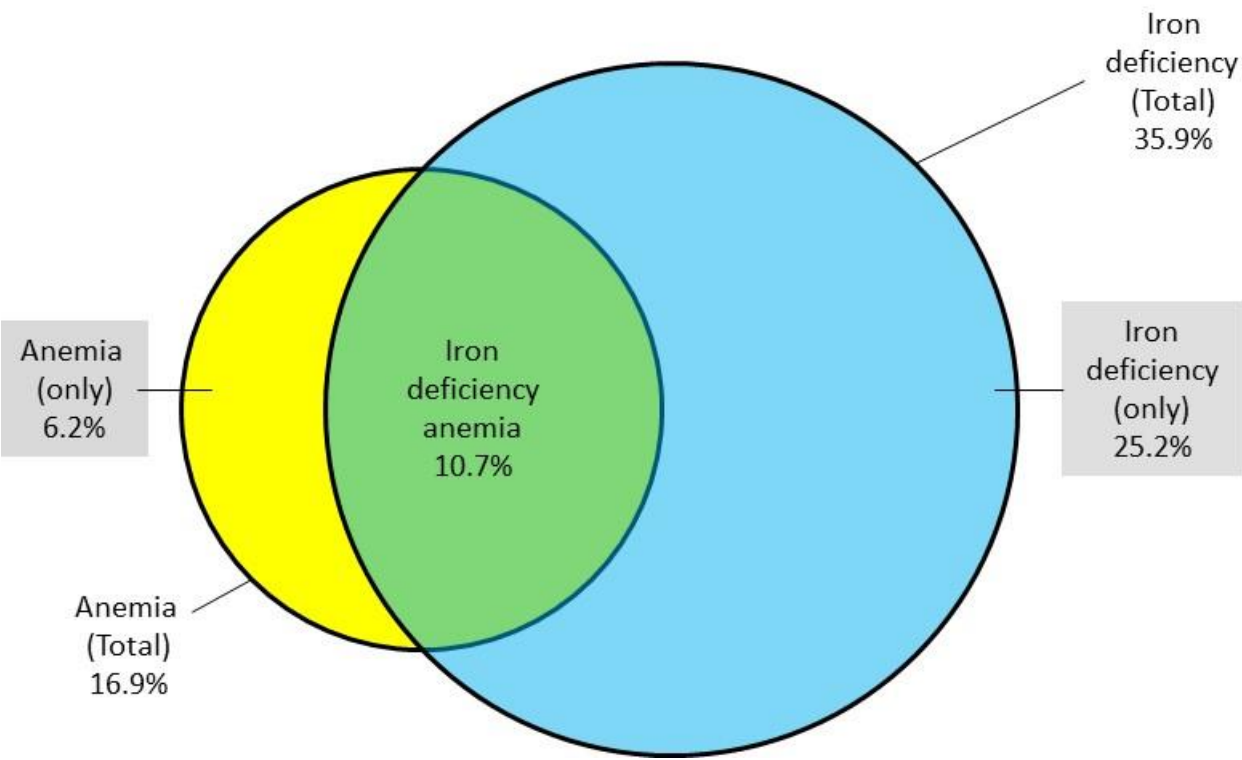


Figure 22. Venn diagram showing overlap between anemia and iron deficiency in children 6-59 months of age, Lebanon 2023

Table 36. Prevalence of anemia, iron deficiency, and iron deficiency anemia in children 6-59 months by various demographic characteristics, Lebanon 2023.

Characteristic	Anemia ^a				Iron deficiency ^b				Iron deficiency anemia ^c			
	N	% ^d	95% CI ^e	p-value ^f	N	% ^d	95% CI ^e	p-value ^f	N	% ^d	95% CI ^e	p-value ^f
Nationality				0.065				0.233				0.003
Lebanese	738	14.4	[10.8,18.9]		742	32.7	[26.9,39.0]		718	6.5	[3.6,11.4]	
Syrian	728	19.6	[14.7,25.7]		722	37.5	[31.1,44.4]		699	14.7	[10.1,20.]	
Palestinian	28	3.0	[0.4,19.5]		29	15.1	[5.4,35.8]		28	3.0	[0.4,19.5]	
Age group (in months)				<0.001				0.002				<0.001
6-11	101	25.3	[14.9,39.6]		102	25.5	[13.6,42.8]		97	9.1	[4.6,17.1]	
12-23	253	17.7	[11.3,26.5]		261	51.2	[43.1,59.2]		246	15.5	[9.4,24.5]	
24-35	280	33.9	[21.7,48.7]		281	46.4	[33.3,59.9]		271	25.5	[13.2,43.]	
36-47	416	12.8	[9.5,16.9]		403	30.6	[23.7,38.6]		397	6.9	[4.1,11.6]	
48-59	448	5.8	[3.7,9.0]		449	26.3	[18.3,36.3]		437	0.9	[0.4,2.2]	
Low birth weight				0.432				0.553				0.662
Yes	242	16.0	[10.1,24.4]		240	39.0	[29.7,49.2]		234	10.4	[5.5,18.6]	
No	1082	20.1	[15.3,26.0]		109	35.3	[29.8,41.1]		1053	12.5	[7.9,19.1]	
Sex				0.324				0.516				0.305
Male	788	18.3	[13.7,23.9]		793	34.5	[28.6,41.0]		766	12.2	[7.7,18.9]	
Female	710	15.2	[11.7,19.7]		703	37.6	[30.5,45.2]		682	8.9	[5.8,13.4]	
Stratum				0.060				0.011				<0.001
Akkar	186	16.6	[10.6,25.2]		193	32.0	[24.9,40.1]		186	7.7	[4.7,12.4]	
Baalbek-Hermel	158	18.4	[10.2,31.0]		153	23.6	[13.8,37.2]		149	2.9	[1.0,8.0]	
Beirut	123	17.2	[9.7,28.6]		124	50.7	[41.0,60.5]		118	11.3	[5.7,21.2]	
Bekaa	141	16.3	[11.0,23.4]		142	34.2	[25.7,43.8]		140	9.2	[5.1,16.0]	
El Nabatieh	122	8.2	[3.7,17.3]		115	23.7	[14.8,35.8]		113	4.1	[1.6,10.4]	
Mount Lebanon	82	15.4	[8.0,27.5]		77	41.2	[27.8,56.0]		75	15.1	[7.0,29.3]	
North	232	18.0	[13.7,23.3]		236	32.2	[26.3,38.7]		222	6.9	[4.5,10.6]	
South	109	11.7	[6.0,21.5]		109	36.5	[23.7,51.6]		108	5.4	[1.6,16.2]	
Palestinian camps	59	17.3	[6.3,39.4]		59	31.8	[21.8,43.7]		59	7.2	[2.1,22.1]	
Syrian ITS	286	28.8	[23.1,35.3]		288	35.8	[29.9,42.2]		278	20.6	[16.0,26.]	

Table continued on next page

Characteristic	Anemia ^a				Iron deficiency ^b				Iron deficiency anemia ^c			
	N	% ^d	95% CI ^e	p-value ^f	N	% ^d	95% CI ^e	p-value ^f	N	% ^d	95% CI ^e	p-value ^f
Wealth quintile				0.025				0.519				<0.001
Lowest	689	19.9	[15.4,25.4]		683	35.2	[26.2,45.4]		663	15.1	[10.7,21.1]	
Second	271	20.2	[12.8,30.3]		270	40.1	[29.5,51.7]		260	11.5	[5.3,23.2]	
Middle	210	15.5	[9.6,23.9]		213	36.9	[27.8,47.0]		207	12.4	[6.9,21.4]	
Fourth	187	12.0	[6.7,20.8]		188	40.8	[31.4,50.9]		183	0.7	[0.2,2.3]	
Highest	141	6.6	[3.5,12.1]		142	26.5	[16.2,40.3]		135	1.6	[0.4,5.4]	
Household food insecurity access				0.353				0.128				0.038
Secure	283	15.4	[8.5,26.5]		285	32.6	[24.2,42.2]		276	11.4	[5.2,23.3]	
Mild	138	16.5	[9.6,27.0]		136	45.0	[31.8,59.1]		128	8.5	[4.0,17.2]	
Moderate	488	13.4	[10.0,17.8]		490	29.1	[22.1,37.3]		477	5.5	[3.8,8.0]	
Severe	589	19.8	[15.2,25.4]		585	39.8	[31.6,48.7]		567	14.3	[9.7,20.6]	
Household sanitation ^g				0.010				0.002				0.014
Inadequate	130	32.3	[20.7,46.6]		129	54.7	[42.8,66.0]		122	26.5	[14.6,43.1]	
Adequate	1333	16.4	[12.7,20.9]		133	34.6	[30.1,39.4]		1293	9.9	[6.3,15.2]	
Safe drinking water ^h				0.157				0.055				0.044
Yes	1287	16.5	[13.0,20.6]		128	34.9	[29.6,40.6]		1241	10.1	[6.7,14.7]	
No	207	20.6	[16.4,25.7]		210	44.7	[36.4,53.3]		203	16.3	[12.4,21.1]	
TOTAL SAMPLE	1498	16.9	[13.7,20.6]		149	35.9	[31.1,41.1]		1448	10.7	[7.6,14.8]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Anemia defined as hemoglobin < 105 g/L for children aged 6-23 months and < 110 g/L for children aged 24-59 months; hemoglobin adjusted for elevation [118].

^b Iron deficiency defined as plasma ferritin < 12 µg/L; ferritin adjusted for inflammation [88].

^c Iron deficiency anemia defined as plasma ferritin < 12 µg/L and hemoglobin < 105 g/L for children aged 6-23 months and < 110 g/L for children aged 24-59 months; ferritin adjusted for inflammation [88] and hemoglobin adjusted for elevation [118].

^d Percentages weighted for unequal probability of selection.

^e CI = confidence interval, calculated taking into account the complex sampling design.

^f Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^g Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate Sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^h Composite variable of main source of drinking water and treating water to make safe for drinking.

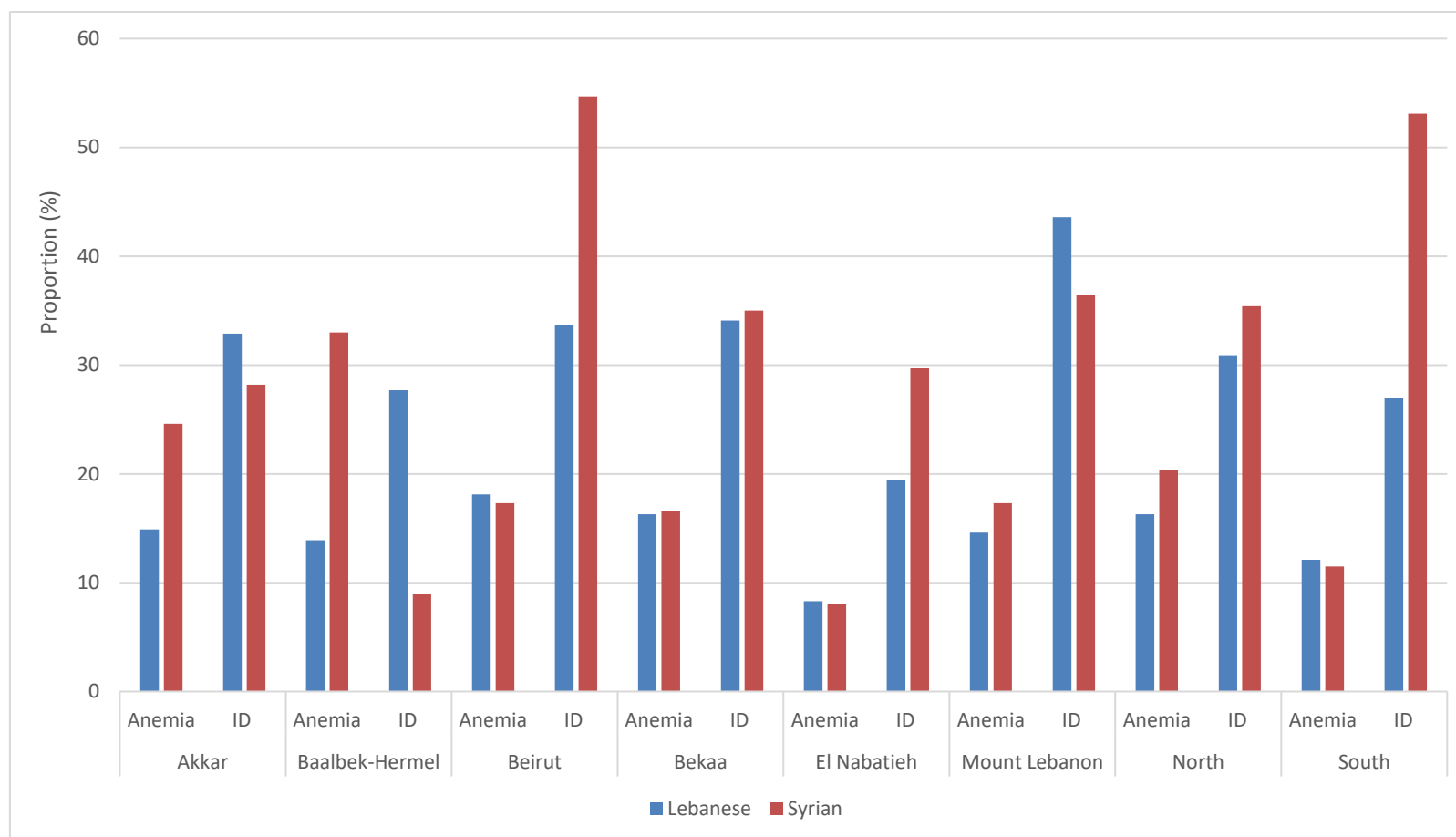


Figure 23. Anemia and iron deficiency (ID) prevalence by nationality in the different governorates, Lebanon 2023

3.3.13. Vitamin A deficiency

As shown in Table 37, the prevalence of vitamin A deficiency in children 6-59 months of age can be classified as mild (2-9%) by WHO [119]. The prevalence is significantly higher in Palestinian children, denoting a severe public health problem. Moreover, children living in poor households are more likely to be vitamin A deficient than those living in wealthier households. Although not significant, data indicates that children in the Palestinian and ITS strata exhibit a higher prevalence of vitamin A deficiency than children living in the governorate strata and that a smaller proportion of children living in food secure households is affected by vitamin A deficiency than children living in food insecure households. Disaggregating the data by governorates and nationality shows that vitamin A deficiency is more prevalent among children of Syrian nationality in the majority of the strata (see Figure 24)⁶.

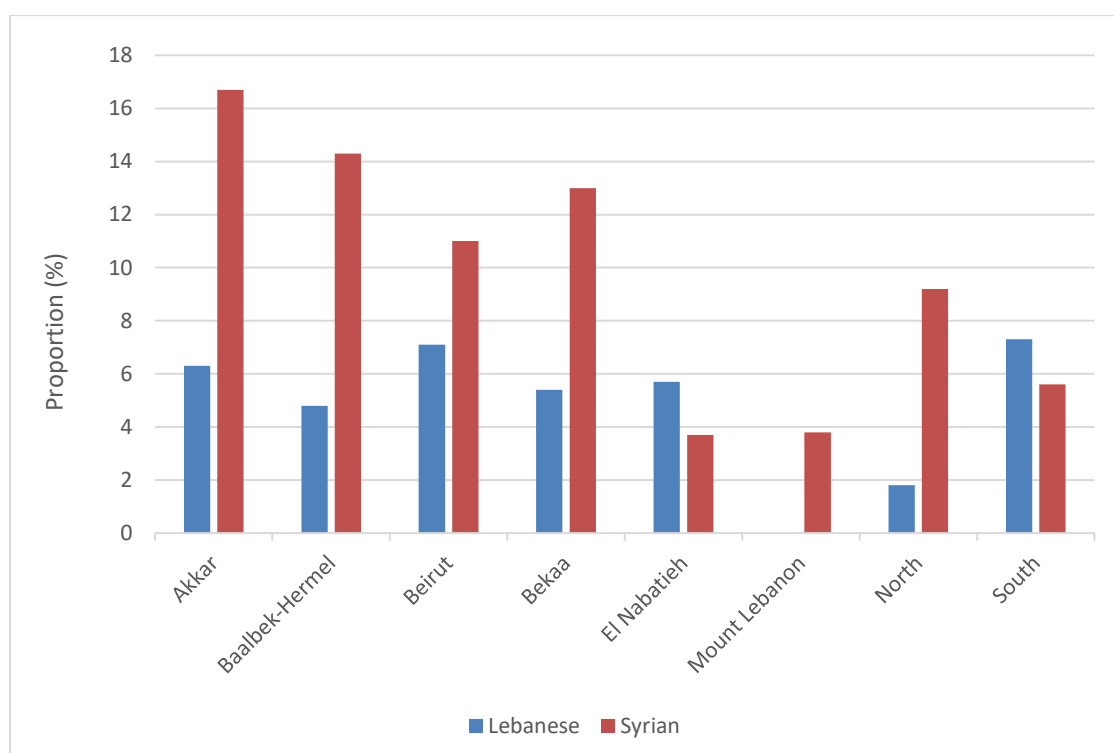


Figure 24. Vitamin A deficiency prevalence by nationality in the different governorates (excluding Syrian ITS and Palestinian camps strata), Lebanon 2023

⁶ Figure 24 excludes Palestinian nationality because of the small number of Palestinian children in each governorate.

Table 37. Prevalence of vitamin A deficiency in children 6-59 months by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with vitamin A deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				0.009
Lebanese	742	3.7	[2.3,5.7]	
Syrian	722	8.5	[6.4,11.2]	
Palestinian	29	26.9	[4.5,74.1]	
Age group (in months)				0.981
6-11	102	7.5	[1.7,27.3]	
12-23	261	6.0	[3.6,10.0]	
24-35	281	6.6	[3.6,11.7]	
36-47	403	6.7	[4.3,10.3]	
48-59	449	6.0	[3.7,9.6]	
Sex				0.464
Male	793	6.9	[5.1,9.3]	
Female	703	5.8	[3.8,8.6]	
Stratum				0.056
Akkar	193	8.3	[4.5,14.8]	
Baalbek-Hermel	153	6.9	[3.6,13.0]	
Beirut	124	10.2	[5.2,18.9]	
Bekaa	142	7.8	[3.8,15.3]	
El Nabatieh	115	4.8	[2.1,10.7]	
Mount Lebanon	77	3.4	[1.2,9.0]	
North	236	4.8	[2.6,8.8]	
South	109	6.6	[2.6,15.5]	
Palestinian camps	59	13.7	[6.8,25.8]	
Syrian ITS	288	13.0	[10.0,16.9]	
Wealth quintile				0.019
Lowest	683	8.0	[5.7,11.0]	
Second	270	9.7	[5.4,16.8]	
Middle	213	3.4	[1.6,7.2]	
Fourth	188	1.9	[0.7,4.8]	
Highest	142	3.8	[1.3,10.2]	
Household food insecurity access				0.052
Secure	285	2.8	[1.5,5.3]	
Mild	136	4.9	[2.4,9.8]	
Moderate	490	7.5	[5.1,10.8]	
Severe	585	7.6	[5.2,11.1]	
TOTAL SAMPLE	1496	6.4	[5.0,8.3]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin A deficiency defined as retinol binding protein (RBP) < 0.62 µmol/L; RBP adjusted for inflammation [51].

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.3.14. Vitamin D deficiency

The prevalence of vitamin D deficiency and insufficiency is shown in Table 38. In total, only about 5% of children are deficient in vitamin D and about 24% of children are insufficient in vitamin D. Just about 30% of children are either vitamin D deficient or insufficient. Vitamin D deficiency significantly differs by stratum and is more common in children living in Beirut and the Palestinian camps, where it affects about half of the children.

Combined vitamin D deficiency and insufficiency are also significantly associated with age group, sex, stratum, nationality and wealth quintile. The prevalence of vitamin D deficiency and insufficiency is lowest in children below 1 year of age compared to older children. Moreover, the prevalence is highest in the Palestinian camps and Beirut, where it affects about half and three quarter of children, respectively. Further, the prevalence of vitamin D deficiency and insufficiency is highest among children of Palestinian nationality. Moreover, children living in households of the second wealth quintile and severely food insecure households exhibit a higher prevalence of vitamin D deficiency or insufficiency.

3.3.15. Zinc deficiency

Zinc status was assessed in a 20% sub-sample of surveyed children 6-59 months of age. The prevalence of zinc deficiency is high and affects nearly 40% of children. No significant associations were found between zinc deficiency and any of the investigated indicators.

Table 38. Prevalence of vitamin D deficiency in children 6-59 months by various demographic characteristics, Lebanon 2023

Characteristic	Deficient ^a				Insufficient ^b		Deficient or insufficient		
	N	% ^c	[95% CI] ^d	p-value ^e	% ^c	[95% CI] ^d	% ^c	[95% CI] ^d	p-value ^e
Nationality				<0.001					<0.001
Lebanese	756	1.3	[0.7,2.6]		15.8	[12.1,20.5]	17.2	[13.2,22.0]	
Syrian	739	8.8	[5.7,13.4]		28.0	[22.8,33.8]	36.8	[30.3,43.8]	
Palestinian	27	13.2	[4.3,34.1]		54.6	[26.0,80.5]	67.8	[40.7,86.6]	
Age group (in months)				0.300					0.009
6-11	106	7.3	[1.6,27.3]		7.9	[3.5,17.0]	15.3	[7.2,29.5]	
12-23	262	1.8	[0.8,3.8]		14.2	[9.1,21.5]	16.0	[10.5,23.6]	
24-35	289	5.7	[3.2,10.1]		30.7	[19.8,44.2]	36.4	[25.5,48.9]	
36-47	415	7.5	[3.5,15.3]		25.9	[19.3,33.9]	33.4	[25.6,42.3]	
48-59	454	5.0	[3.1,8.0]		26.6	[18.2,37.1]	31.6	[23.0,41.7]	
Sex				0.425					0.044
Male	806	6.0	[3.6,9.9]		18.6	[12.7,26.3]	24.6	[18.0,32.7]	
Female	720	4.7	[3.0,7.3]		29.6	[23.4,36.6]	34.3	[27.9,41.3]	
Stratum				<0.001					<0.001
Akkar	189	3.2	[1.2,8.1]		17.8	[9.3,31.4]	21.0	[11.4,35.4]	
Baalbek-Hermel	167	5.6	[1.7,17.0]		23.6	[16.5,32.5]	29.2	[20.0,40.6]	
Beirut	128	17.6	[9.4,30.4]		35.2	[23.6,48.8]	52.8	[41.6,63.6]	
Bekaa	141	5.2	[1.0,22.9]		16.1	[9.1,26.9]	21.3	[12.3,34.3]	
El Nabatieh	122	1.2	[0.3,5.1]		14.0	[8.5,22.4]	15.2	[9.3,24.0]	
Mount Lebanon	78	4.6	[1.5,13.3]		30.3	[17.9,46.4]	34.9	[21.2,51.6]	
North	238	2.1	[0.7,6.4]		25.2	[19.2,32.3]	27.3	[20.9,34.8]	
South	109	5.4	[1.7,16.4]		16.8	[8.6,30.2]	22.2	[11.9,37.8]	
Palestinian camps	59	50.6	[42.0,59.1]		26.8	[14.3,44.4]	77.3	[58.4,89.2]	
Syrian ITS	295	0.5	[0.1,3.0]		14.2	[9.0,21.5]	14.6	[9.2,22.4]	
Wealth quintile				0.045					0.001
Lowest	702	6.3	[3.5,11.0]		26.3	[18.1,36.7]	32.6	[24.4,42.1]	
Second	279	7.8	[4.4,13.5]		34.7	[24.8,46.2]	42.5	[32.6,53.1]	
Middle	212	7.1	[3.2,15.1]		16.8	[9.6,27.8]	24.0	[15.4,35.3]	
Fourth	189	2.4	[0.9,6.3]		17.1	[10.7,26.3]	19.6	[12.5,29.3]	
Highest	144	0.4	[0.1,1.5]		12.4	[7.3,20.2]	12.8	[7.7,20.5]	
Household food insecurity access				0.650					0.046
Secure	286	3.8	[1.8,7.9]		19.9	[12.7,29.9]	23.7	[16.0,33.7]	
Mild	142	7.9	[3.6,16.5]		13.9	[8.8,21.3]	21.8	[14.5,31.5]	
Moderate	499	5.5	[3.3,9.0]		19.9	[14.6,26.4]	25.3	[19.5,32.3]	
Severe	599	5.5	[2.7,10.6]		30.2	[21.4,40.7]	35.7	[26.9,45.5]	
Sun exposure index				0.517					0.776
< 10	317	7.0	[2.7,17.1]		20.6	[15.2,27.2]	27.6	[20.5,36.0]	
10-20	227	6.9	[3.5,13.0]		24.6	[16.4,35.1]	31.4	[22.3,42.3]	
≥ 20	727	4.4	[2.6,7.4]		23.4	[17.0,31.3]	27.8	[20.9,36.0]	
TOTAL SAMPLE	1526	5.4	[3.7,7.9]		23.7	[19.1,29.0]	29.1	[24.0,34.8]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Vitamin D deficiency defined as serum vitamin D 25(OH) < 12 ng/mL; vitamin D 25(OH) concentrations below the limit of detection (< 3 ng/mL; n=2) were recoded to 3 ng/mL // ^b Vitamin D insufficiency defined as serum vitamin D 25(OH) 12-19.9 ng/mL // ^c Percentages weighted for unequal probability of selection.

^d CI = confidence interval, calculated taking into account the complex sampling design. // ^e Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

Table 39. Prevalence of zinc deficiency in children 6-59 months by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with zinc deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				0.617
Lebanese	145	37.0	[26.3,49.0]	
Syrian	127	39.3	[22.9,58.5]	
Palestinian	8	14.5	[3.2,46.6]	
Age group (in months)				0.537
6-11	20	34.0	[12.6,64.9]	
12-23	46	38.7	[17.3,65.7]	
24-35	50	26.2	[10.4,51.9]	
36-47	66	46.4	[32.1,61.3]	
48-59	98	42.4	[27.7,58.7]	
Sex				0.578
Male	145	35.7	[24.2,49.1]	
Female	135	40.5	[26.2,56.7]	
Wealth quintile				0.907
Lowest	115	41.9	[22.7,64.0]	
Second	62	32.4	[16.5,53.8]	
Middle	38	31.0	[13.1,57.3]	
Fourth	33	41.7	[21.4,65.1]	
Highest	32	39.0	[20.7,61.0]	
Household food insecurity access				0.106
Secure	52	36.2	[18.3,58.9]	
Mild	30	14.1	[4.0,39.4]	
Moderate	92	39.5	[23.3,58.3]	
Severe	106	48.2	[33.0,63.9]	
TOTAL SAMPLE	280	37.8	[27.4,49.5]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

Zinc deficiency measured in a 20% sub-sample of children.

^a Percentages weighted for unequal probability of selection.

^b Zinc deficiency defined as plasma zinc < 65 µg/dL for morning sample in a non-fasting state and < 57 µg/dL for afternoon samples in a non-fasting state [80].

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.3.16. Associations between micronutrient deficiencies and various factors

Table 40 presents the associations between anemia and various health and nutritional factors. Anemia is significantly associated with ID, vitamin A deficiency, and stunting. The prevalence of anemia among iron-deficient children is about three times as large as the prevalence in iron-replete children, and the anemia prevalence is twice as high in children with vitamin A deficiency. Moreover, a significantly larger proportion of stunted children are anemic than non-stunted children. The prevalence of anemia is higher in children with inflammation than in those without, however, these results are not statistically significant.

Table 40. Association between various factors and anemia in children 6-59 months of age, Lebanon 2023

Characteristic	N	% ^a with anemia	p-value ^c
Child had diarrhea			0.385
Yes	260	19.7	
No	1230	16.4	
Child had fever			0.028
Yes	356	25.0	
No	1134	14.2	
Child had lower respiratory infection			0.911
Yes	96	17.5	
No	1394	16.9	
Minimum dietary diversity (6-23 months only)			0.735
Yes	65	22.5	
No	289	18.8	
Child consumed commercially fortified baby cereal			0.083
Yes	139	23.7	
No	1344	16.6	
Child consumed micronutrient powder			0.628
Yes	102	19.1	
No	1378	16.9	
Child consumed infant formula with added iron			0.721
Yes	114	15.6	
No	1363	17.0	
Child took iron tablet or syrup in past six months			0.412
Yes	157	13.8	
No	1318	17.2	
Child took multivitamin supplement in past six			0.655
Yes	148	15.0	
No	1324	17.2	
Developmentally on track (6-23 months)			0.755
Yes	60	20.0	
No	39	18.0	
Developmentally on track (24-59 months)			0.778
Yes	113	16.7	
No	53	15.6	

Table continued on next page

Characteristic	N	% ^a with anemia	p-value ^c
Child stunted			0.003
Yes	256	26.9	
No	1221	14.7	
Child wasted			0.241
Yes	24	26.2	
No	1440	16.8	
Child underweight			0.077
Yes	96	26.0	
No	1378	16.2	
Child obese or overweight			0.690
Yes	68	14.4	
No	1396	17.0	
Child had inflammation			0.051
Yes	517	23.1	
No	931	14.5	
Child iron deficient			<0.001
Yes	476	29.5	
No	972	10.3	
Child vitamin A deficient			0.001
Yes	126	33.6	
No	1322	16.2	
Child vitamin D deficient/ insufficient			0.567
Yes	366	18.7	
No	1115	16.6	
Child zinc deficient^d			0.833
Yes	98	13.2	
No	175	14.7	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Anemia defined as hemoglobin < 105 g/L for children aged 6-23 months and < 110 g/L for children aged 24-59 months; hemoglobin adjusted for elevation [118].

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of children.

The correlations between ID and potential risk factors are presented in Table 41. This analysis shows that the ID prevalence is significantly lower in children consuming iron fortified foods or supplements, including micronutrient powders, infant formula, iron supplements, and multivitamin supplements. The ID prevalence is significantly higher in vitamin D deficient/insufficient children compared to their vitamin D replete counterparts. The prevalence of ID is also significantly lower among children with zinc deficiency and inflammation. Lastly, the survey found a higher ID prevalence in children who consumed at least 5 food groups the day before the survey.

Table 41. Association between various factors and iron deficiency in children 6-59 months of age, Lebanon 2023

Characteristic	N	% ^a with iron deficiency ^b	p-value ^c
Child had diarrhea			0.527
Yes	265	38.9	
No	1222	35.4	
Child had fever			0.405
Yes	362	33.0	
No	1125	37.0	
Child had lower respiratory infection			0.141
Yes	97	26.2	
No	1390	36.6	
Minimum dietary diversity (6-23 months)			0.020
Yes	65	59.3	
No	297	39.1	
Child consumed commercially fortified baby cereal			0.405
Yes	139	31.5	
No	1340	36.4	
Child consumed micronutrient powder			0.006
Yes	103	20.3	
No	1374	36.8	
Child consumed infant formula with added iron			0.036
Yes	116	24.3	
No	1359	37.0	
Child took iron tablet or syrup in past six months			0.002
Yes	159	20.0	
No	1314	38.0	
Child took multivitamin supplement in past six			0.007
Yes	150	22.4	
No	1320	37.8	
Developmentally on track (6-23 months)			0.228
Yes	92	40.3	
No	79	51.6	
Developmentally on track (24-59 months)			0.552
Yes	215	33.5	
No	103	29.4	
Child stunted			0.097
Yes	257	43.8	
No	1220	34.3	
Child wasted			0.468
Yes	24	43.7	
No	1441	35.8	
Child underweight			0.630
Yes	97	40.5	
No	1375	35.6	
Child obese or overweight			0.289
Yes	70	27.0	
No	1395	36.3	

Table continued on next page

Characteristic	N	% ^a with iron deficiency ^b	p-value ^c
Child had inflammation			0.024
Yes	536	30.0	
No	960	38.9	
Child vitamin A deficient			0.876
Yes	132	36.8	
No	1364	35.8	
Child vitamin D deficient/ insufficient			0.014
Yes	362	46.4	
No	1099	31.9	
Child zinc deficient^d			0.033
Yes	100	20.3	
No	177	39.2	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Iron deficiency defined as plasma ferritin < 12 µg/L; ferritin adjusted for inflammation [88].

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 25% sub-sample of children.

Children with vitamin A deficiency have a higher prevalence of investigated morbidities two weeks prior to the survey (see Table 42). Vitamin A status is associated with wasting, underweight and overweight/ obesity: a larger proportion of wasted and underweight children and a smaller proportion of overweight and obese children suffer from vitamin A deficiency. Vitamin A deficiency is more prevalent in children who are vitamin D deficient/ insufficient compared to children that are sufficient. The data also indicates that children who achieve minimum dietary diversity are less likely to be vitamin A deficient, although this association does not reach significance. Lastly, the vitamin A deficiency prevalence is higher among children 24-59 months of age that are not developmentally on track.

Table 42. Association between various factors and vitamin A deficiency in children 6-59 months of age, Lebanon 2023

Characteristic	N	% ^a with vitamin A deficiency ^b	p-value ^c
Child had diarrhea			0.010
Yes	265	11.1	
No	1222	5.2	
Child had fever			0.001
Yes	362	11.3	
No	1125	4.4	
Child had lower respiratory infection			0.001
Yes	97	18.5	
No	1390	5.5	
Minimum dietary diversity (6-23 months only)			0.052
Yes	65	2.3	
No	297	7.8	
Child consumed commercially fortified baby cereal			0.527
Yes	139	4.9	
No	1340	6.3	

Table continued on next page

Characteristic	N	% ^a with vitamin A deficiency ^b	p-value ^c
Child consumed micronutrient powder			0.959
Yes	103	6.4	
No	1374	6.2	
Child took multivitamin supplement in past six months			0.280
Yes	150	4.1	
No	1320	6.5	
Developmentally on track (6-23 months)			0.406
Yes	13	5.5	
No	18	8.4	
Developmentally on track (24-59 months)			0.040
Yes	57	5.0	
No	41	9.0	
Child stunted			0.098
Yes	257	9.4	
No	1220	5.7	
Child wasted			0.037
Yes	24	19.1	
No	1441	6.2	
Child underweight			0.001
Yes	97	17.1	
No	1375	5.6	
Child obese or overweight			0.045
Yes	70	1.6	
No	1395	6.5	
Child had inflammation			0.085
Yes	536	8.4	
No	960	5.4	
Child vitamin D deficient/ insufficient			<0.001
Yes	362	11.3	
No	1099	4.5	
Child zinc deficient^d			0.971
Yes	108	5.2	
No	169	5.3	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin A deficiency defined as retinol binding protein (RBP) < 0.62 µmol/L; RBP adjusted for inflammation [51].

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 25% sub-sample of children.

The associations between vitamin D status and potential risk factors are presented in Table 43. Children who had consumed commercially fortified baby cereal the day before the survey have a lower prevalence of vitamin D deficiency or insufficiency than those who did not consume the fortified baby cereal. Moreover, the prevalence of vitamin D deficiency/insufficiency is significantly lower in children consuming vitamin D and/ or multivitamin supplements in the 6 months prior to the survey. In addition, vitamin D status is significantly associated with a diverse diet. Children who achieve minimum dietary diversity are more likely to be vitamin D sufficient than those who do not achieve minimum dietary diversity. No significant associations were found between any of the other investigated variables and vitamin D status.

Associations between zinc deficiency and potential risk factors are shown in Table 44. Zinc deficiency prevalence is substantially higher in children who had LRI in the past 2 weeks prior to the survey. In addition, the zinc deficiency proportion is significantly smaller among children consuming fortified cereals or micronutrient powders compared to those not consuming products. None of the other investigated risk factors is significantly associated with zinc deficiency.

Table 43. Association between various factors and vitamin D deficiency in children 6-59 months of age, Lebanon 2023

Characteristic	N	% ^a with vitamin D deficiency or insufficiency ^b	p-value ^c
Child had diarrhea			0.307
Yes	268	22.0	
No	1250	30.4	
Child had fever			0.845
Yes	370	28.1	
No	1148	29.2	
Child had lower respiratory infection			0.188
Yes	99	21.0	
No	1419	29.4	
Minimum dietary diversity (6-23 months only)			<0.001
Yes	64	3.5	
No	304	19.7	
Child consumed commercially fortified baby cereal			0.006
Yes	143	15.1	
No	1366	29.9	
Child took multivitamin supplement in past six months			0.005
Yes	151	15.0	
No	1349	30.6	
Child took vitamin D tablets or syrup in past six months			<0.001
Yes	160	11.6	
No	1342	31.0	
Child took fish oil supplements in past six months			0.997
Yes	48	29.1	
No	1456	29.0	
Child was taking fish oil supplements at the time of the			0.219
Yes	10	10.5	
No	38	32.7	
Developmentally on track (6-23 months)			0.165
Yes	37	13.1	
No	33	20.5	
Developmentally on track (24-59 months)			0.778
Yes	199	31.7	
No	104	33.3	

Table continued on next page

Characteristic	N	% ^a with vitamin D deficiency or insufficiency ^b	p-value ^c
Child stunted			0.109
Yes	258	20.8	
No	1247	30.2	
Child wasted			0.640
Yes	26	23.7	
No	1466	28.8	
Child underweight			0.547
Yes	96	22.5	
No	1406	29.2	
Child obese or overweight			0.889
Yes	70	29.8	
No	1422	28.7	
Child zinc deficient^d			0.648
Yes	522	27.8	
No	939	30.7	
Sun exposure index			0.776
< 10	317	27.6	
10-20	227	31.4	
≥ 20	727	27.8	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin D deficiency defined as serum vitamin D 25(OH) < 12 ng/mL; vitamin D insufficiency defined as serum vitamin D 25(OH) between 12-19.9 ng/mL.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 25% sub-sample of children.

Table 44. Association between various factors and zinc deficiency in children 6-59 months of age, Lebanon 2023

Characteristic	N	% ^a with zinc deficiency ^b	p-value ^c
Child had diarrhea			0.235
Yes	50	49.4	
No	228	35.3	
Child had fever			0.099
Yes	75	48.5	
No	203	33.4	
Child had lower respiratory infection			0.004
Yes	20	72.1	
No	258	33.8	
Minimum dietary diversity (6-23 months of age)			0.343
Yes	20	50.4	
No	45	30.4	
Consumed commercially fortified baby cereal			0.050
Yes	26	18.3	
No	251	38.3	
Consumed micronutrient powder			0.010
Yes	20	10.3	
No	257	38.6	
Took multivitamin supplement in past six months			0.721
Yes	33	45.3	
No	243	38.8	
Developmentally on track (6-23 months)			0.584
Yes	15	46.2	
No	10	34.9	
Developmentally on track (24-59 months)			0.229
Yes	51	33.3	
No	26	47.5	
Child stunted			0.187
Yes	45	24.1	
No	227	40.7	
Child wasted			0.741
Yes	7	31.8	
No	263	38.4	
Child underweight			0.388
Yes	22	51.3	
No	251	37.6	
Child obese or overweight			0.298
Yes	14	51.9	
No	256	37.7	
Child had inflammation			0.153
Yes	95	47.3	
No	182	31.9	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.
Zinc deficiency measured in a 25% sub-sample of children.

^a Percentages weighted for unequal probability of selection.

^b Zinc deficiency defined as plasma zinc < 65 µg/dL for morning sample in a non-fasting state and < 57 µg/dL for afternoon samples in a non-fasting state [80].

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

3.4. Non-pregnant adolescent girls 10-19 years of age

3.4.1. Characteristics

Overall, 2247 adolescent girls aged 10-19 years participated in the LIMA (Table 45). Adolescent girls are equally distributed between the age categories and about two thirds have Lebanese nationality, whereas about 30% are Syrians. Only 12 adolescent girls have a nationality that was not either Lebanese, Syrian, or Palestinian, and these 12 adolescent girls are not included in any of the nationality-specific analyses in this chapter. Only a small proportion of the girls were married at the time of the survey. A slightly larger proportion of adolescent girls live in households in the lowest wealth quintile.

Table 45. Description of adolescent girls 10-19 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Nationality			
Lebanese	1445	66.8	[61.1,72.0]
Syrian	674	30.2	[25.3,35.5]
Palestinian	116	2.6	[1.4,4.9]
Other	12	0.5	[0.2,1.2]
Age group (in years)			
10-12	819	34.8	[32.0,37.7]
13-15	689	32.5	[29.8,35.3]
16-19	739	32.7	[29.8,35.7]
Stratum			
Akkar	216	5.3	[4.0,6.8]
Baalbek-Hermel	255	4.9	[3.6,6.8]
Beirut	247	4.9	[3.7,6.5]
Bekaa	219	6.7	[4.8,9.4]
El Nabatieh	244	7.5	[5.6,10.0]
Mount Lebanon	176	33.7	[27.6,40.4]
North	326	18.5	[13.5,24.9]
South	246	11.5	[8.2,16.0]
Palestinian camps	126	1.5	[1.0,2.1]
Syrian ITS	192	5.4	[4.0,7.3]
Marital status			
Never married	2152	95.9	[94.3,97.1]
Married	89	3.7	[2.5,5.3]
Divorced/separated/widowed	5	0.4	[0.1,1.6]
Wealth quintile			
Lowest	655	26.8	[22.4,31.8]
Second	434	19.4	[15.5,24.1]
Middle	421	19.4	[16.3,23.0]
Fourth	412	17.4	[14.0,21.5]
Highest	325	16.9	[13.4,20.9]
TOTAL SAMPLE	2247		

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

When the nationality of girls was investigated within each wealth quintile, the majority of girls in the lowest wealth quintile are Syrian while the majority of girls in the higher wealth quintiles are of Lebanese and Palestinian nationalities (Figure 24).

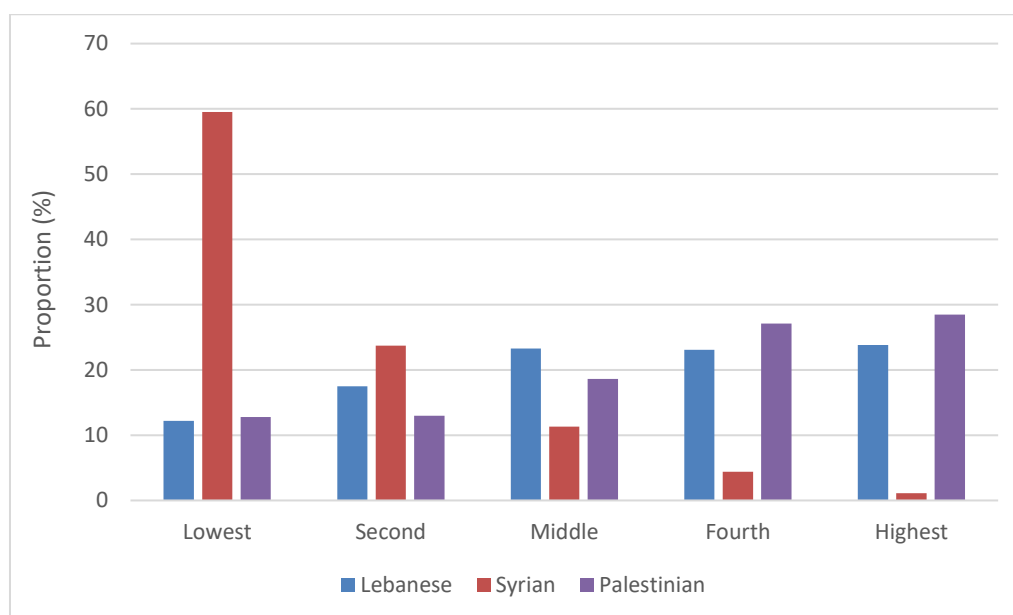


Figure 25. Adolescent girls 10-19 years of age wealth quintile distribution by nationality, Lebanon 2023

3.4.2. Recent illness and health indicators

Lower respiratory infection in the past two weeks prior to the survey was uncommon in adolescent girls. Almost 7% had diarrhea and about every tenth adolescent girl had fever in the past two weeks prior to the survey. Nearly one-third of surveyed adolescent girls have inflammation.

When examining recent illness and inflammation by nationality (see Figure 25), no cases of LRI were reported two weeks prior to the survey among Palestinian girls, and these girls are also less likely to have diarrhea and fever. The proportion of inflammation is nearly 40% among Lebanese girls and approximately 20% for other nationalities.

3.4.3. Dietary diversity

About half of participating adolescent girls achieve minimum dietary diversity, about one third live in moderate food poverty and approximately 10% of girls live in severe food poverty (see Table 47). Dietary diversity is significantly associated with stratum, nationality, household wealth quintile, marital status and household food insecurity (access). A larger proportion of Lebanese girls achieve minimum dietary diversity and a smaller proportion live in moderate and severe food poverty compared to girls of Syrian and Palestinian nationality. Moreover, the proportion of adolescent girls consuming a diverse diet is highest among those in households in the higher wealth quintiles. Similarly, a larger proportion of girls living in food secure households consume a minimum diverse diet and fewer live in food poverty compared

to girls residing in food insecure households. Nationally, the mean dietary score is 4.8, and the most common number of food groups consumed is five, reported by 21.5 % (95% CI: 18.8, 24.6) of adolescent girls (data not shown).

Table 46. Health indicators in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Had lower acute respiratory infection in past 2			
Yes	49	2.2	[1.4,3.5]
No	2190	97.8	[96.5,98.6]
Had diarrhea in past 2 weeks			
Yes	161	6.6	[5.1,8.7]
No	2078	93.4	[91.3,94.9]
Had fever in past 2 weeks			
Yes	201	9.6	[7.5,12.1]
No	2038	90.4	[87.9,92.5]
Inflammation^d			
None	1436	67.7	[64.3,70.9]
Early (High CRP, Normal AGP)	21	1.2	[0.6,2.4]
Acute (High CRP, High AGP)	154	7.8	[6.0,10.0]
Convalescent (Normal CRP, High AGP)	462	23.4	[20.5,26.6]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Questions on recent illness were phrased according to the MICS manual [114].

^d Elevated CRP defined as > 5 mg/L and elevated AGP defined as > 1 g/L according to Thurnham *et al.* [77].

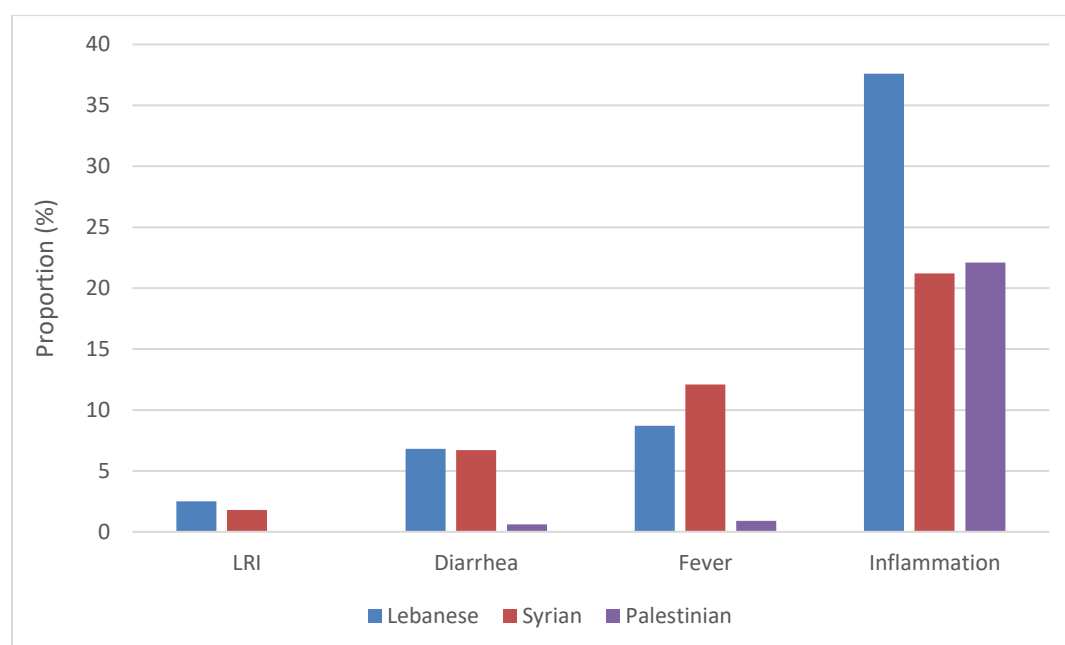


Figure 26. Prevalence of illness in the past 2 weeks (lower respiratory infection (LRI), diarrhea, fever) and inflammation (elevated AGP and/or CRP) by nationality, adolescent girls 10-19 years, Lebanon 2023

Table 47. Dietary diversity in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	Mean dietary score ^a	Minimum dietary diversity (consumed ≥ 5 food groups)			Moderate food poverty (consumed 3-4 food groups)			Severe food poverty (consumed 0-2 food groups)		
			% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	p-value ^c
Nationality					<0.001			0.039			<0.001
Lebanese	1445	5.0	59.9	[55.1,64.5]		30.6	[26.8,34.6]		9.5	[7.3,12.4]	
Syrian	674	4.4	40.2	[31.7,49.2]		40.1	[32.5,48.2]		19.7	[14.6,26.1]	
Palestinian	116	4.7	45.0	[35.6,54.8]		38.3	[25.5,52.8]		16.7	[7.3,33.9]	
Age group (in years)					0.878			0.417			0.604
10-12	819	4.8	53.5	[47.2,59.7]		33.3	[28.4,38.7]		13.2	[9.3,18.4]	
13-15	689	4.8	52.5	[45.9,59.0]		36.2	[30.4,42.6]		11.2	[8.2,15.3]	
16-19	739	5.0	54.6	[47.7,61.3]		31.4	[26.4,36.9]		14.0	[10.1,19.2]	
Stratum					<0.001			0.005			<0.001
Akkar	216	4.3	42.9	[30.7,56.1]		40.9	[31.8,50.6]		16.2	[9.8,25.5]	
Baalbek-Hermel	255	4.0	39.8	[27.9,53.1]		37.3	[27.3,48.5]		22.9	[13.9,35.2]	
Beirut	247	4.5	49.2	[39.6,58.9]		37.5	[30.1,45.4]		13.3	[9.2,18.9]	
Bekaa	219	5.5	72.9	[64.7,79.8]		22.5	[16.9,29.2]		4.6	[2.4,8.7]	
El Nabatieh	244	5.2	66.0	[52.9,77.1]		23.9	[17.2,32.2]		10.1	[4.7,20.3]	
Mount Lebanon	176	5.3	59.0	[47.5,69.6]		30.8	[22.8,40.1]		10.2	[5.5,18.0]	
North	326	4.4	46.6	[39.7,53.6]		42.2	[34.3,50.5]		11.2	[7.7,16.0]	
South	246	4.6	48.2	[38.6,57.9]		35.1	[30.0,40.6]		16.7	[9.2,28.3]	
Palestinian camps	126	4.3	39.9	[30.7,49.9]		23.5	[12.7,39.2]		36.6	[27.6,46.7]	
Syrian ITS	192	4.3	42.9	[34.7,51.5]		35.5	[26.2,46.0]		21.7	[14.4,31.2]	
Wealth quintile					<0.001			0.010			0.017
Lowest	655	4.5	41.9	[34.1,50.1]		40.2	[33.2,47.7]		17.9	[14.0,22.5]	
Second	434	4.4	41.8	[34.9,49.0]		41.3	[33.6,49.4]		16.9	[11.0,25.1]	
Middle	421	5.3	59.6	[50.8,67.9]		28.6	[21.5,36.8]		11.8	[6.6,20.1]	
Fourth	412	5.0	63.2	[53.1,72.2]		29.3	[21.4,38.7]		7.5	[4.0,13.6]	
Highest	325	5.2	68.5	[59.8,76.0]		24.7	[17.9,32.9]		6.9	[3.4,13.4]	
Marital status					0.112			0.624			0.012
Never married	2152	4.9	54.3	[49.8,58.7]		33.5	[29.9,37.3]		12.2	[9.8,15.0]	
Married	89	4.5	39.3	[22.6,58.9]		29.1	[15.3,48.2]		31.7	[15.0,54.9]	

Table continued on next page

Characteristic	N	Mean dietary score ^a	Minimum dietary diversity (consumed ≥ 5 food groups)			Moderate food poverty (consumed 3-4 food groups)			Severe food poverty (consumed 0-2 food groups)		
			% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	p-value ^c
Household food insecurity access					0.012			0.268			<0.001
Secure	596	5.2	61.8	[52.4,70.4]		29.9	[23.4,37.2]		8.3	[4.8,14.1]	
Mild	208	5.2	53.4	[39.1,67.2]		42.5	[28.9,57.3]		4.1	[2.1,8.0]	
Moderate	701	4.9	57.0	[50.5,63.2]		31.5	[26.0,37.6]		11.6	[8.4,15.8]	
Severe	742	4.4	43.2	[34.9,51.9]		36.6	[30.0,43.7]		20.2	[15.6,25.8]	
Menstruation					0.989			0.641			0.602
Menarche	1561	4.8	53.5	[48.7,58.3]		34.0	[30.2,38.1]		12.4	[9.8,15.6]	
Pre-menarche	686	4.8	53.5	[46.8,60.1]		32.6	[27.3,38.4]		13.9	[9.5,19.9]	
TOTAL SAMPLE	2247	4.8	53.5	[49.0,58.0]		33.6	[30.1,37.4]		12.8	[10.4,15.8]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.4.4. Wheat flour consumption

As shown in Table 48, adolescent girls consume an average of about 75 grams of wheat flour per day. Wheat flour consumption is significantly associated with age group and is slightly lower among older girls. Approximately 4% of adolescent girls consume no wheat flour products, and there is a mean consumption of wheat flour of 77.3 grams per day when these girls are excluded from the analysis (data not shown).

Table 48. Mean wheat flour intake (grams per day) in adolescent girls 10-19 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Mean ^a	[95% CI] ^b	p-value ^c
Nationality				0.315
Lebanese	1445	71.6	[64.6,78.6]	
Syrian	674	81.0	[70.9,91.0]	
Palestinian	116	60.5	[45.0,76.0]	
Age group (in years)				0.041
10-12	819	77.4	[68.8,86.0]	
13-15	689	78.9	[70.8,87.0]	
16-19	739	66.1	[58.7,73.6]	
Stratum				0.086
Akkar	216	75.8	[65.7,85.9]	
Baalbek-Hermel	255	76.0	[70.6,81.5]	
Beirut	247	85.2	[69.0,101.3]	
Bekaa	219	78.0	[64.6,91.5]	
El Nabatieh	244	49.6	[44.2,55.0]	
Mount Lebanon	176	60.7	[49.8,71.7]	
North	326	93.7	[87.1,100.3]	
South	246	69.5	[49.0,90.0]	
Palestinian camps	126	71.8	[52.0,91.7]	
Syrian ITS	192	118.9	[87.1,150.6]	
Wealth quintile				0.781
Lowest	655	80.9	[70.1,91.8]	
Second	434	66.2	[55.4,77.0]	
Middle	421	64.5	[54.2,74.9]	
Fourth	412	74.5	[59.5,89.4]	
Highest	325	83.7	[70.1,97.2]	
Marital status				0.062
Never married	2152	74.8	[69.2,80.4]	
Married	89	58.2	[41.4,75.0]	
Household food insecurity access				0.786
Secure	596	80.7	[67.8,93.6]	
Mild	208	54.4	[41.4,67.4]	
Moderate	701	70.1	[60.3,79.9]	
Severe	742	77.4	[68.8,86.1]	
Menstruation				0.884
Menarche	1561	74.0	[67.6,80.5]	
Pre-menarche	686	74.7	[67.3,82.1]	
TOTAL SAMPLE	2247	74.2	[68.7,79.8]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Means weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.4.5. Consumption of vitamin and mineral supplements

As shown in Table 49 the consumption of vitamin and mineral supplements is very low in adolescent girls in Lebanon: About only 8% had taken iron and/ or vitamin D supplements in the six months prior to the survey, and less than half of those were still taking those supplements at the time of the survey. Multivitamins, vitamin B12, and fish oil supplements were taken by less than 4% of girls. Only 1% of girls took vitamin A, folic acid supplements, and drugs for intestinal worms in the past six months prior to the survey. When examining supplement consumption by nationality, Figure 27 shows that vitamin A supplements are consumed more often by Syrian girls; no other associations are significant.

Table 49. Consumption of mineral and vitamin supplements in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Took iron tablet or syrup in past six months			
Yes	163	7.7	[6.1,9.7]
No	2079	92.1	[90.1,93.7]
Don't know	5	0.2	[0.0,0.8]
Is still taking iron			
Yes	67	41.5	[29.6,54.4]
No	96	58.5	[45.6,70.4]
Took folic acid supplements in past six months			
Yes	29	0.8	[0.5,1.3]
No	2204	98.6	[97.6,99.1]
Don't know	14	0.7	[0.2,1.7]
Is still taking folic acid			
Yes	9	42.9	[20.3,69.0] ^c
No	16	57.1	[31,79.7] ^d
Took vitamin B12 supplements in past six months			
Yes	44	2.6	[1.5,4.4]
No	2193	97.1	[95.3,98.2]
Don't know	10	0.3	[0.1,0.6]
Is still taking vitamin B12			
Yes	16	38.7	[15.1,69.1]
No	28	61.3	[30.9,84.9]
Took vitamin D tablet or syrup in past six months			
Yes	165	8.0	[5.8,11.1]
No	2065	91.4	[88.4,93.8]
Don't know	17	0.5	[0.2,1.0]
Is still taking vitamin D tablets or syrup			
Yes	92	52.8	[42.1,63.2] ^e
No	72	47.2	[36.8,57.9]
Took vitamin A tablets or other preparations in past six			
Yes	16	1.3	[0.5,3.3]
No	2223	98.5	[96.5,99.3]
Don't know	8	0.2	[0.1,0.7]
Is still taking vitamin A			
Yes	5	58.9	[17.8,90.5]
No	8	41.1	[9.5,82.2] ^f

Table continued on next page

Characteristic	N	% ^a	[95% CI] ^b
Took multivitamin tablets or other preparations in past six			
Yes	78	3.8	[2.5,5.7]
No	2154	95.8	[93.9,97.1]
Don't know	15	0.4	[0.2,0.8]
Is still taking multivitamins			
Yes	41	36.0	[20.4,55.1]
No	37	64.0	[44.9,79.6]
Took fish oil supplements in past six months			
Yes	52	2.5	[1.6,3.7]
No	2177	96.8	[95.4,97.8]
Don't know	18	0.7	[0.3,1.8]
Is still taking fish oil supplements			
Yes	18	37.3	[17.9,62.0] ^g
No	28	62.7	[38.0,82.1] ^h
Took drug for intestinal worms in past six months			
Yes	33	1.6	[0.8,3.4]
No	2205	98.0	[96.3,98.9]
Don't know	9	0.4	[0.2,0.9]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Data from Mount Lebanon (1 observation) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup. // ^d Data from Bekaa (1 observation) and North (2 observations) were excluded from analysis since the small N's in these strata caused instability in the estimation of the confidence interval for this subgroup. // ^e Data from Palestinian camps (1 observation) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup. // ^f Data from Mount Lebanon (1 observation), North (2 observations), and Palestinian camps (1 observation) were excluded from analysis since the small N's in these strata caused instability in the estimation of the confidence interval for this subgroup. // ^g Data from Bekaa (3 observations) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup. // ^h Data from Baalbek-Hermel (2 observations) and South (1 observation) were excluded from analysis since the small N's in these strata caused instability in the estimation of the confidence interval for this subgroup.

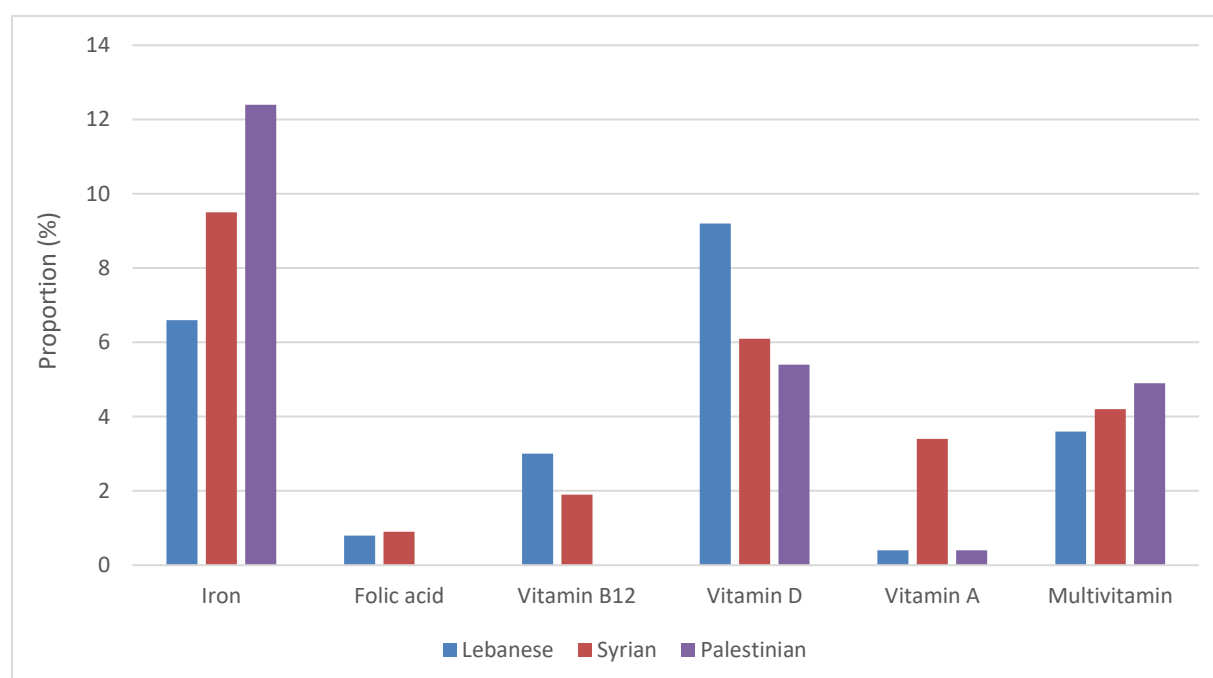


Figure 27. Mineral and vitamin supplement consumption in adolescent girls 10-19 years by nationality, Lebanon 2023

3.4.6. Smoking

Nearly 7% of the adolescent girls smoke 1 to 9 cigarettes per day, and none of the surveyed girls smoke more than 9 cigarettes per day (self-reported). Cigarette smoking is significantly associated with age group: the smoking prevalence increases consistently by age group, and about 16% of girls 16-19 years of age are smokers. No significant difference was observed by any other investigated indicators (see Figure 28).

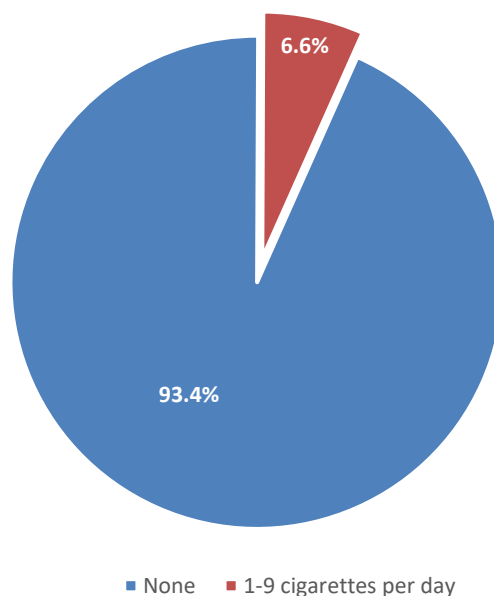


Figure 28. Number of cigarettes smoked per day in adolescent girls 10-19 years of age, Lebanon 2023

3.4.7. Sun exposure

Practices related to sun exposure are described in Table 50. The results show that nearly half of Lebanese girls report wearing a hijab. About 25% of girls report covering their head at times when outside, but only about 8% cover their head “most of the time” or “all the time”. Covering of arms “most of the time” or “all the time” when outside is as infrequently practiced, while more than 13% of girls “always” cover their hands when outside. About 30% of women reported using sunscreen, with about half of them reporting using it “most of the time” or “all the time”. About 80% of girls have one hour or more of direct sun exposure per day. In combination with the minimal covering practices, the sun exposure index shows relatively high index scores (i.e., ≥ 10) for more than 70% of girls. About 16% ($n=336$; 95% CI: 12.2, 20.6) of girls have a sun exposure index score of 0 indicating no sun exposure (data not shown).

Table 50. Sun exposure patterns in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	% a	[95% CI] b
Wears Hijab (veil)			
Yes	1226	46.2	[41.6,50.8]
No	1021	53.8	[49.2,58.4]
Usually protects head from sun when outside (non-hijab wearing girls) ^c			
Never/rarely	738	75.1	[70.3,79.4]
Sometimes	205	16.9	[13.3,21.3]
Most of the time	65	6.5	[4.1,10.3]
All the time	13	1.4	[0.6,3.5]
Usually covers arms when outside (non-hijab wearing girls) ^c			
Never/rarely	754	76.1	[70.8,80.7]
Sometimes	211	19.9	[15.9,24.7]
Most of the time	47	3.5	[2.1,5.9]
All the time	9	0.4	[0.2,1.0]
Usually covers hands when outside			
Never/rarely	1389	68.5	[63.4,73.1]
Sometimes	325	12.3	[9.9,15.1]
Most of the time	161	6.0	[4.3,8.3]
All the time	372	13.3	[9.9,17.5]
Approx. time on weekdays spent under the sun			
None	3	0.0	
1-29 minutes	156	9.1	[6.7,12.4]
30-59 minutes	117	9.7	[6.5,14.2]
1-2 hours	367	23.9	[19.9,28.6]
2-3 hours	343	19.1	[15.7,22.9]
> 3 hours	869	38.2	[33.6,43.0]
Approx. time on weekends spent under the sun			
None	15	0.5	[0.1,2.2]
1-29 minutes	222	13.4	[10.6,16.9]
30-59 minutes	124	9.1	[6.5,12.7]
1-2 hours	455	26.3	[22.5,30.5]
2-3 hours	455	23.9	[20.4,27.8]
> 3 hours	549	26.7	[22.8,31.0]
Usually uses sunscreen			
Never/rarely	1581	69.5	[65.6,73.1]
Sometimes	350	16.9	[13.7,20.6]
Most of the time	178	6.8	[5.3,8.5]
All the time	138	6.9	[5.3,9.0]
Respondent skin color			
Very white	48	3.2	[2.0,5.2]
White	809	35.6	[32.1,39.3]
Olive	1207	52.5	[49.0,56.0]
Dark	175	8.4	[6.5,10.7]
Very dark	8	0.2	[0.1,0.8]

Table continued on next page

Characteristic	N	% ^a	[95% CI] ^b
Sun exposure index			
< 10	1147	60.3	[55.4,65.0]
10-20	142	9.4	[7.1,12.5]
≥ 20	518	30.3	[26.1,34.8]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Only includes women not wearing a hijab.

3.4.8. Short stature

Figure 29 shows the distribution of the height-for-age z-score in the surveyed population of adolescent girls 10-19 years of age. The distribution of the height-for-age z-scores is slightly shifted towards the left of the WHO Growth Standard curve.

Nationally, the prevalence of short stature is less than 6%, with the highest prevalence among girls in the Syrian ITS stratum. Short stature prevalence is also significantly higher in Syrian girls compared to girls with Lebanese or Palestinian nationalities. Significant differences are also found by menstruation and household wealth quintile. Pre-menarche girls are more likely to be of short stature compared to menarche girls, and the prevalence of short stature is higher among girls living in the poorest households (see Table 51).

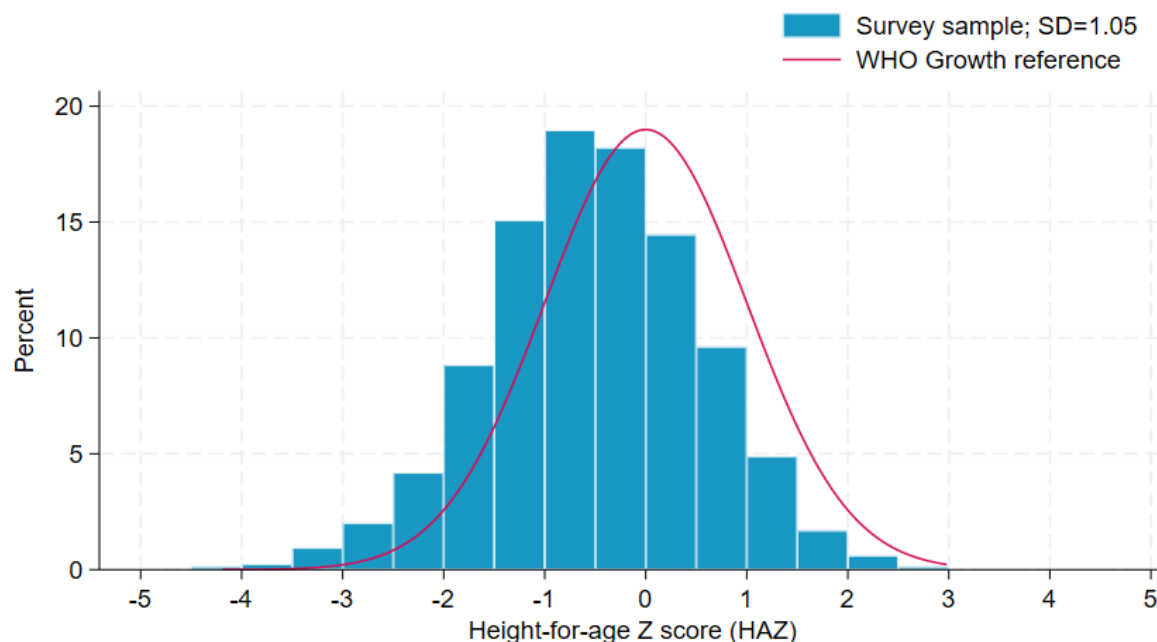


Figure 29. Distribution of height-for-age z-scores in adolescent girls 10-19 years of age, Lebanon 2023

Table 51. Percentage of adolescent girls 10-19 years of age with short stature, Lebanon 2023

Characteristic	N	% ^{a,b}	[95% CI] ^c	p-value ^d
Nationality				0.001
Lebanese	1406	4.3	[3.0,6.3]	
Syrian	619	9.4	[6.5,13.5]	
Palestinian	90	1.6	[0.3,7.2]	
Age group (in years)				0.840
10-12	780	5.7	[4.1,7.9]	
13-15	645	6.4	[4.1,9.8]	
16-19	705	5.4	[3.2,8.8]	
Menstruation				<0.001
Menarche	1472	4.1	[2.9,5.8]	
Pre-menarche	651	10.0	[7.3,13.6]	
Stratum				0.133
Akkar	213	8.9	[5.7,13.7]	
Baalbek-Hermel	252	6.4	[3.9,10.3]	
Beirut	235	7.6	[4.2,13.5]	
Bekaa	209	6.1	[2.6,13.4]	
El Nabatieh	241	7.6	[4.8,11.8]	
Mount Lebanon	176	4.6	[2.1,9.7]	
North	323	3.6	[2.0,6.5]	
South	228	5.5	[2.5,11.8]	
Palestinian camps	78	6.1	[1.9,17.8]	
Syrian ITS	175	13.5	[7.1,24.1]	
Wealth quintile				0.001
Lowest	612	9.6	[6.3,14.4]	
Second	409	5.0	[2.8,8.7]	
Middle	407	7.4	[4.5,11.8]	
Fourth	394	2.4	[1.0,5.5]	
Highest	308	2.3	[1.2,4.4]	
Marital status				0.679
Never married	2033	5.7	[4.3,7.5]	
Married	84	8.8	[3.5,20.3]	
Household food insecurity access				0.395
Secure	552	4.5	[2.5,7.8]	
Mild	187	7.2	[3.8,13.3]	
Moderate	683	5.2	[3.5,7.9]	
Severe	708	7.1	[4.6,10.8]	
Household sanitation ^e				0.482
Inadequate	107	8.0	[3.2,18.6]	
Adequate	1992	5.7	[4.3,7.6]	
Safe drinking water ^f				0.201
Yes	1914	5.6	[4.2,7.5]	
No	214	8.0	[4.9,12.7]	
TOTAL SAMPLE	2130	5.8	[4.4,7.6]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. // ^a Stunting is defined as having a height-for-age z-score below -2 standard deviations from the WHO Growth reference data for 5-18 years population median. // ^b Percentages weighted for unequal probability of selection. // ^c CI = confidence interval, calculated taking into account the complex sampling design. // ^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. // ^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate Sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. // ^f Composite variable of main source of drinking water and treating water to make safe for drinking.

3.4.9. Thinness, overweight and obesity

Figure 30 shows the distribution of the BMI-for-age z-score in the surveyed population of adolescent girls 10-19 years of age. The distribution of the BMI-for-age z-scores is slightly shifted towards the right of the WHO Growth Standard curve.

Thinness is uncommon and affects only about 3% of the adolescent girls in Lebanon. Thinness is associated with menstruation, nationality, and stratum. Thinness is more prevalent in pre-menarche girls, and highest among girls in the Syrian ITS and South strata. The thinness prevalence is smaller in Lebanese girls than Syrian and Palestinian girls.

Overall, almost one-third of adolescent girls are overweight or obese, with 20% classified as overweight and 10% as obese. Overweight and obesity is significantly associated with marital status and household food insecurity (access). Married girls exhibit a higher prevalence of overweight and obesity than unmarried girls, and girls living in mildly food insecure households have a higher prevalence than girls living in households of the other food insecurity access categories.

When examining the obesity prevalence by nationality within each governorate (Figure 31), significant differences were only found in Baalbek-El Hermel, where the obesity prevalence is higher in Lebanese compared to Syrian girls⁷.

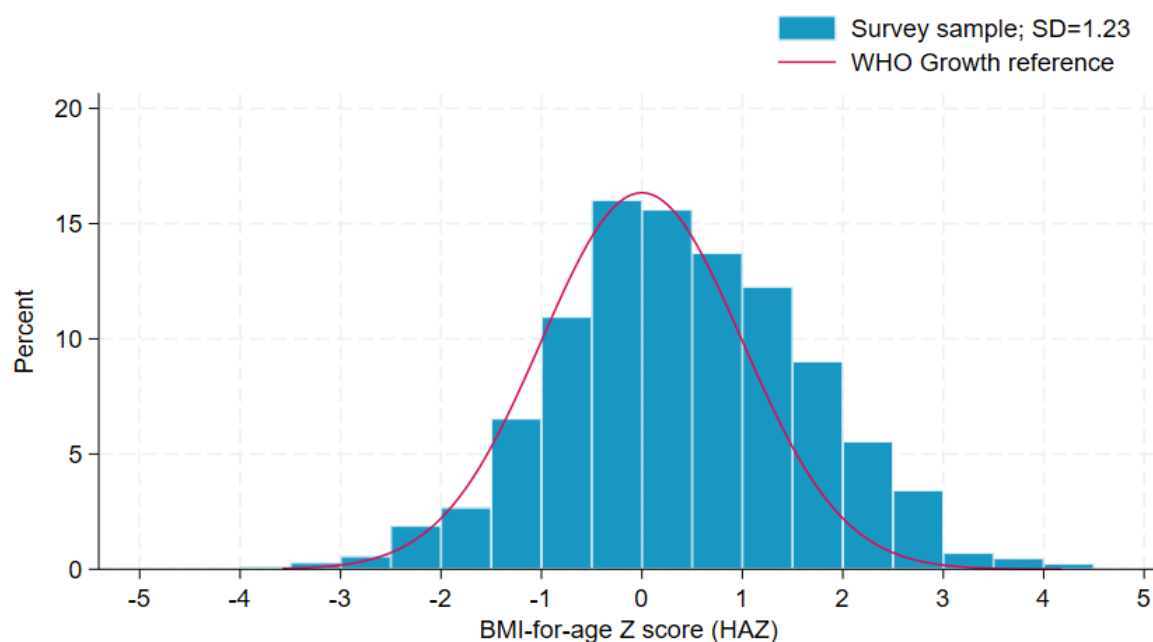


Figure 30. Distribution of BMI-for-age z-scores in adolescent girls 10-19 years of age, Lebanon 2023

⁷ Figure 31 excludes Palestinian nationality because of the small number of Palestinian girls in each governorate.

Table 52. Prevalence of thinness, overweight and obesity in adolescent girls 10-19 years, Lebanon 2023

Characteristic	Thinness ^a				Overweight ^a		Obesity ^a			Overweight or obesity		
	N	% ^b	[95% CI] ^c	p-value ^d	% ^b	[95% CI] ^c	% ^b	[95% CI] ^c	p-value ^d	% ^b	[95% CI] ^c	p-value ^d
Nationality				0.020					0.415			0.251
Lebanese	140	2.0	[1.2,3.2]		20.6	[17.2,24.5]	10.	[8.2,13.7]		31.2	[27.3,35.5]	
Syrian	617	5.4	[2.8,10.4]		18.2	[14.3,23.0]	8.1	[4.5,14.1]		26.3	[21.1,32.3]	
Palestinian	90	5.1	[1.5,15.3]		23.2	[11.1,42.2]	12.	[7.6,20.4]		35.9	[20.7,54.6]	
Age group (in years)				0.051					0.090			0.032
10-12	778	5.2	[2.9,9.3]		21.1	[17.0,25.8]	12.	[9.3,17.8]		34.0	[28.6,39.8]	
13-15	645	2.1	[0.8,5.4]		21.6	[17.0,27.0]	9.2	[6.1,13.5]		30.7	[25.6,36.4]	
16-19	705	1.7	[0.9,3.4]		17.0	[13.0,21.8]	7.7	[5.2,11.3]		24.7	[20.2,29.8]	
Menstruation				0.001					0.436			0.173
Menarche	147	1.6	[0.9,3.1]		22.0	[18.4,26.1]	9.4	[7.2,12.4]		31.5	[27.6,35.6]	
Pre-menarche	649	6.7	[3.8,11.4]		14.6	[11.0,19.2]	11.	[7.4,17.5]		26.2	[20.4,32.9]	
Stratum				0.022					0.154			0.137
Akkar	213	1.5	[0.5,4.5]		21.6	[16.3,28.0]	7.4	[5.0,10.8]		29.0	[22.4,36.5]	
Baalbek-Hermel	252	3.8	[1.2,11.0]		12.7	[8.4,18.7]	8.8	[5.6,13.4]		21.5	[15.1,29.7]	
Beirut	235	0.5	[0.1,1.6]		20.3	[14.9,27.1]	15.	[9.2,24.8]		35.8	[26.8,45.9]	
Bekaa	209	1.4	[0.5,4.1]		21.9	[17.5,26.9]	14.	[8.9,21.5]		35.9	[29.8,42.6]	
El Nabatieh	241	0.8	[0.2,3.0]		27.1	[20.7,34.6]	11.	[7.3,17.0]		38.4	[30.7,46.6]	
Mount Lebanon	176	3.0	[1.2,7.3]		18.4	[12.3,26.6]	7.4	[3.8,13.9]		25.8	[19.2,33.8]	
North	321	3.0	[1.6,5.5]		24.1	[19.0,30.1]	9.7	[6.7,14.1]		33.9	[27.8,40.5]	
South	228	5.8	[2.5,12.9]		13.9	[8.2,22.7]	15.	[7.9,29.2]		29.8	[18.9,43.6]	
Palestinian camps	78	3.0	[1.0,8.9]		20.0	[10.4,35.0]	16.	[8.7,28.7]		36.3	[20.6,55.7]	
Syrian ITS	175	6.4	[3.1,12.8]		19.0	[13.9,25.4]	5.1	[1.8,14.0]		24.1	[18.6,30.6]	
Wealth quintile				0.319					0.082			0.248
Lowest	610	5.0	[2.5,9.8]		17.6	[13.9,22.2]	8.1	[4.2,15.0]		25.8	[20.5,31.9]	
Second	409	2.6	[0.8,8.6]		18.1	[12.2,25.9]	8.4	[5.0,13.7]		26.5	[20.0,34.2]	
Middle	407	2.4	[0.8,6.8]		24.9	[17.1,34.7]	8.4	[5.1,13.4]		33.2	[25.3,42.1]	
Fourth	394	1.2	[0.5,3.0]		19.0	[14.1,25.2]	17.	[11.7,24.0]		36.0	[28.0,44.8]	
Highest	308	3.2	[1.5,6.6]		20.6	[14.6,28.2]	9.6	[5.9,15.3]		30.2	[22.8,38.8]	

Table continued on next page

Characteristic	Thinness ^a			Overweight ^a			Obesity ^a			Overweight or obesity		
	N	% ^b	[95% CI] ^c	p-value ^d	% ^b	[95% CI] ^c	% ^b	[95% CI] ^c	p-value ^d	% ^b	[95% CI] ^c	p-value ^d
Marital status				0.714					0.499			0.023
Never married	203	3.2	[2.1,4.7]		19.5	[16.6,22.7]	9.8	[7.6,12.5]		29.3	[25.8,33.1]	
Married	84	1.5	[0.4,6.1]		32.4	[20.0,47.8]	16.	[5.4,39.8]		48.6	[33.2,64.4]	
Household food secure				0.070					0.848			0.042
Secure	552	4.7	[2.5,8.7]		14.0	[10.4,18.5]	10.	[7.0,16.3]		24.7	[19.0,31.5]	
Mild	187	0.1	[0.0,0.9]		31.7	[19.8,46.6]	12.	[7.2,19.5]		43.8	[31.4,57.1]	
Moderate	682	1.8	[0.9,3.3]		20.8	[16.0,26.5]	9.2	[6.4,13.0]		29.9	[24.8,35.7]	
Severe	707	3.6	[1.7,7.5]		21.2	[16.3,27.0]	9.6	[5.8,15.5]		30.7	[25.4,36.7]	
Household				0.104					0.873			0.920
Inadequate	106	1.0	[0.2,4.1]		19.6	[9.6,35.9]	11.	[3.0,33.3]		30.6	[16.6,49.5]	
Adequate	199	3.2	[2.1,4.8]		19.9	[16.9,23.1]	9.9	[7.7,12.6]		29.7	[26.3,33.4]	
Safe drinking water ^f				0.402					0.011			0.319
Yes	191	3.1	[2.1,4.8]		19.8	[16.9,23.0]	10.	[8.2,13.3]		30.2	[26.9,33.8]	
No	214	2.2	[1.0,4.6]		21.1	[13.4,31.6]	4.1	[2.0,8.3]		25.2	[17.0,35.6]	
TOTAL SAMPLE	212	3.1	[2.1,4.6]		19.9	[17.1,23.0]	10.	[7.9,12.6]		29.9	[26.6,33.4]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Thinness is defined as BMI-for-age z-score smaller than -2, overweight is defined as having a BMI-for-age z-score greater than +1 but less than or equal to +2 standard deviations and obesity is defined as having a BMI-for-age z-score greater than +2 standard deviations from the WHO Growth reference data for 5-19 years population median.

^b Percentages weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate Sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household.

Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

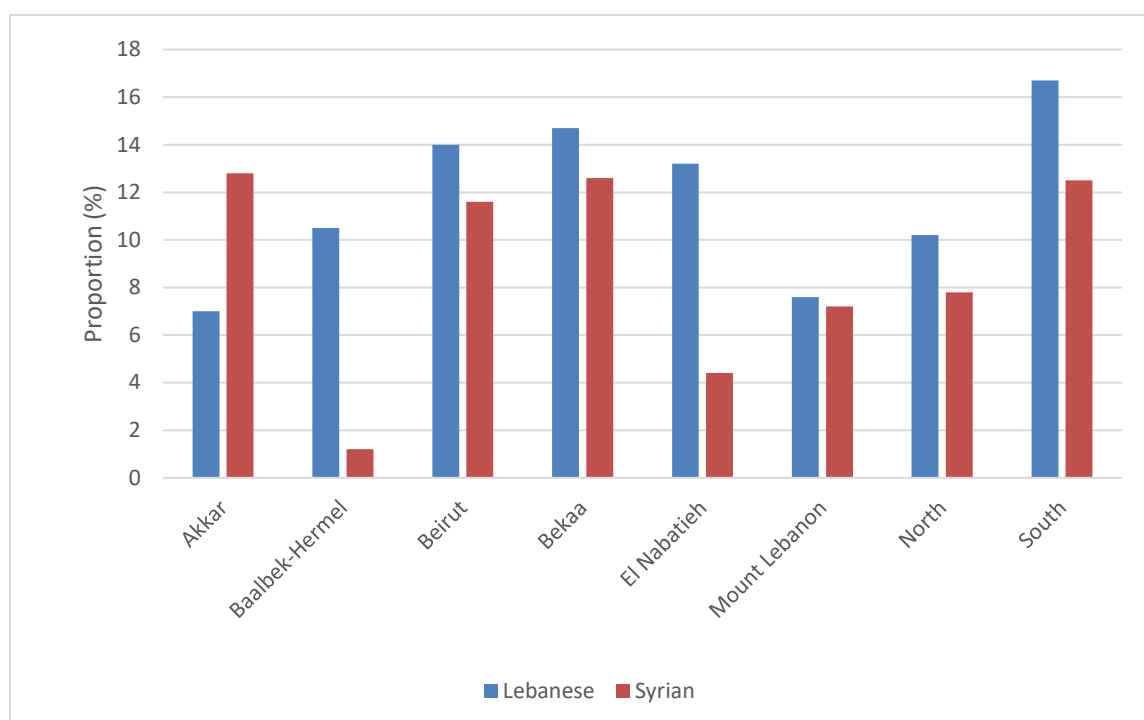


Figure 31. Obesity prevalence by nationality in the different governorate strata (excluding Syrian ITS and Palestinian camps strata) in adolescent girls 10-19 years, Lebanon 2023

3.4.10. History of cardiometabolic diseases

As shown in Table 53, only 2% of the girls surveyed have ever had their cholesterol or triglycerides measured. Among girls who reported having their cholesterol or triglycerides measured, approximately 20% reported having raised cholesterol or triglycerides. Approximately 2% of girls reported ever having their blood sugar measured, and very few reported having elevated blood glucose levels.

Table 53. History of cardiometabolic diseases in adolescent girls 10-19 years, Lebanon 2023

Characteristic	N	% ^a
Ever had cholesterol or triglycerides measured		
Yes	38	2.0
No	2209	98.0
Ever had raised cholesterol or triglycerides^b		
Yes	7	20.9
No	31	79.1
Took any prescribed oral medication for raised total cholesterol or triglycerides, in the past 2 weeks^c		
Yes	0	0
No	7	100
Ever seen a traditional/alternative healer for raised cholesterol or triglycerides^c		
Yes	1	4.7
No	6	95.3
Currently taking any herbal or traditional remedy for your raised cholesterol or triglycerides^c		
Yes	1	3.4
No	6	96.6
Ever had your blood sugar or other diabetes test measured		
Yes	49	2.5
No	2198	97.5
Ever had raised blood sugar or diabetes^b		
Yes	6	10.2
No	43	89.8
Currently taking any prescribed medicines, tablets or pills (other than insulin injections) for diabetes^c		
Yes	1	6.6
No	5	93.4
Currently taking prescribed insulin injection for diabetes^c		
Yes	4	34.7
No	0	65.3
Ever seen a traditional/alternative healer for raised blood sugar or diabetes^c		
Yes	1	6.6
No	5	93.4
Currently taking any herbal or traditional/alternative remedy for diabetes^c		
Yes	1	6.6
No	5	93.4

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Only includes women with the respective cardiometabolic disease ever measured.

^c Only includes women ever having the respective cardiometabolic disease.

3.4.11. *Anemia, iron deficiency, and iron deficiency anemia*

Valid hemoglobin measurements are available for 2062 adolescent girls. The distribution of hemoglobin values for girls is roughly symmetric with the majority of values above the anemia cut-off point (Figure 32). The weighted mean hemoglobin concentration is 126 g/L (95% CI: 125, 127) and weighted median is 127 g/L (IQR: 120, 132) (data not shown). Nationally, about 20% of adolescent girl are anemic (Table 54). Only 0.2% of girls have severe anemia, and 7.8% and 12.3% of girls can be classified with moderate and mild anemia, respectively (see Appendix 8.2). According to WHO, anemia in adolescent girls denotes a moderate public health problem [10]. Almost 30% of adolescent girls are iron deficient, and ID poses a moderate public health problem according to WHO classification [102].

As shown in Figure 33, the prevalence of adolescent girls with concomitant anemia and ID is nearly 14%. About 6% of adolescent girls have anemia without i ID and the prevalence of non-anemic iron deficient girls is about 16%. Approximately 69% of anemic girls are iron deficient (data not shown).

The prevalences of anemia, ID, and IDA are significantly associated with age, menarche status, and period bleeding (Table 54). The prevalences of all three indicators increase consistently by age group and are higher in menarche compared to pre-menarche girls. However, this latter finding is likely to be due to the higher age of menarche girls. Prevalences are also highest among girls reporting severe period bleeding. ID (not anemia or iron deficiency anemia) is significantly higher in girls living in households with inadequate sanitation.

Figure 34 presents the prevalence of anemia and ID by nationality within each governorate⁸. The prevalence of ID is significantly higher in Syrian girls in Bekaa and North governorates. All other associations are not statistically significant.

⁸ Figure 34 Figure 23 excludes Palestinian nationality because of the small number of Palestinian girls in each governorate.

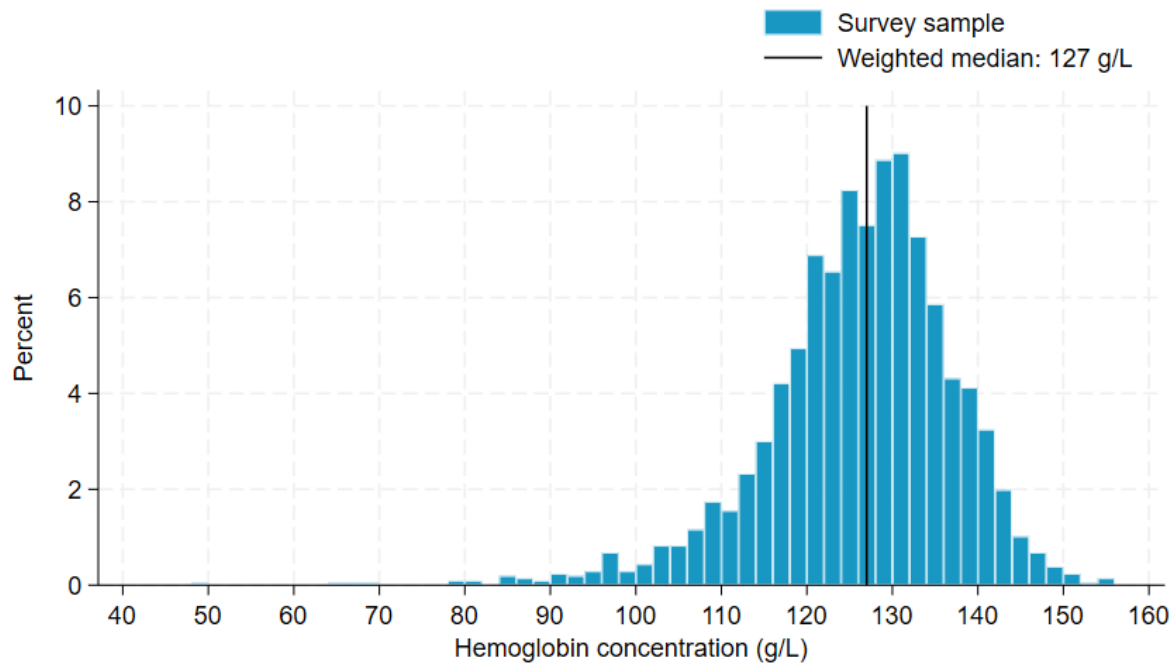


Figure 32. Distribution of adjusted hemoglobin (g/L) in adolescent girls 10-19 years, Lebanon 2023

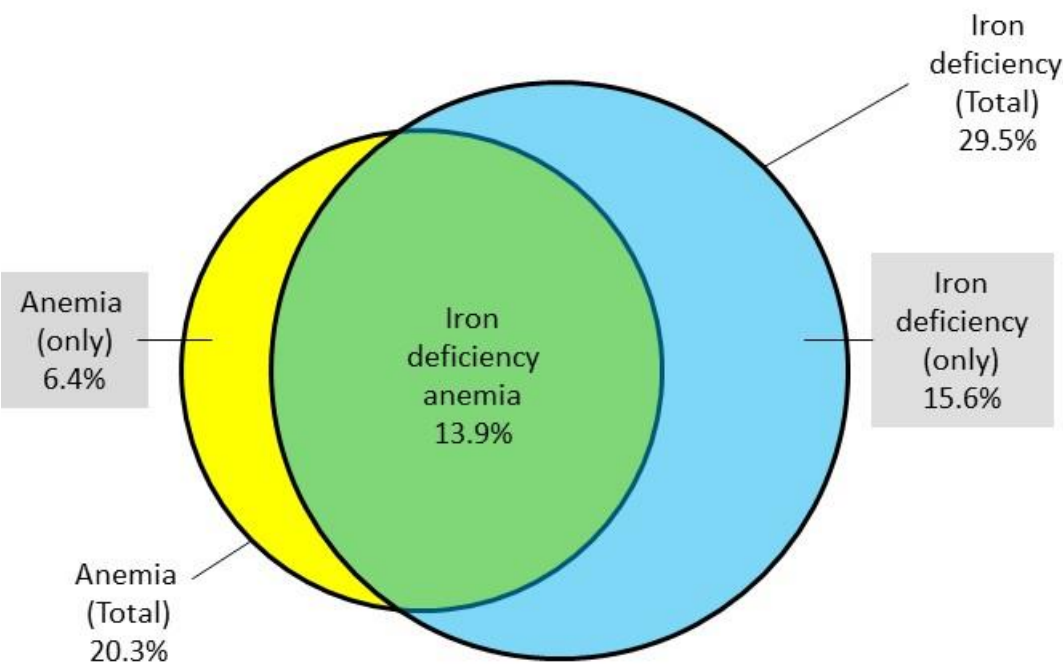


Figure 33. Venn diagram showing overlap between anemia and iron deficiency in adolescent girls 10-19 years old age, Lebanon 2023

Table 54. Prevalence of anemia, iron deficiency, and iron deficiency anemia in adolescent girls 10-19 years by various demographic characteristics, Lebanon 2023

Characteristic	Anemia ^d				Iron deficiency ^e				Iron deficiency anemia ^f			
	N	% ^a	95% CI ^b	p-value ^c	N	% ^a	95% CI ^b	p-value ^c	N	% ^a	95% CI ^b	p-value ^c
Nationality				0.150				0.084				0.130
Lebanese	1356	18.9	[14.9,23.8]		1363	27.2	[22.3,32.7]		1342	12.3	[8.7,17.3]	
Syrian	601	23.1	[17.0,30.6]		602	33.8	[27.1,41.3]		590	16.8	[11.9,23.4]	
Palestinian	91	30.6	[18.8,45.6]		94	40.8	[29.1,53.8]		90	23.4	[12.1,40.5]	
Age group (in years)				<0.001				<0.001				<0.001
10-12	739	12.2	[8.1,17.8]		743	19.9	[15.5,25.3]		729	6.5	[3.9,10.5]	
13-15	627	20.2	[15.9,25.2]		635	34.1	[28.0,40.8]		621	14.2	[10.4,19.1]	
16-19	696	28.4	[22.2,35.5]		695	34.5	[27.7,42.0]		686	20.7	[14.5,28.7]	
Menstruation				<0.001				<0.001				<0.001
Menarche	1435	23.7	[19.4,28.6]		1443	34.1	[29.1,39.6]		1416	17.4	[13.3,22.4]	
Pre-menarche	620	12.1	[7.6,18.6]		623	17.9	[12.6,24.9]		613	5.2	[2.8,9.4]	
Period bleeding				0.005				0.005				0.006
Severe	300	33.7	[25.9,42.5]		303	44.8	[35.1,55.0]		293	26.9	[19.4,36.2]	
Moderate	924	21.0	[16.6,26.1]		926	32.2	[26.9,38.1]		914	14.7	[10.7,19.8]	
Mild/ minimal	169	18.0	[10.3,29.6]		170	23.9	[15.2,35.4]		167	12.9	[6.2,25.1]	
Governorate				0.479				0.605				0.727
Akkar	202	20.4	[14.6,27.8]		214	26.1	[18.3,35.9]		201	9.5	[5.6,15.7]	
Baalbek-Hermel	247	20.8	[15.6,27.3]		246	30.1	[23.1,38.2]		245	14.0	[9.3,20.7]	
Beirut	220	24.5	[17.8,32.7]		217	35.0	[27.8,42.9]		216	19.1	[12.8,27.6]	
Bekaa	207	21.1	[15.2,28.4]		204	28.2	[18.7,40.3]		204	12.3	[6.8,21.2]	
El Nabatieh	241	16.7	[12.0,22.8]		237	25.5	[19.2,33.0]		237	11.1	[7.0,17.2]	
Mount Lebanon	156	19.4	[10.4,33.4]		155	28.4	[18.2,41.5]		154	15.2	[7.8,27.5]	
North	310	22.6	[17.7,28.5]		316	32.9	[26.5,40.0]		305	13.1	[8.7,19.2]	
South	224	16.8	[9.8,27.3]		226	27.0	[20.4,35.0]		223	12.0	[5.2,25.3]	
Palestinian camps	89	33.7	[20.1,50.7]		88	42.0	[24.9,61.2]		88	16.0	[8.8,27.4]	
Syrian ITS	166	22.1	[15.5,30.3]		170	30.2	[22.8,38.9]		163	17.0	[12.1,23.5]	

Table continued on next page

Characteristic	Anemia ^d				Iron deficiency ^e				Iron deficiency anemia ^f			
	N	% ^a	95% CI ^b	p-value ^c	N	% ^a	95% CI ^b	p-value ^c	N	% ^a	95% CI ^b	p-value ^c
Wealth quintile				0.853				0.172				0.421
Lowest	600	19.9	[14.1,27.3]		603	30.3	[24.0,37.5]		590	13.2	[9.1,18.7]	
Second	403	20.3	[13.7,29.0]		403	25.1	[18.3,33.3]		399	12.2	[6.8,21.0]	
Middle	389	18.1	[11.9,26.6]		388	28.1	[20.7,36.9]		381	10.7	[5.9,18.7]	
Fourth	381	24.2	[14.2,38.0]		385	38.8	[26.8,52.4]		379	20.5	[10.6,35.7]	
Highest	289	19.5	[12.7,28.8]		294	24.6	[17.9,32.6]		287	13.3	[7.8,21.7]	
Household food insecurity access				0.575				0.553				0.396
Secure	536	23.7	[15.5,34.5]		537	33.5	[23.5,45.1]		529	17.2	[9.8,28.5]	
Mild	179	16.8	[11.4,24.2]		180	25.3	[16.1,37.5]		176	10.7	[6.2,17.8]	
Moderate	663	19.2	[14.2,25.5]		665	28.7	[22.8,35.4]		654	14.2	[9.8,20.1]	
Severe	684	19.2	[13.9,25.9]		691	27.7	[23.3,32.6]		677	11.4	[8.0,16.0]	
Household sanitation ^g				0.156				0.006				0.221
Inadequate	103	30.4	[16.8,48.5]		101	57.1	[35.2,76.6]		98	21.8	[10.0,41.3]	
Adequate	1930	19.8	[15.8,24.5]		1943	28.1	[23.9,32.7]		1909	13.5	[10.2,17.7]	
Safe drinking water ^h				0.623				0.404				0.873
Yes	1845	20.2	[16.0,25.1]		1855	29.8	[25.3,34.7]		1820	13.8	[10.3,18.3]	
No	215	22.7	[15.0,32.7]		216	25.7	[18.6,34.4]		214	14.5	[8.8,22.9]	
TOTAL SAMPLE	2062	20.3	[16.5,24.9]		2073	29.5	[25.3,34.0]		2036	13.9	[10.6,18.0]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^d Anemia defined as hemoglobin < 115 g/L for girls < 12 years of age and < 120 g/L for girls ≥ 12 years of age; hemoglobin adjusted for elevation and smoking [118]. ^e Iron deficiency defined as plasma ferritin < 15 µg/L; ferritin adjusted for inflammation [88]. ^f Iron deficiency anaemia defined as plasma ferritin < 15 µg/L and hemoglobin < 115 g/L for girls < 12 years of age or < 120 g/L for girls ≥ 12 years of age; ferritin adjusted for inflammation [88].

^g Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^h Composite variable of main source of drinking water and treating water to make safe for drinking.

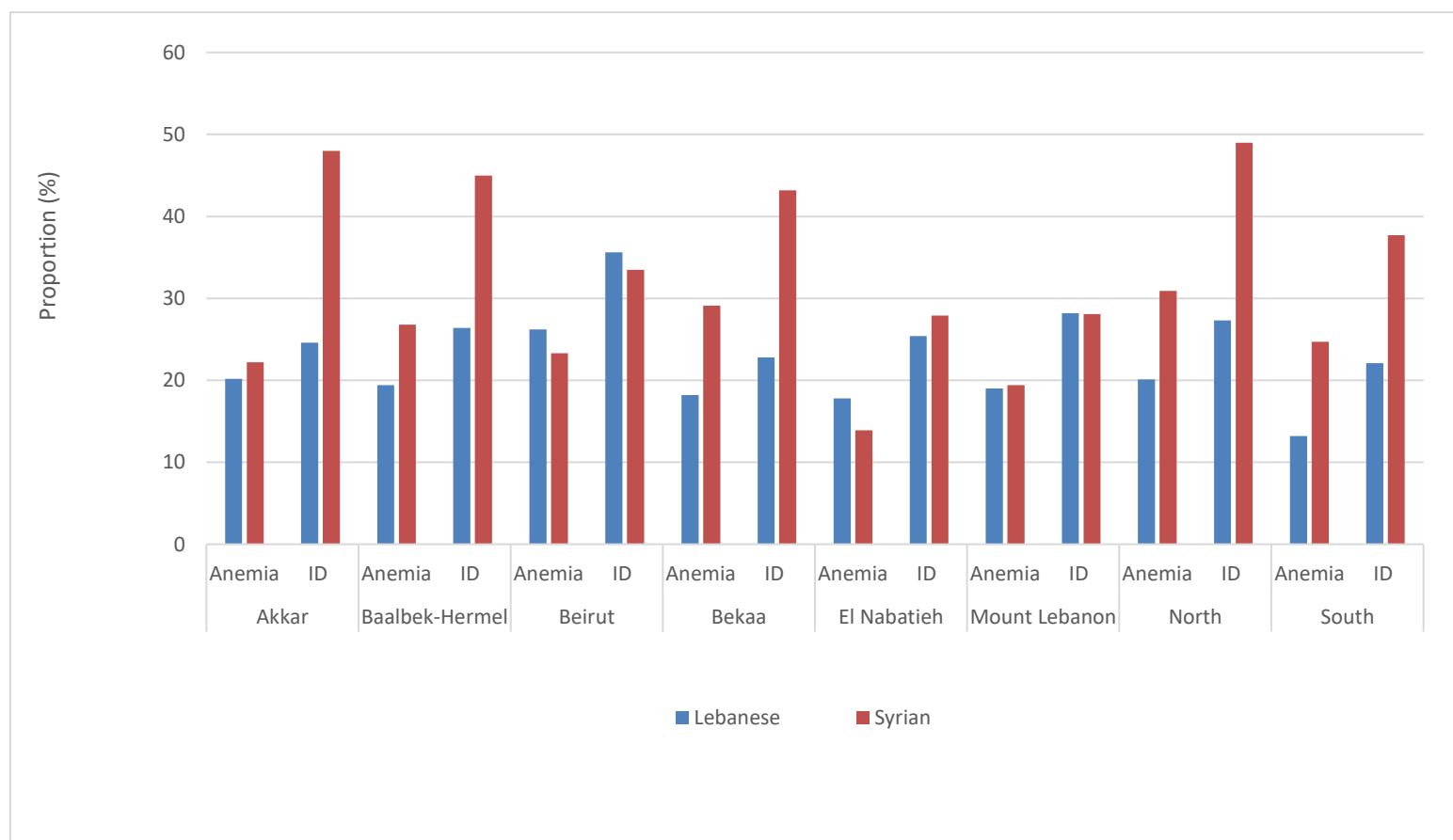


Figure 34. Anemia and iron deficiency prevalence by nationality in the different governorate strata (excluding Syrian ITS and Palestinian camps strata) in adolescent girls 10-19 years, Lebanon 2023

3.4.12. *Vitamin A deficiency*

The prevalence of vitamin A deficiency in adolescent girls is low and denotes a mild public health problem according to WHO classification [101]. None of the investigated variables are significantly associated with vitamin A deficiency.

3.4.13. *Folate and vitamin B12 deficiency*

As shown in Table 56, folate deficiency affects approximately 15% of adolescent girls. The deficiency prevalence is significantly associated with age and menarche status, with higher prevalences found in girls 16-19 years of age and menarche girls. Conversely, folate deficiency is significantly lower in married adolescent girls, despite the average age of married adolescent girls (i.e., 17.9 years) being higher than that of unmarried girls (i.e., 14.4 years). In addition, folate deficiency is significantly associated with nationality and stratum, with the lowest prevalences found in Syrian girls and in girls residing in the Syrian ITS stratum. The highest prevalence of folate deficiency was found in Mount Lebanon. Lastly, wealth quintile is significantly associated with folate deficiency, with the prevalence increasing as wealth quintile increased; in the fourth and highest quintiles approximately 25% of adolescent girls are folate deficient.

The prevalence of vitamin B12 deficiency is shown in Table 57. Similar to folate deficiency, vitamin B12 deficiency is significantly higher in girls 16-19 years of age and menarche girls. Despite the higher mean age of married girls, the prevalence of vitamin B12 deficiency is also lower in girls who are married compared to unmarried girls. In contrast to the folate results, the vitamin B12 deficiency prevalence is significantly higher in Syrian girls compared to Lebanese or Palestinian girls.

Figure 35 presents the prevalence of folate and B12 deficiencies by nationality within each governorate⁹. The prevalence of folate deficiency is significantly higher in Lebanese girls in Beirut and Mount Lebanon governorates, and vitamin B12 deficiency is significantly higher in Syrian girls in the North governorate. All other associations are not statistically significant.

⁹ Figure 35 Figure 23excludes Palestinian nationality because of the small number of Palestinian girls in each governorate.

Table 55. Prevalence of vitamin A deficiency in adolescent girls 10-19 years by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with vitamin A deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				0.203
Lebanese	1363	3.2	[1.9,5.3]	
Syrian	602	5.6	[3.1,9.7]	
Palestinian	94	2.6	[0.6,10.6]	
Age group (in years)				0.674
10-12	743	4.8	[2.9,8.0]	
13-15	635	3.7	[1.8,7.6]	
16-19	695	3.1	[1.2,7.5]	
Menstruation				0.207
Menarche	1443	3.3	[1.9,5.5]	
Pre-menarche	623	5.4	[3.2,8.9]	
Stratum				0.871
Akkar	214	4.8	[1.8,11.9]	
Baalbek-Hermel	246	3.1	[1.2,7.9]	
Beirut	217	3.8	[1.8,7.9]	
Bekaa	204	4.8	[2.2,10.1]	
El Nabatieh	237	2.4	[1.2,5.0]	
Mount Lebanon	155	4.0	[1.8,8.7]	
North	316	3.0	[1.4,6.4]	
South	226	5.8	[2.3,14.0]	
Palestinian camps	88	4.8	[1.8,12.1]	
Syrian ITS	170	2.7	[1.0,7.2]	
Wealth quintile				0.108
Lowest	603	6.3	[3.5,11.0]	
Second	403	3.9	[1.6,9.0]	
Middle	388	2.2	[0.9,5.2]	
Fourth	385	4.3	[1.8,10.0]	
Highest	294	1.2	[0.4,3.1]	
Household food insecurity access				0.156
Secure	537	6.1	[3.0,11.9]	
Mild	180	2.8	[1.1,7.1]	
Moderate	665	2.6	[1.5,4.6]	
Severe	691	3.4	[2.0,5.6]	
Household sanitation^e				0.658
Inadequate	101	5.6	[1.0,25.0]	
Adequate	1943	3.8	[2.5,5.5]	
Safe drinking water^f				0.139
Yes	1855	4.1	[2.8,5.8]	
No	216	1.9	[0.7,5.0]	
TOTAL SAMPLE	2073	3.9	[2.7,5.5]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin A deficiency defined as (retinol binding protein) RBP < 0.62 µmol/L.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

Table 56. Prevalence of folate deficiency in adolescent girls 10-19 years by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with folate deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				<0.001
Lebanese	1360	17.5	[12.7,23.7]	
Syrian	599	6.9	[4.6,10.4]	
Palestinian	89	15.1	[7.9,27.0]	
Age group (in years)				<0.001
10-12	738	6.6	[4.0,10.7]	
13-15	628	16.3	[11.6,22.3]	
16-19	696	20.2	[14.3,27.6]	
Menstruation				<0.001
Menarche	1437	17.4	[13.3,22.4]	
Pre-menarche	618	6.6	[3.9,11.0]	
Marital status				0.023
Never married	1968	14.7	[11.3,19.1]	
Married	81	5.1	[1.9,13.1]	
Stratum				0.046
Akkar	203	6.3	[3.8,10.4]	
Baalbek-Hermel	247	7.3	[3.9,13.5]	
Beirut	217	16.4	[10.0,25.7]	
Bekaa	206	12.1	[6.8,20.6]	
El Nabatieh	242	11.8	[7.5,18.0]	
Mount Lebanon	157	17.6	[9.5,30.1]	
North	311	15.1	[10.8,20.9]	
South	226	17.0	[12.0,23.6]	
Palestinian camps	86	15.1	[7.2,28.9]	
Syrian ITS	167	4.5	[2.2,8.7]	
Wealth quintile				0.001
Lowest	599	5.9	[3.9,9.0]	
Second	402	9.3	[5.9,14.4]	
Middle	390	12.5	[7.5,19.9]	
Fourth	380	25.3	[13.0,43.4]	
Highest	291	25.2	[16.2,37.1]	
Household food insecurity access				0.109
Secure	536	20.8	[11.9,33.8]	
Mild	180	13.5	[6.9,25.0]	
Moderate	665	13.7	[8.5,21.3]	
Severe	681	9.4	[6.7,13.1]	
Household sanitation^e				0.249
Inadequate	104	19.3	[11.7,30.3]	
Adequate	1929	14.1	[10.6,18.6]	
Safe drinking water^f				0.366
Yes	1843	14.6	[11.0,19.1]	
No	217	11.1	[6.4,18.7]	
TOTAL	2062	14.4	[11.0,18.5]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection. // ^b Folate deficiency defined as plasma folate < 10 nmol/L.

^c CI = confidence interval, calculated taking into account the complex sampling design. // ^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. // ^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

Table 57. Prevalence of vitamin B12 deficiency in adolescent girls 10-19 years by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with vitamin B12 deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				0.020
Lebanese	1359	15.5	[11.8,20.3]	
Syrian	598	22.9	[17.9,28.8]	
Palestinian	89	15.3	[8.6,25.9]	
Age group (in years)				<0.001
10-12	738	11.1	[8.0,15.2]	
13-15	627	18.7	[13.9,24.7]	
16-19	695	23.1	[18.2,28.8]	
Menstruation				0.003
Menarche	1435	19.9	[16.1,24.3]	
Pre-menarche	618	12.0	[8.3,17.0]	
Marital status				0.003
Never married	1967	16.9	[13.6,20.8]	
Married	80	39.8	[23.5,58.8]	
Stratum				0.119
Akkar	203	14.4	[9.1,21.8]	
Baalbek-Hermel	247	28.1	[20.0,37.8]	
Beirut	217	18.2	[11.6,27.4]	
Bekaa	206	22.3	[15.0,31.7]	
El Nabatieh	242	19.0	[12.9,27.1]	
Mount Lebanon	157	13.5	[6.6,25.7]	
North	311	20.4	[15.3,26.8]	
South	225	17.0	[10.0,27.6]	
Palestinian camps	86	6.7	[2.9,14.7]	
Syrian ITS	166	24.3	[17.7,32.4]	
Wealth quintile				0.114
Lowest	598	20.6	[16.0,26.3]	
Second	402	18.2	[12.0,26.6]	
Middle	390	19.0	[13.2,26.5]	
Fourth	380	20.1	[10.2,35.8]	
Highest	290	7.7	[5.1,11.4]	
Household food insecurity access				0.091
Secure	535	15.2	[8.4,25.8]	
Mild	180	9.1	[5.5,14.8]	
Moderate	665	17.0	[12.9,22.0]	
Severe	680	22.8	[18.5,27.8]	
Household sanitation^e				0.217
Inadequate	103	26.4	[13.4,45.2]	
Adequate	1928	17.1	[13.7,21.2]	
Safe drinking water^f				0.229
Yes	1842	18.0	[14.5,22.2]	
No	216	13.3	[8.3,20.5]	
TOTAL SAMPLE	2060	17.7	[14.4,21.5]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection. // ^b Vitamin B12 deficiency defined as serum vitamin B12 < 150 pmol/L.

^c CI = confidence interval, calculated taking into account the complex sampling design. // ^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. // ^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

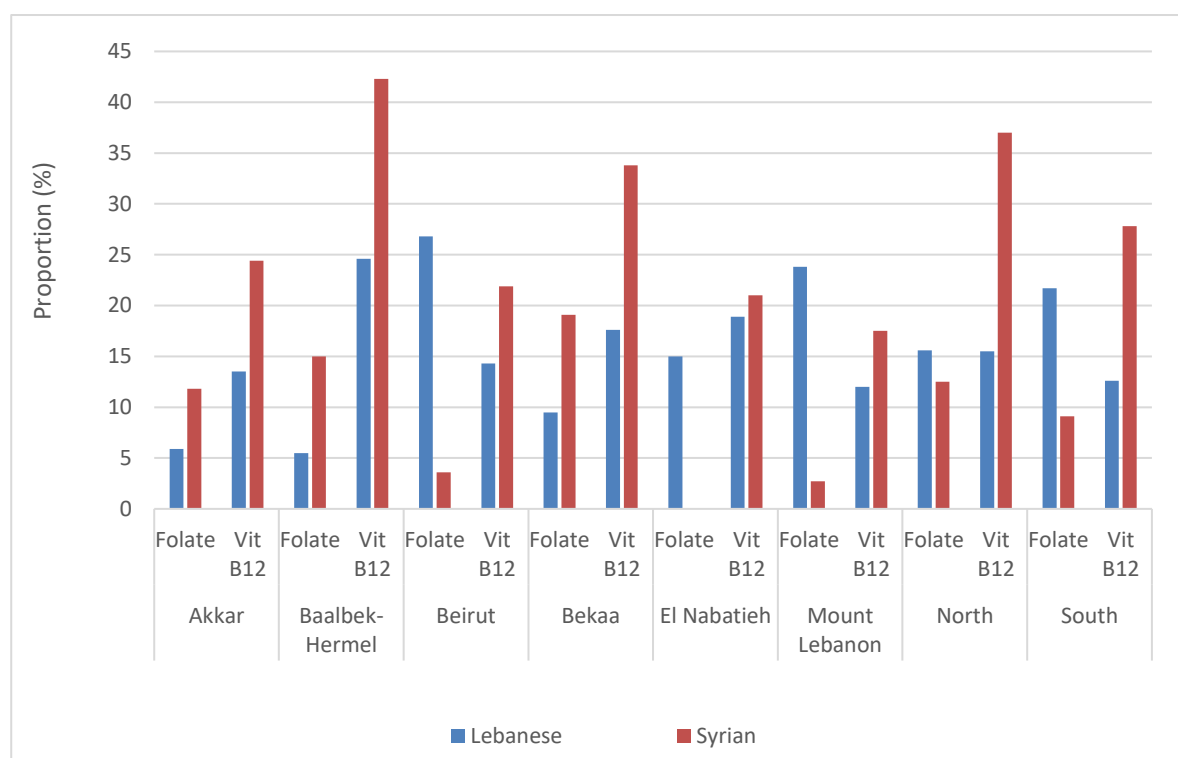


Figure 35. Folate and vitamin B12 deficiency prevalence by nationality in the different governorate strata (excluding Syrian ITS and Palestinian camps strata) in adolescent girls 10-19 years, Lebanon 2023

3.4.14. Vitamin D deficiency

As shown in Table 58, vitamin D deficiency and insufficiency are very common among adolescent girls. Approximately 42% and 37% of girls are deficient and insufficient in vitamin D, respectively, and combined vitamin D deficiency *and* insufficiency is found in almost 80% of girls. Impaired vitamin D status is significantly associated with age group and increases with age. Moreover, the prevalence in menarche girls is significantly higher than in pre-menarche girls, but this finding is likely to be due to the higher age of menarche girls. Impaired vitamin D status is also significantly related to stratum and nationality. Vitamin D deficiency and insufficiency are highest in the Syrian ITS and Palestinian Camp strata and the prevalence is significantly lower in Lebanese girls than in Syrian and Palestinian girls. The prevalences of vitamin D deficiency and combined deficiency/insufficiency decrease as household wealth increases; girls in higher wealth households have significantly lower prevalences of vitamin D deficiency/insufficiency.

Lastly, the prevalence of impaired vitamin D status is substantially higher among girls with little sun exposure (i.e., sun exposure index < 10) and among girls who wear a hijab.

Table 58. Prevalence of vitamin D deficiency in adolescent girls 10-19 years by various demographic characteristics, Lebanon 2023

Characteristic	N	Deficient ^a				Insufficient ^b		Deficient or insufficient		
		% ^c	[95% CI] ^d	p-value ^e		% ^c	[95% CI] ^d	% ^c	[95% CI] ^d	p-value ^e
Nationality				<0.001						<0.001
Lebanese	1359	29.4	[24.6,34.6]			42.8	[38.0,47.7]	72.2	[67.2,76.7]	
Syrian	598	68.1	[60.5,74.8]			23.4	[18.0,29.8]	91.5	[87.0,94.5]	
Palestinian	89	65.6	[45.0,81.6]			25.2	[11.8,45.7]	90.7	[75.9,96.8]	
Age group (in years)				0.011						0.143
10-12	738	34.4	[27.8,41.6]			39.4	[34.5,44.4]	73.7	[67.5,79.1]	
13-15	627	42.6	[35.1,50.5]			35.9	[30.1,42.2]	78.5	[71.7,84.1]	
16-19	695	48.4	[41.2,55.7]			34.4	[27.3,42.3]	82.8	[75.0,88.5]	
Menstruation				0.049						0.003
Menarche	1435	44.4	[38.5,50.4]			37.0	[31.5,42.9]	81.4	[76.8,85.2]	
Pre-menarche	618	35.0	[27.6,43.2]			35.5	[29.9,41.6]	70.5	[63.4,76.7]	
Stratum				0.004						0.013
Akkar	203	44.0	[31.5,57.3]			32.3	[24.7,40.9]	76.3	[65.0,84.7]	
Baalbek-Hermel	247	42.6	[32.6,53.4]			43.3	[35.1,52.0]	86.0	[78.8,91.0]	
Beirut	217	46.3	[36.3,56.6]			32.5	[23.7,42.7]	78.8	[65.8,87.8]	
Bekaa	206	38.1	[30.5,46.2]			43.7	[35.4,52.4]	81.8	[74.2,87.5]	
El Nabatieh	242	34.9	[27.7,42.9]			38.8	[31.4,46.8]	73.8	[67.6,79.1]	
Mount Lebanon	157	35.3	[24.9,47.2]			36.4	[26.9,47.1]	71.6	[61.7,79.8]	
North	311	43.0	[29.5,57.6]			37.4	[28.3,47.5]	80.4	[70.5,87.5]	
South	225	48.1	[35.5,60.9]			37.4	[29.4,46.1]	85.4	[76.7,91.3]	
Palestinian camps	86	79.6	[69.9,86.8]			17.1	[11.4,24.9]	96.7	[90.2,98.9]	
Syrian ITS	166	63.0	[54.5,70.8]			27.7	[20.9,35.7]	90.7	[86.0,93.9]	

Table continued on next page

Characteristic	Deficient ^a				Insufficient ^b		Deficient or insufficient		
	N	% ^c	[95% CI] ^d	p-value ^e	% ^c	[95% CI] ^d	% ^c	[95% CI] ^d	p-value ^e
Wealth quintile				<0.001					<0.001
Lowest	598	58.4	[49.9,66.4]		29.5	[23.4,36.4]	87.9	[82.8,91.6]	
Second	402	47.1	[36.0,58.5]		37.4	[28.6,47.3]	84.6	[78.7,89.1]	
Middle	390	39.0	[30.3,48.3]		41.2	[32.5,50.6]	80.2	[72.5,86.1]	
Fourth	380	31.8	[24.5,40.1]		39.0	[32.2,46.2]	70.7	[61.9,78.3]	
Highest	290	21.5	[15.2,29.5]		39.3	[30.2,49.1]	60.8	[49.7,70.9]	
Household food insecurity access				0.001					0.046
Secure	535	32.1	[25.6,39.3]		40.8	[34.2,47.7]	72.8	[65.1,79.4]	
Mild	180	33.2	[22.6,45.8]		40.2	[27.6,54.2]	73.4	[59.5,83.9]	
Moderate insecure	665	41.0	[32.3,50.4]		37.9	[30.3,46.1]	78.9	[72.3,84.3]	
Severe	680	53.6	[45.3,61.7]		30.6	[25.0,36.8]	84.2	[79.0,88.3]	
Household sanitation				0.033					0.207
Inadequate	103	62.9	[40.6,80.7]		25.0	[11.8,45.3]	87.8	[70.0,95.7]	
Adequate	1928	40.6	[35.8,45.5]		37.3	[33.1,41.6]	77.8	[73.8,81.4]	
Safe drinking water ^g				0.701					0.763
Yes	1842	41.6	[36.6,46.9]		36.9	[32.6,41.4]	78.5	[74.4,82.1]	
No	216	44.3	[31.2,58.3]		32.6	[23.2,43.5]	76.9	[65.2,85.5]	
Sun exposure index				<0.0010					<0.001
< 10	1062	57.1	[49.6,64.2]		29.3	[23.5,35.9]	86.4	[81.7,90.1]	
10-20	126	18.3	[10.5,30.1]		56.1	[42.8,68.5]	74.4	[60.7,84.6]	
≥ 20	468	16.3	[11.4,22.8]		48.1	[41.0,55.2]	64.4	[56.8,71.3]	
Girl wears hijab				<0.001					<0.001
Yes	1135	66.2	[59.9,72.0]		26.6	[21.3,32.6]	92.8	[90.5,94.6]	
No	918	20.1	[14.9,26.7]		45.4	[39.4,51.5]	65.5	[59.7,70.9]	
TOTAL SAMPLE	2060	41.8	[36.9,47.0]		36.6	[32.5,40.8]	78.4	[74.5,81.8]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Vitamin D deficiency defined as serum vitamin D 25(OH) < 12 ng/mL; vitamin D 25(OH) concentrations below the limit of detection (< 3 ng/mL; n=18) were recoded to 3 ng/mL.

^b Vitamin D insufficiency defined as serum vitamin D 25(OH) 12-19.9 ng/mL.

^c Percentages weighted for unequal probability of selection.

^d CI = confidence interval, calculated taking into account the complex sampling design.

^e Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^f Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^g Composite variable of main source of drinking water and treating water to make safe for drinking.

3.4.15. Zinc deficiency

The prevalence of zinc deficiency is shown in Table 59. None of the investigated demographic indicators is statistically significantly associated with zinc deficiency, which might be owed to the small number of observations. Although not achieving statistical significance, the prevalence is highest among adolescent girls 16-19 years of age and menarche girls, with between 40% and 50% affected.

Table 59. Prevalence of zinc deficiency in adolescent girls 10-19 years by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with zinc deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				0.491
Lebanese	270	40.6	[29.6,52.6]	
Syrian	115	33.0	[17.5,53.2]	
Palestinian	19	26.1	[10.7,51.2]	
Age group (in years)				0.054
10-12	138	26.6	[17.7,38.0]	
13-15	126	33.8	[23.9,45.4]	
16-19	141	49.3	[31.7,67.1]	
Menstruation				0.062
Menarche	286	42.0	[30.4,54.5]	
Pre-menarche	118	27.4	[18.0,39.4]	
Wealth quintile				0.135
Lowest	109	28.2	[18.9,39.9]	
Second	77	58.0	[34.6,78.4]	
Middle	69	26.5	[12.1,48.4]	
Fourth	88	36.0	[20.0,55.9]	
Highest	62	45.7	[23.7,69.5]	
Household food insecurity access				0.723
Secure	102	36.9	[20.8,56.5]	
Mild	33	43.5	[22.6,66.9]	
Moderate	125	44.0	[26.8,62.8]	
Severe	145	33.8	[21.5,48.8]	
Household sanitation^e				0.687
Inadequate	29	31.2	[8.1,69.8]	
Adequate	367	38.1	[28.8,48.3]	
Safe drinking water^f				0.642
Yes	359	38.7	[29.2,49.1]	
No	46	32.0	[11.1,64.1]	
TOTAL SAMPLE	405	38.1	[28.5,48.8]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. Zinc deficiency measured in a 20% sub-sample of adolescent girls.

^a Percentages weighted for unequal probability of selection.

^b Zinc deficiency defined as serum zinc < 70 µg/dL for morning samples in a fasting state, < 66 µg/dL morning sample in a nonfasting state, and < 59 µg/dL afternoon sample in a nonfasting state [80]

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. ^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

3.4.16. Iodine deficiency

Table 60 presents the iodine status of *non-pregnant* adolescent girls. The national median urinary iodine concentration (mUIC) is approximately 131 µg/L, indicating an adequate iodine status. Significant differences were observed by nationality, stratum, household salt iodization status, household sanitation, and access to safe drinking water. Despite these differences, adolescent girls in all subgroups are considered have adequate iodine status (i.e., mUIC 100-299 µg/L). Among the strata, the highest UIC concentration was found in girls living in the Palestinian camps and Akkar. Moreover, girls of Palestinian nationality have the highest UIC concentration.

The mUIC is significantly lower in girls living in households consuming non-iodized salt. While these girls are still classified as having adequate iodine status, their mUIC is the lowest possible concentration in the adequate status category (i.e., 100 µg/L). Surprisingly, girls living in households with inadequate sanitation and those without access to safe drinking water have significantly higher UIC concentrations compared to girls living in households with adequate sanitation and access to drinking water, respectively. Figure 36 presents the prevalence of mUIC of adolescent girls by nationality within each governorate ¹⁰. Notably, the mUIC of Syrian girls residing in El Nabatieh and Mount Lebanon were 75 µg/L and 74 µg/L, respectively, denoting a mild iodine insufficiency.

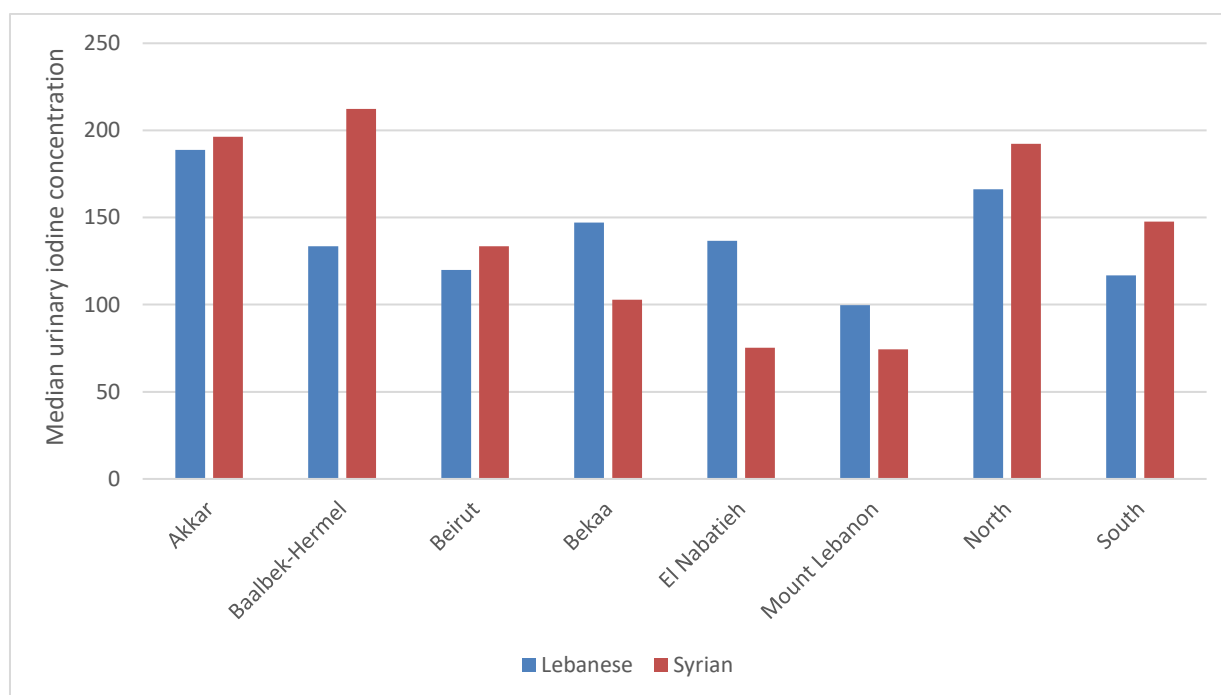


Figure 36. Median urinary iodine concentration by nationality in the different governorates (excluding Syrian ITS and Palestinian camps strata) in adolescent girls 10-19 years, Lebanon 2023

¹⁰ Figure 36 excludes Palestinian nationality because of the small number of Palestinian girls in each governorate.

Table 60. Median urinary iodine concentration in adolescent girls 10-19 years, Lebanon 2023

Characteristic	N	Median UIC ^a	[95% CI] ^b	p-value ^c
Nationality				<0.001
Lebanese	1205	129	[122,144]	
Syrian	567	130	[108,140]	
Palestinian	88	164	[153,192]	
Age group (in years)				0.071
10-12	688	123	[116,138]	
13-15	571	146	[129,153]	
16-19	615	124	[114,141]	
Menstruation				0.054
Menarche	1293	138	[124,147]	
Pre-menarche	575	124	[112,134]	
Stratum				<0.001
Akkar	211	189	[157,194]	
Baalbek-Hermel	231	145	[129,169]	
Beirut	207	119	[105,147]	
Bekaa	200	141	[117,157]	
El Nabatieh	153	118	[101,138]	
Mount Lebanon	138	100	[88,124]	
North	319	173	[147,190]	
South	163	129	[121,141]	
Palestinian camps	83	192	[150,219]	
Syrian ITS	169	138	[117,153]	
Wealth quintile				0.137
Lowest	573	131	[114,144]	
Second	379	148	[131,165]	
Middle	354	126	[105,144]	
Fourth	318	124	[112,157]	
Highest	250	123	[113,143]	
Household food insecurity access				0.637
Secure	467	116	[106,141]	
Mild	137	129	[110,152]	
Moderate	610	146	[122,152]	
Severe	660	135	[121,147]	
Household salt iodization				<0.001
None (<5 ppm)	281	100	[79,113]	
Insufficient (5-14.9 ppm)	142	137	[103,160]	
Adequate ($\geq$ 15 ppm)	520	147	[140,169]	
Household sanitation ^d				0.033
Inadequate	103	182	[137,195] ^f	
Adequate	1745	131	[121,140]	
Safe drinking water ^e				0.014
Yes	1668	129	[120,140]	
No	204	167	[138,192]	
TOTAL SAMPLE	1874	131	[122,141]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Medians weighted for unequal probability of selection; UIC = urinary iodine concentration. // ^b CI = confidence interval, calculated taking into account the complex sampling design using box-cox transformed values. // ^c Chi-square p-value <0.05 indicates that the mean of the box-cox transformed urinary iodine concentration in one subgroup is significantly different from the values in at least one other subgroup. // ^d Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. // ^e Composite variable of main source of drinking water and treating water to make safe for drinking. // ^f Confidence intervals were calculated based on box cox transformed UIC data for all strata except Akkar, Beirut, Mount Lebanon, and South. These strata were excluded from the calculation of CIs for this subgroup since these strata had <5 adolescent girls residing in households with inadequate sanitation. The small N's in these strata caused instability in the estimation of the confidence intervals for this subgroup, and had to be excluded for the CI calculation only.

3.4.17. Associations between micronutrient deficiencies and various factors

Table 61 displays the associations between anemia and various health and nutritional factors. The prevalence of anemia among iron-deficient adolescent girls is almost five times higher than the prevalence in iron-replete girls. Moreover, a substantially larger proportion of vitamin B12 deficient girls are anemic compared to those that are sufficient in vitamin B12. The anemia prevalence is significantly higher in girls with inflammation than in those without, and higher among girls that took multivitamin supplements in the past 6 months compared to those who did not consume multivitamin supplements.

Health and nutritional factors associated with ID are presented in Table 62. The prevalence of ID is significantly higher in adolescent girls that are deficient in vitamin A, folate, vitamin B12, and vitamin D (deficiency/insufficiency). The ID prevalence is two times higher in vitamin A deficient girls and about 50% higher vitamin D deficient/insufficient girls. The ID prevalence is about 60% higher in girls with vitamin B12 and folate deficiencies. No statistically significant associations were found between ID and the other potential risk factors.

Table 61. Correlation between anemia and various factors in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	% ^a with anemia ^b	p-value ^c
Girl had diarrhea			0.187
Yes	146	28.3	
No	1903	19.9	
Girl had fever			0.730
Yes	186	22.0	
No	1863	20.2	
Girl had lower respiratory infection			0.486
Yes	43	27.7	
No	2006	20.2	
Girl had minimum dietary diversity			0.091
Yes	1060	23.3	
No	995	17.1	
Girl took iron tablet or syrup in past six months			0.973
Yes	150	20.1	
No	1900	20.2	
Girl took folate supplement in past six			0.606
Yes	28	24.6	
No	2015	20.3	
Girl took multivitamin supplement in past six months			0.009
Yes	72	6.8	
No	1972	20.8	
Girl consumes coffee or tea during or directly after meal			0.338
Yes	1311	21.5	
No	744	18.1	

Table continued on next page

Characteristic	N	% ^a with anemia ^b	p-value ^c
Girl with thin			0.634
Yes	57	15.5	
No	1968	20.3	
Girl overweight or obese			0.887
Yes	630	19.8	
No	1395	20.3	
Girl has inflammation			0.006
Yes	624	26.8	
No	1412	17.3	
Girl iron deficient			<0.001
Yes	604	46.9	
No	1432	9.3	
Girl vitamin A deficient			0.175
Yes	70	33.4	
No	1966	19.9	
Girl folate deficient			0.138
Yes	258	28.2	
No	1796	19.0	
Girl B12 deficient			0.023
Yes	397	28.8	
No	1657	18.5	
Girl vitamin D deficient/ insufficient			0.205
Yes	1661	21.4	
No	393	16.4	
Girl zinc deficient^d			0.905
Yes	143	21.5	
No	253	20.5	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Anemia defined as hemoglobin < 115 g/L for girls < 12 years of age and < 120 g/L for girls ≥ 12 years of age; hemoglobin adjusted for elevation and smoking [118].

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of adolescent girls.

Table 62. Correlation between iron deficiency and various factors in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	% ^a with iron deficiency ^b	p-value ^c
Girl had diarrhea			0.918
Yes	146	30.2	
No	1914	29.5	
Girl had fever			0.104
Yes	186	40.6	
No	1874	28.3	
Girl had lower respiratory infection			0.407
Yes	44	37.6	
No	2016	29.3	
Girl had minimum dietary diversity			0.175
Yes	1071	32.1	
No	995	26.6	
Girl took iron tablet or syrup in past six months			0.882
Yes	148	28.8	
No	1913	29.6	
Girl took multivitamin supplement in past six months			0.742
Yes	72	26.7	
No	1982	29.6	
Girl consumes coffee or tea during or directly after meal			0.789
Yes	1315	29.2	
No	751	30.3	
Girl thin			0.356
Yes	58	20.2	
No	1980	29.8	
Girl overweight or obese			0.641
Yes	634	30.6	
No	1404	29.1	
Girl had inflammation			0.630
Yes	637	28.4	
No	1436	30.0	
Girl vitamin A deficient			0.003
Yes	73	54.3	
No	2000	28.5	
Girl folate deficient			0.027
Yes	256	43.9	
No	1776	27.0	
Girl B12 deficient			0.001
Yes	391	45.7	
No	1639	26.0	
Girl vitamin D deficient/ insufficient			0.033
Yes	1638	31.4	
No	392	22.8	
Girl zinc deficient^d			0.574
Yes	145	20.6	
No	258	25.3	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Iron deficiency defined as plasma ferritin < 15 µg/L; ferritin adjusted for inflammation [88]

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of adolescent girls.

Table 63 displays the associations between vitamin A deficiency and various health and nutritional risk factors. The prevalence of vitamin A deficiency is three times higher in girls who had fever in the past 2 weeks prior to the survey. Moreover, vitamin A deficiency is significantly more prevalent in overweight or obese than in normal weight girls. In addition, a substantially larger proportion of folate deplete girls also have vitamin A deficiency than folate replete girls.

Associations between folate deficiency and various risk factors are shown in Table 64. Of the investigated risk factors, only minimum dietary diversity is correlated with folate status. Surprisingly, a substantially larger proportion of girls achieving minimum dietary diversity are folate deficient than girls living in food poverty.

Table 65 presents the associations between vitamin B12 and various risk factors. The prevalence of vitamin B12 deficiency is significantly lower among girls that consumed vitamin B12 supplements in the past six months compared to girls that did not consume these supplements. In addition, the prevalence of vitamin B12 deficiency is significantly lower in girls that are replete in vitamin D compared to vitamin D deficient/insufficient girls.

Regarding vitamin D deficiency or insufficiency (see Table 66), associations were found with minimum dietary diversity, with a higher prevalence found in those girls achieving minimum dietary diversity. In addition, the prevalence of vitamin D deficiency is substantially lower among girls who took vitamin D supplements in the past 6 months prior to the survey. No correlation between vitamin D deficiency and any other potential risk factor was found.

The associations between zinc deficiency and potential risk factors are presented in Table 67. No correlation was found between zinc deficiency and any of the investigated risk factors.

Table 63. Correlation between vitamin A deficiency and various factors in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	% ^a with vitamin A deficiency ^b	p-value ^c
Girl had diarrhea			0.513
Yes	146	2.9	
No	1914	3.9	
Girl had fever			0.018
Yes	186	9.6	
No	1874	3.2	
Girl had lower respiratory infection			0.971
Yes	44	4.0	
No	2016	3.9	
Girl had minimum dietary diversity			0.190
Yes	1071	2.9	
No	995	5.0	
Girl took vitamin A tablet in past six			0.650
Yes	12	0.0	
No	2048	3.9	
Girl took multivitamin supplement in past six months			0.105
Yes	72	0.9	
No	1982	4.0	
Girl thin			0.828
Yes	58	4.5	
No	1980	3.9	
Girl overweight or obese			<0.001
Yes	634	1.4	
No	1404	4.9	
Girl had inflammation			0.561
Yes	637	4.5	
No	1436	3.6	
Girl folate deficient			0.029
Yes	256	8.5	
No	1776	3.1	
Girl B12 deficient			0.705
Yes	391	4.5	
No	1639	3.7	
Girl vitamin D deficient/ insufficient			0.168
Yes	1638	4.3	
No	392	2.4	
Girl zinc deficient^d			0.441
Yes	145	5.3	
No	258	2.9	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin A deficiency defined as (retinol binding protein) RBP < 0.62 µmol/L.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of adolescent girls.

Table 64. Correlation between folate deficiency and various factors in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	% ^a with folate deficiency ^b	p-value ^c
Girl had diarrhea			0.248
Yes	146	20.2	
No	1903	14.0	
Girl had fever			0.789
Yes	185	13.3	
No	1864	14.5	
Girl had lower respiratory infection			0.171
Yes	42	7.4	
No	2007	14.5	
Girl had minimum dietary diversity			0.001
Yes	1061	19.0	
No	994	9.0	
Girl took folate supplement in past six			0.658
Yes	28	11.1	
No	2015	14.5	
Girl took multivitamin supplement in past six months			0.459
Yes	72	20.7	
No	1972	14.2	
Girl thin			0.080
Yes	57	5.6	
No	1970	14.5	
Girl overweight or obese			0.779
Yes	630	13.5	
No	1397	14.4	
Girl had inflammation			0.180
Yes	623	12.4	
No	1409	15.5	
Girl B12 deficient			0.543
Yes	398	17.3	
No	1662	13.7	
Girl vitamin D deficient/ insufficient			0.125
Yes	1666	13.2	
No	394	18.4	
Girl zinc deficient^d			0.088
Yes	143	25.6	
No	252	13.1	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Folate deficiency defined as plasma folate < 10 nmol/L.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of adolescent girls.

Table 65. Correlation between vitamin B12 deficiency and various factors and in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	% ^a with vitamin B12 deficiency ^b	p-value ^c
Girl had diarrhea			0.679
Yes	146	20.0	
No	1901	17.5	
Girl had fever			0.808
Yes	185	19.1	
No	1862	17.5	
Girl had lower respiratory infection			0.460
Yes	42	12.8	
No	2005	17.8	
Girl's household had adequate sanitation			0.216
Yes	1928	17.1	
No	103	26.4	
Girl's household had safe drinking water			0.229
Yes	1842	18.0	
No	216	13.3	
Girl had minimum dietary diversity			0.202
Yes	1060	15.6	
No	993	20.1	
Girl took folate supplement in past six			0.528
Yes	28	11.4	
No	2013	17.8	
Girl took vitamin B12 supplement in past			0.042
Yes	39	4.7	
No	2006	18.0	
Girl took multivitamin supplement in past six months			0.791
Yes	72	15.5	
No	1970	17.7	
Girl thin			0.736
Yes	57	14.1	
No	1968	17.9	
Girl overweight or obese			0.378
Yes	630	19.7	
No	1395	16.9	
Girl had inflammation			0.356
Yes	622	16.0	
No	1408	18.3	
Girl vitamin D deficient/ insufficient			<0.001
Yes	1666	20.4	
No	394	7.9	
Girl zinc deficient^d			0.989
Yes	143	14.9	
No	251	14.8	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin B12 deficiency defined as serum vitamin B12 < 150 pmol/L.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of adolescent girls.

Table 66. Correlation between vitamin D deficiency or insufficiency and various factors and in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic ^c	N	% ^a with vitamin D deficiency or insufficiency ^b	p-value ^c
Girl had diarrhea			0.344
Yes	146	73.1	
No	1901	78.6	
Girl had fever			0.957
Yes	185	78.0	
No	1862	78.3	
Girl had lower respiratory infection			0.175
Yes	42	87.0	
No	2005	78.1	
Girl had minimum dietary diversity			0.009
Yes	1060	74.6	
No	993	82.6	
Girl took multivitamin supplement in past six months			0.277
Yes	72	84.8	
No	1970	78.1	
Girl took vitamin D supplement in past six months			<0.001
Yes	147	44.2	
No	1893	81.0	
Girl thin			0.480
Yes	57	83.8	
No	1968	78.1	
Girl overweight or obese			0.084
Yes	630	82.2	
No	1395	76.7	
Girl had inflammation			0.222
Yes	622	75.3	
No	1408	79.4	
Girl zinc deficient ^d			0.803
Yes	143	76.1	
No	251	78.3	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin D deficiency defined as serum vitamin D 25(OH) < 12 ng/mL; vitamin D insufficiency defined as serum vitamin D 25(OH) between 12-19.9 ng/mL.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of adolescent girls.

Table 67. Correlation between zinc deficiency and various factors in adolescent girls 10-19 years of age, Lebanon 2023

Characteristic	N	% ^a with zinc deficiency ^b	p-value ^c
Girl had diarrhea			0.825
Yes	36	41.5	
No	367	38.4	
Girl had fever			0.743
Yes	31	33.9	
No	372	39.0	
Girl had lower respiratory infection			0.068
Yes	10	0.0	
No	393	39.5	
Girl's household had adequate sanitation			0.661
Yes	367	38.7	
No	29	31.2	
Girl's household had safe drinking water			0.612
Yes	359	39.3	
No	46	32.0	
Girl had minimum dietary diversity			0.742
Yes	197	40.1	
No	207	37.1	
Girl took multivitamin supplement in past six months			0.060
Yes	9	74.2	
No	394	37.8	
Girl took vitamin D supplement in past six months			0.073
Yes	27	67.4	
No	375	36.4	
Girl thin			0.294
Yes	13	21.7	
No	384	39.2	
Girl overweight or obese			0.240
Yes	130	32.4	
No	267	41.0	
Girl had inflammation			0.758
Yes	121	36.9	
No	282	39.5	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. Zinc deficiency was measured in a 20% sub-sample of adolescent girls.

^a Percentages weighted for unequal probability of selection.

^b Zinc deficiency defined as serum zinc < 70 µg/dL for morning samples in a fasting state, < 66 µg/dL morning sample in a non fasting state, and < 59 µg/dL afternoon sample in a non fasting state [80].

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

3.4.18. *Diabetes mellitus, lipid profile, visceral/central obesity, hypertension and metabolic syndrome*

Table 68 presents the national prevalences and subgroup prevalences for age group and menstruation status for seven indicators of cardiometabolic health. The prevalence of diabetes and pre-diabetes, total cholesterol, hypertension, and metabolic syndrome are low, and affect 3-6% of girls nationally. In contrast, the prevalences of visceral obesity, elevated triglycerides, and low HDL cholesterol are high, affecting 22%, 34%, and 26% of girls, respectively. Elevated triglycerides are associated with age group and menstruation status, with the highest prevalences occurring in girls 10-12 years of age and pre-menarche girls. Visceral obesity is associated with age group and the prevalence is highest in younger girls.

Table 68. Prevalence of cardiometabolic indicators in adolescents 10-19 years of age, by age group and menstruation status, Lebanon 2023

Indicator and Characteristic	N	% ^a	[95% CI] ^b	p-value ^c
Diabetes^d				
TOTAL	2047	0.2	[0.1,0.4]	
Age group (in years)				0.327
10-12	730	0.1	[0.0,0.7]	
13-15	624	0.1	[0.0,0.5]	
16-19	693	0.3	[0.1,0.9]	
Menstruation				0.188
Menarche	1428	0.2	[0.1,0.6]	
Pre-menarche	612	0.0	0.0	
Elevated HbA1c (diabetes or pre-diabetes)^d				
TOTAL	2047	3.4	[2.5,4.6]	
Age group (in years)				0.001
10-12	730	5.7	[3.5,9.2]	
13-15	624	3.3	[2.1,5.0]	
16-19	693	1.3	[0.8,2.3]	
Menstruation				0.020
Menarche	1428	2.5	[1.8,3.6]	
Pre-menarche	612	5.7	[3.2,9.9]	
Elevated triglycerides^e				
TOTAL	2062	33.8	[29.7,38.1]	
Age group (in years)				<0.001
10-12	738	46.0	[40.2,51.9]	
13-15	628	39.0	[32.4,46.1]	
16-19	696	17.2	[12.1,23.8]	
Menstruation				<0.001
Menarche	1437	28.5	[23.2,34.6]	
Pre-menarche	618	47.6	[41.7,53.6]	

Table continued on next page

Indicator and Characteristic	N	% ^a	[95% CI] ^b	p-value ^c
Elevated total cholesterol^f				
TOTAL	2062	2.9	[1.7,4.8]	
Age group (in years)				0.144
10-12	738	3.8	[2.1,6.9]	
13-15	628	3.7	[1.3,10.1]	
16-19	696	1.1	[0.6,2.1]	
Menstruation				0.988
Menarche	1437	2.9	[1.5,5.5]	
Pre-menarche	618	2.9	[1.4,5.8]	
Low HDL cholesterol^g				
TOTAL	2062	26.2	[23.4,29.1]	
Age group (in years)				0.071
10-12	738	24.7	[20.0,30.1]	
13-15	628	22.3	[17.9,27.5]	
16-19	696	31.0	[25.5,37.1]	
Menstruation				0.995
Menarche	1437	26.2	[22.8,29.9]	
Pre-menarche	618	26.2	[21.0,32.2]	
Visceral/central obesity^h				
TOTAL	2130	21.9	[19.0,25.1]	
Age group (in years)				0.024
10-12	778	26.5	[21.4,32.2]	
13-15	649	21.4	[16.8,26.9]	
16-19	703	17.5	[13.9,21.7]	
Menstruation				0.734
Menarche	1472	21.6	[18.3,25.3]	
Pre-menarche	651	22.8	[17.3,29.4]	
Hypertensionⁱ				
TOTAL	2062	2.6	[1.4,4.9]	
Age group (in years)				0.870
10-12	732	3.0	[1.2,7.6]	
13-15	639	2.3	[0.8,6.5]	
16-19	691	2.4	[0.9,6.6]	
Menstruation				0.858
Menarche	1448	2.5	[1.3,4.8]	
Pre-menarche	607	2.8	[0.9,8.4]	

Table continued on next page

Metabolic syndrome ^j				
TOTAL	1961	4.4	[3.2,5.9]	
Age group (in years)				0.698
10-12	683	3.6	[2.1,6.1]	
13-15	607	5.1	[2.8,9.2]	
16-19	671	4.4	[2.7,7.2]	
Menstruation				0.936
Menarche	1385	4.4	[2.9,6.6]	
Pre-menarche	569	4.3	[2.4,7.4]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. //

^a Percentages, means and medians weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other. // ^d Diabetes defined as HbA1c $\geq$ 6.5%; elevated HbA1c defined as $\geq$ 5.7% [82]. // ^e Elevated triglycerides defined as $\geq$ 90 mg/dL for girls aged < 18 years in fasting status, $\geq$ 130 mg/dL for girls aged < 18 years in non-fasting status, $\geq$ 150 mg/dL for girls aged $\geq$ 18 years in fasting status, $\geq$ 200 mg/dL for girls aged $\geq$ 18 years in non-fasting status. // ^f Elevated total cholesterol defined as $\geq$ 200 mg/dL for girls aged < 18 years, $\geq$ 240 mg/dL for girls aged $\geq$ 18 years. // ^g Low HDL cholesterol defined as < 40 mg/dL for girls aged < 18 years, < 50 mg/dL for girls aged $\geq$ 18 years. // ^h Visceral/central obesity defined as waist circumference $\geq$ 69.0 cm for girls aged 10-11 years, $\geq$ 71.6 cm for girls aged 11-12 years, $\geq$ 74.0 cm for girls aged 12-13 years, $\geq$ 75.8 cm for girls aged 13-14 years, $\geq$ 77.3 cm for girls aged 14-15 years, $\geq$ 78.3 cm for girls aged 15-16 years, $\geq$ 78.9 cm for girls aged 16-17 years, $\geq$ 79.5 cm for girls aged 17-18 years, $\geq$ 80.0 cm for girls aged $\geq$ 18 years [70,120]. // ⁱ Hypertension defined as systolic blood pressure $\geq$ 140 mmHg and/or diastolic blood pressure $\geq$ 90 mmHg. // ^j Metabolic syndrome defined as central obesity defined as $\geq$ 75.5 cm for girls aged 10-11 years, $\geq$ 78.3 cm for girls aged 11-12 years, $\geq$ 80.0 cm for girls aged $\geq$ 12 years, plus any two of the following four factors: elevated HbA1c defined as $\geq$ 5.7%; elevated triglycerides defined as $\geq$ 150 mg/dL; low HDL cholesterol defined as < 40 mg/dL for girls aged < 15 years, < 50 mg/dL for girls aged $\geq$ 15 years; elevated blood pressure defined as systolic blood pressure $\geq$ 135 mmHg and/or diastolic blood pressure $\geq$ 85 mmHg [109].

3.4.19. Associations between cardiometabolic risk factors and health and nutrition indicators

Associations between cardiometabolic risk factors and various health and nutrition factors are shown in Table 69. The most consistent association found is between some cardiometabolic risk factors (i.e., elevated HbA1c, low HDL cholesterol, central/visceral obesity) and inflammation, with the prevalence of all aforementioned indicators higher amongst girls with inflammation. Elevated HbA1c is also significantly associated with anemia, ID, and folate deficiency, however, the direction of the association is not constant. While the prevalence of elevated HbA1c is higher amongst girls with anemia and ID, the prevalence is lower among girls with folate deficiency. Low HDL cholesterol is associated with vitamin B12 status, with higher prevalence found amongst girls with vitamin B12 deficiency. Hypertension is associated with vitamin D status, with a higher prevalence found amongst girls with vitamin D deficiency or insufficiency. Lastly, central/visceral obesity is associated with zinc status, and a higher prevalence is observed amongst girls that are zinc replete.

Table 69. Association between cardiometabolic risk factors and nutrition indicators in non-pregnant adolescents 10-19 years of age, Lebanon 2023

Characteristic	Elevated HbA1c ^a			Elevated triglycerides ^b			Low HDL cholesterol ^c			Hypertension ^d			Central/visceral obesity ^e		
	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g
Minimum dietary diversity			0.709			0.277			0.128			0.144			0.823
Yes	1056	3.6		1061	32.2		1061	24.1		1065	1.3		1094	22.3	
No	984	3.2		994	35.8		994	28.6		990	3.8		1029	21.6	
Anemia			0.001			0.069			0.166			0.076			0.589
Yes	425	7.7		424	27.9		424	29.8		402	1.2		413	18.4	
No	1621	2.3		1630	35.1		1630	25.4		1575	3.0		1615	20.4	
Iron deficiency			0.066			0.948			0.323			0.103			0.103
Yes	602	5.0		601	34.0		601	29.0		590	1.4		603	16.8	
No	1420	2.7		1431	33.7		1431	24.9		1401	3.2		1438	21.7	
Iron deficiency anemia			0.003			0.188			0.367			0.172			0.562
Yes	267	8.3		265	27.9		265	29.1		256	1.3		260	17.9	
No	1754	2.6		1763	34.9		1763	25.6		1698	2.9		1744	20.4	
Folate deficiency			0.004			0.940			0.942			0.150			0.800
Yes	255	1.1		259	33.4		259	26.5		242	1.0		250	19.3	
No	1785	3.8		1803	33.9		1803	26.1		1737	2.9		1780	20.4	
Vitamin B12 deficiency			0.437			0.758			0.020			0.054			0.546
Yes	396	4.3		398	32.9		398	33.5		385	0.9		394	18.4	
No	1644	3.2		1662	34.0		1662	24.6		1592	3.0		1634	20.6	
Zinc deficiency			0.286			0.108			0.978			0.148			0.015
Yes	137	1.2		137	21.6		137	26.6		132	0.0		138	14.0	
No	255	2.4		258	37.3		258	26.8		249	5.9		260	29.0	

Table continued on next page

Characteristic	Elevated HbA1c ^a			Elevated triglycerides ^b			Low HDL cholesterol ^c			Hypertension ^d			Central/visceral obesity ^e		
	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g
Vitamin D deficiency or insufficiency			0.537			0.591			0.350			0.001			0.169
Yes	1652	3.2		1666	34.4		1666	27.0		1599	3.2		1635	21.2	
No	388	4.2		394	31.9		394	23.1		378	0.5		393	16.8	
Excess sodium intake			0.695			0.332			0.551			0.248			0.613
Yes	1009	3.6		1015	35.8		1015	26.9		1011	3.8		1034	21.2	
No	790	4.2		795	32.2		795	25.1		784	1.8		808	20.0	
Low potassium intake			0.727			0.427			0.396			0.298			0.900
Yes	1680	3.9		1691	33.8		1691	25.7		1676	2.7		1723	20.8	
No	123	3.3		123	39.5		123	31.9		123	6.6		123	21.5	
Inflammation			<0.001			0.085			<0.001			0.626			<0.001
Yes	620	6.1		623	38.8		623	37.2		614	3.1		630	36.2	
No	1402	2.1		1409	31.4		1409	20.8		1377	2.4		1411	12.7	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Elevated HbA1c defined as $\geq 5.7\%$.

^b Elevated triglycerides defined as ≥ 90 mg/dL for women aged < 18 years in fasting status, ≥ 130 mg/dL for women aged < 18 years in non-fasting status, ≥ 150 mg/dL for women aged ≥ 18 years in fasting status, ≥ 200 mg/dL for women aged ≥ 18 years in non-fasting status.

^c Low HDL cholesterol defined as < 40 mg/dL for women aged < 18 years, < 50 mg/dL for women aged ≥ 18 years.

^d Hypertension defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

^e Visceral/central obesity defined as waist circumference ≥ 69.0 cm for girls aged 10-11 years, ≥ 71.6 cm for girls aged 11-12 years, ≥ 74.0 cm for girls aged 12-13 years, ≥ 75.8 cm for girls aged 13-14 years, ≥ 77.3 cm for girls aged 14-15 years, ≥ 78.3 cm for girls aged 15-16 years, ≥ 78.9 cm for girls aged 16-17 years, ≥ 79.5 cm for girls aged 17-18 years, ≥ 80.0 cm for girls aged ≥ 18 years [70,120].

^f Percentages and weighted for unequal probability of selection.

^g Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

3.4.20. Sodium intake and associated factors

Urinary sodium results are presented in Table 70. The mean and median sodium intake of adolescent girls is 2.6 and 2.3 grams, respectively. When examined by strata, the lowest mean sodium intake was found in Beirut, and the highest sodium intake was found in Baalbek-Hermel. Mean and median sodium intake exceed the threshold for excessive sodium intake (i.e., as ≥ 2 grams of sodium per day, [121]) in all subgroups. Approximately 58% of adolescent girls have excessive sodium intake; no significant differences in excessive sodium intake were observed by demographic subgroup.

Excessive sodium intake is significantly associated with low potassium intake (Table 71), with a lower proportion found in those with normal potassium intake.

Table 70. Daily estimated sodium intake and prevalence of excess sodium intake using urinary sodium excretion in adolescents 10-19 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Mean sodium intake (g) ^a	Median sodium intake (g) ^a	Excess sodium intake ^b		
				% ^a	[95% CI] ^c	p-value ^d
Nationality						0.235
Lebanese	1199	2.6	2.2	56.0	[50.6,61.1]	
Syrian	559	2.9	2.4	62.1	[54.4,69.2]	
Palestinian	73	2.7	2.4	54.6	[41.2,67.4]	
Age group (in years)						0.198
10-12	680	2.5	2.2	53.9	[47.2,60.4]	
13-15	555	2.5	2.2	57.7	[51.2,64.1]	
16-19	610	2.9	2.4	61.6	[55.2,67.6]	
Menstruation						0.780
Menarche	1268	2.7	2.2	57.3	[51.9,62.5]	
Pre-menarche	571	2.6	2.3	58.4	[51.7,64.9]	
Stratum						0.083
Akkar	199	2.7	2.4	55.7	[48.6,62.6]	
Baalbek-Hermel	233	3.0	2.5	60.2	[52.7,67.3]	
Beirut	205	2.1	1.8	45.3	[36.4,54.5]	
Bekaa	203	2.5	2.0	50.7	[42.7,58.7]	
El Nabatieh	155	2.5	2.2	53.3	[42.5,63.8]	
Mount Lebanon	141	2.8	2.4	65.7	[55.3,74.7]	
North	311	2.5	2.1	51.8	[44.3,59.2]	
South	168	2.5	2.2	53.4	[40.8,65.5]	
Palestinian camps	66	2.5	2.2	53.3	[42.5,63.8]	
Syrian ITS	164	2.9	2.3	61.2	[54.0,67.9]	
Wealth quintile						0.160
Lowest	557	2.9	2.4	65.3	[58.9,71.1]	
Second	375	2.5	2.2	54.8	[46.2,63.1]	
Middle	349	2.7	2.2	58.1	[48.2,67.3]	
Fourth	314	2.5	2.2	54.3	[44.3,64.0]	
Highest	250	2.4	2.1	50.8	[39.2,62.4]	
Household food insecurity access						0.420
Secure	452	2.9	2.4	61.5	[53.2,69.2]	
Mild	136	2.5	2.1	56.5	[42.2,69.8]	
Moderate	602	2.4	2.2	53.3	[45.6,60.7]	
Severe	655	2.7	2.3	59.0	[52.6,65.1]	

Table continued on next page

Characteristic	N	Mean sodium intake (g) ^a	Median sodium intake (g) ^a	Excess sodium intake ^b		
				% ^a	[95% CI] ^c	p-value ^d
Household sanitation^e						0.842
Inadequate	97	2.7	2.6	58.7	[48.3,68.3]	
Adequate	1721	2.6	2.3	57.6	[53.1,62.0]	
Safe drinking water^f						0.087
Yes	1639	2.7	2.3	58.6	[54.0,63.0]	
No	204	2.5	1.8	46.9	[34.8,59.3]	
TOTAL SAMPLE	1845	2.6	2.3	57.7	[53.4,61.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages, means and medians weighted for unequal probability of selection.

^b Excess sodium intake defined as ≥ 2 g/day according to WHO [121].

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab or composting toilet not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

Table 71. Associations between daily sodium intake using urinary sodium excretion and various health factors in adolescents 10-19 years of age, Lebanon 2023

Characteristic	N	Mean sodium intake (g) ^a	Median sodium intake (g) ^a	Excess sodium intake ^b		
				% ^a	[95% CI] ^c	p-value ^d
Elevated triglycerides^e						0.328
Yes	585	2.6	2.3	59.9	[53.1,66.4]	
No	1225	2.7	2.3	55.9	[50.9,60.8]	
Elevated total cholesterol^f						0.762
Yes	42	2.5	2.3	52.7	[24.7,79.2]	
No	1768	2.7	2.3	57.4	[53.2,61.5]	
Low HDL cholesterol^g						0.641
Yes	458	2.7	2.4	58.6	[51.7,65.2]	
No	1352	2.7	2.3	56.8	[52.1,61.4]	
Elevated HbA1c^h						0.737
Yes	83	2.8	2.4	54.4	[37.6,70.2]	
No	1716	2.7	2.3	57.4	[53.0,61.8]	
Hypertensionⁱ						0.259
Yes	29	4.0	4.2	74.0	[42.6,91.6]	
No	1766	2.6	2.3	57.5	[53.3,61.6]	
Visceral obesity^j						0.562
Yes	405	2.7	2.3	59.4	[51.4,66.8]	
No	1437	2.6	2.3	57.3	[53.0,61.4]	
Low potassium intake^k						<0.001
Yes	1721	2.5	2.2	56.0	[51.5,60.5]	
No	124	5.0	4.3	87.4	[78.5,93.0]	
TOTAL SAMPLE	1845	2.6	2.3	57.7	[53.4,61.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages, means and medians weighted for unequal probability of selection.

^b Excess sodium intake defined as ≥ 2 g/day according to WHO [121].

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^e Elevated triglycerides defined as ≥ 90 mg/dL for girls aged < 18 years in fasting status, ≥ 130 mg/dL for girls aged < 18 years in non-fasting status, ≥ 150 mg/dL for girls aged ≥ 18 years in fasting status, ≥ 200 mg/dL for girls aged ≥ 18 years in non-fasting status.

^f Elevated total cholesterol defined as ≥ 200 mg/dL for girls aged < 18 years, ≥ 240 mg/dL for girls aged ≥ 18 years.

^g Low HDL cholesterol defined as < 40 mg/dL for girls aged < 18 years, < 50 mg/dL for girls aged ≥ 18 years.

^h Elevated HbA1c defined as $\geq 5.7\%$.

ⁱ Hypertension defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

^j Visceral/central obesity defined as waist circumference ≥ 69.0 cm for girls aged 10-11 years, ≥ 71.6 cm for girls aged 11-12 years, ≥ 74.0 cm for girls aged 12-13 years, ≥ 75.8 cm for girls aged 13-14 years, ≥ 77.3 cm for girls aged 14-15 years, ≥ 78.3 cm for girls aged 15-16 years, ≥ 78.9 cm for girls aged 16-17 years, ≥ 79.5 cm for girls aged 17-18 years, ≥ 80.0 cm for girls aged ≥ 18 years [70,120].

^k Low potassium intake defined as < 3510 mg/day according to WHO [122].

3.4.21. Potassium intake and associated factors

As shown in Table 72, adolescent girls have a mean potassium intake of 1.8 grams per day, an intake that is well below the 3.5 grams per day threshold established by WHO [122]. Nearly all (95%) of the adolescent girls surveyed have a low potassium intake. Low potassium intake is significantly associated with nationality, stratum, and wealth quintile, with lower prevalences found in Syrian girls, and girls in the Syrian ITS stratum and the lowest wealth quintile.

No associations were found between low potassium intake and risk factors of metabolic syndrome, such as hypertension, visceral obesity, cholesterol status, and diabetes (Table 73).

3.4.22. Sodium to potassium intake ratio

As noted in Section 2.7.3, it is recommended that adults consume <2 grams / day of sodium and >3.5 grams/day of potassium [121]. This optimal consumption results in a sodium-to-potassium ratio of ≤ 1.0 . As shown in Table 74, that average sodium-to-potassium ratio in adolescent girls is 2.9, and nearly 88% of girls have a sub-optimal ratio. No demographic indicators are associated with the proportion of girls with a sub-optimal sodium-to-potassium ratio (Table 74). The prevalence of a sub-optimal sodium-to-potassium ratio is, however, positively associated with excess sodium intake (Table 75).

Table 72. Daily estimated potassium intake and prevalence of low intake using urinary potassium excretion in adolescents 10-19 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Mean potassium intake (g) ^a	Median potassium intake (g) ^a	Low potassium intake ^d		
				% ^a	[95% CI] ^b	p-value ^c
Nationality						0.001
Lebanese	1201	1.7	1.5	96.4	[94.9,97.4]	
Syrian	561	2.0	1.6	91.3	[86.9,94.4]	
Palestinian	73	1.6	1.2	97.7	[90.8,99.5]	
Age group (in years)						0.706
10-12	681	1.8	1.6	94.8	[91.5,96.9]	
13-15	557	1.8	1.5	95.3	[92.8,97.0]	
16-19	611	1.7	1.5	93.9	[90.6,96.1]	
Menstruation						0.434
Menarche	1271	1.7	1.5	95.3	[93.4,96.6]	
Pre-menarche	572	1.9	1.6	94.0	[90.3,96.4]	

Table continued on next page

Characteristic	N	Mean potassium intake (g) ^a	Median potassium intake (g) ^a	Low potassium intake ^d		
				% ^a	[95% CI] ^b	p-value ^c
Stratum						<0.001
Akkar	199	1.8	1.7	96.1	[91.8,98.2]	
Baalbek-Hermel	234	2.2	1.9	87.3	[80.1,92.2]	
Beirut	206	1.5	1.3	96.1	[91.7,98.2]	
Bekaa	203	1.9	1.6	92.1	[84.0,96.3]	
El Nabatieh	155	1.7	1.4	96.5	[92.0,98.5]	
Mount Lebanon	142	1.7	1.6	96.6	[92.5,98.5]	
North	311	1.7	1.5	95.1	[90.9,97.4]	
South	168	1.6	1.4	97.5	[93.2,99.1]	
Palestinian camps	66	1.6	1.2	97.8	[87.0,99.7]	
Syrian ITS	165	2.4	2.1	80.3	[67.3,88.9]	
Wealth quintile						<0.001
Lowest	559	2.0	1.7	89.5	[85.1,92.7]	
Second	375	1.6	1.5	96.1	[92.2,98.1]	
Middle	350	1.8	1.6	97.8	[96.1,98.7]	
Fourth	315	1.7	1.5	94.8	[90.4,97.2]	
Highest	250	1.6	1.5	98.5	[96.0,99.5]	
Household food insecurity access						0.285
Secure	453	1.8	1.6	96.4	[92.2,98.4]	
Mild	137	1.6	1.5	96.4	[91.2,98.6]	
Moderate	604	1.7	1.4	94.5	[90.9,96.8]	
Severe	655	1.9	1.7	92.9	[90.1,95.0]	
Household sanitation^e						0.615
Inadequate	98	1.8	1.6	95.9	[88.4,98.6]	
Adequate	1724	1.8	1.6	94.6	[92.9,95.9]	
Safe drinking water^f						0.074
Yes	1642	1.8	1.6	95.1	[93.4,96.3]	
No	205	1.8	1.5	89.8	[79.5,95.3]	
TOTAL SAMPLE	1849	1.8	1.6	94.7	[93.0,96.0]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages, means and medians weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^d Low potassium intake defined as < 3510 mg/day according to WHO [122].

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab or composting toilet not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

Table 73. Associations between daily potassium intake using urinary potassium excretion and various health factors in adolescents 10-19 years of age, Lebanon 2023

Characteristic	N	Mean potassium intake (g) ^a	Median potassium intake (g) ^a	Low potassium intake ^d		
				% ^a	[95% CI] ^b	p-value ^c
Elevated triglycerides^e						0.454
Yes	585	1.9	1.6	93.7	[90.0,96.1]	
No	1229	1.7	1.5	95.0	[93.0,96.4]	
Elevated total cholesterol^f						0.807
Yes	42	1.8	1.8	95.5	[79.6,99.1]	
No	1772	1.8	1.4	94.5	[92.8,95.8]	
Low HDL cholesterol^g						0.446
Yes	459	1.8	1.5	93.4	[88.4,96.3]	
No	1355	1.7	1.6	94.9	[93.1,96.3]	
Elevated HbA1c^h						0.793
Yes	83	2.1	2.1	95.2	[87.6,98.2]	
No	1720	1.7	1.5	94.5	[92.7,95.8]	
Hypertensionⁱ						0.258
Yes	29	2.6	2.0	87.0	[53.0,97.6]	
No	1770	1.7	1.5	94.8	[93.3,96.1]	
Visceral obesity^j						0.911
Yes	406	1.9	1.7	94.6	[91.0,96.8]	
No	1440	1.7	1.5	94.7	[92.8,96.2]	
TOTAL SAMPLE	1846	1.8	1.6	94.7	[93.0,96.0]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages, means and medians weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other. //

^d Low potassium intake defined as < 3510 mg/day according to WHO [122]. // ^e Elevated triglycerides defined as ≥ 90 mg/dL for girls aged < 18 years in fasting status, ≥ 130 mg/dL for girls aged < 18 years in non-fasting status, ≥ 150 mg/dL for girls aged ≥ 18 years in fasting status, ≥ 200 mg/dL for girls aged ≥ 18 years in non-fasting status. // ^f Elevated total cholesterol defined as ≥ 200 mg/dL for girls aged < 18 years, ≥ 240 mg/dL for girls aged ≥ 18 years. // ^g Low HDL cholesterol defined as < 40 mg/dL for girls aged < 18 years, < 50 mg/dL for girls aged ≥ 18 years. // ^h Elevated HbA1c defined as ≥ 5.7%. // ⁱ Hypertension defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg. // ^j Visceral/central obesity defined as waist circumference ≥ 69.0 cm for girls aged 10-11 years, ≥ 71.6 cm for girls aged 11-12 years, ≥ 74.0 cm for girls aged 12-13 years, ≥ 75.8 cm for girls aged 13-14 years, ≥ 77.3 cm for girls aged 14-15 years, ≥ 78.3 cm for girls aged 15-16 years, ≥ 78.9 cm for girls aged 16-17 years, ≥ 79.5 cm for girls aged 17-18 years, ≥ 80.0 cm for girls aged ≥ 18 years [70,120].

Table 74. Sodium to potassium (Na:K) intake ratio and prevalence of suboptimal intake ratio in adolescents 10-19 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Mean Na:K ratio ^a	Suboptimal Na:K ratio ^d		
			% ^a	[95% CI] ^b	p-value ^c
Nationality					0.516
Lebanese	1206	2.9	88.6	[85.2,91.3]	
Syrian	567	2.9	86.5	[82.1,90.0]	
Palestinian	86	3.3	90.0	[77.1,96.0]	

Table continued on next page

Characteristic	N	Mean Na:K ratio ^a	Suboptimal Na:K ratio ^d			p-value ^c
			% ^a	[95% CI] ^b		
Age group (in years)						0.177
10-12	687	2.8	85.3	[80.8,88.9]		
13-15	566	2.8	90.1	[85.9,93.1]		
16-19	620	3.1	88.5	[83.7,92.1]		
Menstruation						0.650
Menarche	1294	3.0	88.2	[84.8,90.9]		
Pre-menarche	573	2.7	87.2	[82.7,90.6]		
Stratum						0.795
Akkar	201	2.8	87.2	[80.7,91.7]		
Baalbek-Hermel	233	2.6	86.0	[79.2,90.9]		
Beirut	208	2.8	86.7	[77.0,92.7]		
Bekaa	204	2.7	81.2	[71.6,88.0]		
El Nabatieh	156	2.8	91.0	[83.8,95.2]		
Mount Lebanon	141	3.2	89.8	[82.1,94.4]		
North	312	2.8	87.3	[81.5,91.5]		
South	169	3.1	88.8	[78.8,94.4]		
Palestinian camps	85	3.1	87.6	[72.7,95.0]		
Syrian ITS	164	2.5	84.5	[75.2,90.7]		
Wealth quintile						0.657
Lowest	568	3.0	86.5	[82.2,89.9]		
Second	383	3.1	87.4	[80.8,92.0]		
Middle	352	2.9	88.3	[80.7,93.2]		
Fourth	318	2.9	87.0	[80.2,91.7]		
Highest	252	2.7	91.5	[86.2,94.9]		
Household food insecurity access						0.203
Secure	469	3.0	89.4	[83.5,93.4]		
Mild	138	3.4	88.5	[79.8,93.7]		
Moderate	607	3.0	89.9	[85.7,93.0]		
Severe	659	2.7	84.5	[79.4,88.5]		
Household sanitation^e						0.595
Inadequate	100	2.7	85.4	[73.5,92.5]		
Adequate	1746	2.9	88.0	[84.9,90.5]		
Safe drinking water^f						0.095
Yes	1665	3.0	88.3	[85.3,90.8]		
No	206	2.5	82.9	[75.1,88.6]		
TOTAL SAMPLE	1873	2.9	87.9	[85.0,90.3]		

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^d Recommended ratio of sodium to potassium ≤ 1 mmol according to WHO [121].

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab or composting toilet not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

Table 75. Associations between sodium to potassium intake ratio and various health factors in adolescents 10-19 years of age, Lebanon 2023

Characteristic	N	Mean Na:K ratio ^a	Suboptimal Na:K ratio ^d		
			% ^a	[95% CI] ^b	p-value ^c
Elevated triglycerides ^e					0.081
Yes	586	2.7	90.5	[87.1,93.0]	
No	1250	3.0	86.5	[82.4,89.7]	
Elevated total cholesterol ^f					0.965
Yes	43	2.4	87.5	[68.1,95.9]	
No	1793	3.0	87.8	[84.9,90.3]	
Low HDL cholesterol ^g					0.574
Yes	83	2.6	88.8	[84.3,92.1]	
No	1743	3.0	87.5	[84.1,90.2]	
Elevated HbA1c ^h					0.824
Yes	83	2.6	86.6	[72.3,94.1]	
No	1743	3.0	87.8	[84.8,90.2]	
Hypertension ⁱ					0.736
Yes	29	2.7	91.4	[55.8,98.9]	
No	1770	2.9	88.2	[85.5,90.4]	
Visceral obesity ^j					0.591
Yes	406	2.7	86.7	[78.9,91.9]	
No	1440	3.0	88.3	[85.6,90.6]	
Excess sodium intake ^k					<0.001
Yes	1035	3.8	99.6	[99.1,99.8]	
No	810	1.8	72.1	[66.7,76.9]	
Low potassium intake ^l					0.197
Yes	1721	3.0	88.2	[85.2,90.7]	
No	124	1.9	83.1	[73.2,89.9]	
TOTAL SAMPLE	1846	2.9	88.0	[85.1,90.4]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Recommended ratio of sodium to potassium ≤ 1 mmol according to WHO [121].

^e Elevated triglycerides defined as ≥ 90 mg/dL for girls aged < 18 years in fasting status, ≥ 130 mg/dL for girls aged < 18 years in non-fasting status, ≥ 150 mg/dL for girls aged ≥ 18 years in fasting status, ≥ 200 mg/dL for girls aged ≥ 18 years in non-fasting status.

^f Elevated total cholesterol defined as ≥ 200 mg/dL for girls aged < 18 years, ≥ 240 mg/dL for girls aged ≥ 18 years.

^g Low HDL cholesterol defined as < 40 mg/dL for girls aged < 18 years, < 50 mg/dL for girls aged ≥ 18 years.

^h Elevated HbA1c defined as ≥ 5.7%.

ⁱ Hypertension defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

^j Visceral/central obesity defined as waist circumference ≥ 69.0 cm for girls aged 10-11 years, ≥ 71.6 cm for girls aged 11-12 years, ≥ 74.0 cm for girls aged 12-13 years, ≥ 75.8 cm for girls aged 13-14 years, ≥ 77.3 cm for girls aged 14-15 years, ≥ 78.3 cm for girls aged 15-16 years, ≥ 78.9 cm for girls aged 16-17 years, ≥ 79.5 cm for girls aged 17-18 years, ≥ 80.0 cm for girls aged ≥ 18 years [70,120].

^k Excess sodium intake defined as ≥ 2 g/day according to WHO [121].

^l Low potassium intake defined as < 3510 mg/day according to WHO [122].

3.5. All females 15-49 years of age

3.5.1. Pregnancy and birth history

Pregnancy and birth history results for all (i.e., pregnant and non-pregnant) married women 15-49 years of age¹¹ are presented in Table 76. Approximately 10% of all women surveyed are pregnant and approximately 6% of women are lactating. Of the women surveyed, approximately 80% had 2 or more pregnancies and approximately 80% had 2 or more deliveries.

Nearly 64% of women reported taking iron or folic acid supplements during their last or current pregnancy, but only 5% reported starting to take these supplements prior to becoming pregnant. On average, women took iron or folic acid supplements for 166 days (i.e., 5.5 months). About one-half of women reported taking multivitamin supplements during their last or current pregnancy, but only 6% reported starting these supplements prior to becoming pregnant. Women took multivitamin supplements for 195 days during their last pregnancy (i.e., 6.4 months). When currently pregnant women were removed from analysis, the duration of supplementation raised only slightly to 171 days (i.e., 5.6 months) for iron or folic acid supplements and to 199 days (i.e., 6.5 months) for multivitamin supplements.

Table 76. Distribution of pregnancy and birth variables in all females 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Pregnant at the time of the survey			
Yes	224	9.6	[7.5,12.3]
No	1695	89.5	[86.6,91.8]
Don't know	10	0.9	[0.2,3.6]
Lactating at the time of the survey^c			
Yes	96	6.1	[3.6,10.0]
No	1596	93.9	[90.0,96.4]
Number of pregnancies			
0	166	8.0	[6.1,10.5]
1	268	13.9	[11.7,16.3]
2	372	20.9	[18.1,24.0]
3	385	21.8	[18.6,25.3]
4	276	15.6	[12.7,19.1]
≥5	462	19.8	[17.2,22.6]

Table continued on next page

¹¹ Adolescent girls 10-14.9 years of age were not included in this analysis because girls < 15 years of age are not considered women of reproductive age.

Characteristic	N	% ^a	[95% CI] ^b
Number of births (live and still)			
0	71	3.2	[2.2,4.6]
1	298	17.8	[15.2,20.8]
2	445	26.5	[23.4,29.9]
3	410	25.9	[22.7,29.2]
4	286	15.7	[13.0,18.9]
≥5	241	10.9	[8.9,13.3]
Took iron or folic acid supplements during last or current pregnancy			
Yes	1098	63.9	[59.3,68.4]
No	596	32.2	[28.1,36.6]
Don't know	57	3.9	[2.4,6.2]
When did girl/ woman start taking iron or folic acid			
Pre-pregnancy	52	5.4	[3.5,8.2]
During pregnancy	1043	94.4	[91.6,96.3]
Don't know	3	0.2	[0.1,0.7]
Number of days taking iron or folic acid supplements			
Mean	1098	166	[155,177]
Took multivitamin capsules during last or current			
Yes	823	50.3	[45.7,54.8]
No	862	44.9	[40.6,49.2]
Don't know	66	4.9	[3.1,7.6]
When did girl/ woman start taking multivitamin			
Pre-pregnancy	36	6.3	[3.7,10.3]
During pregnancy	785	93.5	[89.5,96.1]
Don't know	2	0.2	[0.0,0.9]
Number of days taking multivitamin supplements			
Mean	823	195	[184,206]
TOTAL SAMPLE	1929	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection. Pregnancy and lactation module only administered to currently married females.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Girls 15-19 years of age and women ≥20 years of age were excluded from the analysis of current breastfeeding if they a) had not yet had menarche (N=62), b) had never been pregnant (N=111), or c) were pregnant but had never delivered a child (N=71).

3.6. Non-pregnant women 15-49 years of age

3.6.1. Characteristics

Table 77 describes the demographic characteristics of the 2989 sampled non-pregnant women 15-49 years of age. All age groups are approximately equally represented with the exception of the youngest age group (i.e., 15-19 years) as it only includes a 5-year period. More than two-thirds of the women have Lebanese nationality, and more than half have completed basic secondary or less. Further, more than half of the surveyed women are married and less than 5% were breast feeding a child at the time of the survey.

Figure 37 shows that the proportion of Lebanese non-pregnant increases as household wealth increases; nearly 98% of non-pregnant women in the highest wealth quintile are Lebanese. In contrast, the proportion of Syrian women decreases as household wealth increases, and nearly 64% of the women in the lowest wealth quintile are Syrian. The proportion of Palestinian women in each wealth quintile is <3% due to the small proportion of the population that is Palestinian. Age and marital status are strongly associated ($p < 0.001$): non married women's mean age was 24.8 years of age, married women were 36.8 years old and divorced, separated or widowed women were on average 40.8 years old.

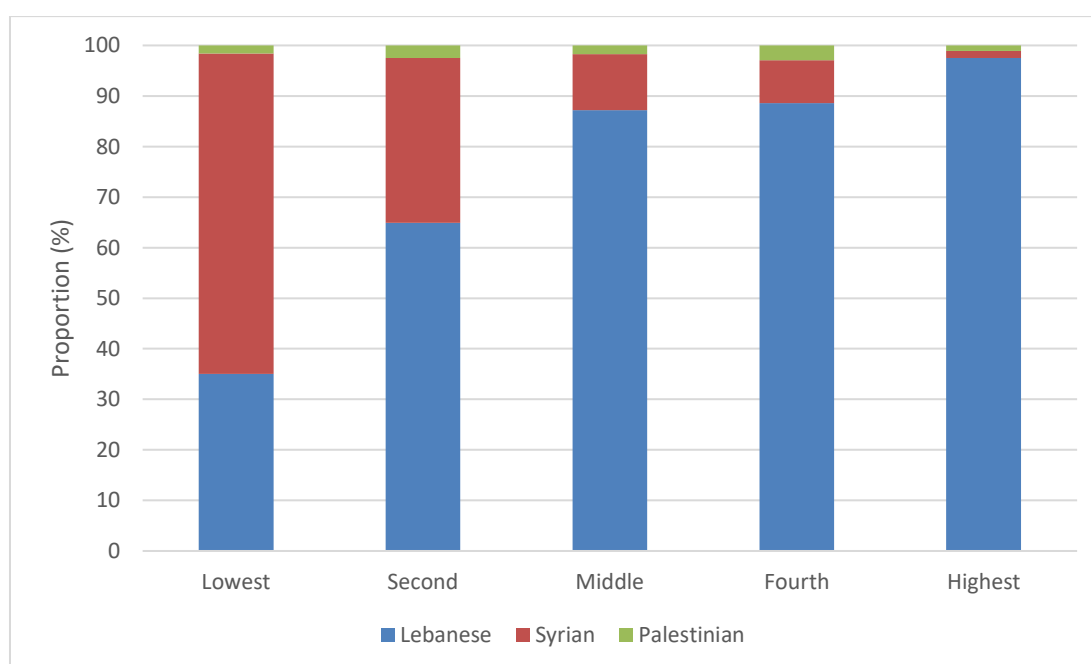


Figure 37. Wealth distribution in non-pregnant women 15-49 years of age by nationality, Lebanon 2023

Table 77. Description of non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Nationality			
Lebanese	2093	70.7	[65.7,75.2]
Syrian	740	26.1	[21.6,31.2]
Palestinian	124	2.2	[1.4,3.5]
Other	32	1.0	[0.6,1.8]
Age group (in years)			
15-19	484	15.9	[13.9,18.0]
20-29	818	25.7	[22.9,28.8]
30-39	810	27.2	[23.9,30.7]
40-49	877	31.2	[28.3,34.3]
Stratum			
Akkar	250	4.5	[3.5,5.8]
Baalbek-Hermel	350	5.1	[3.8,6.9]
Beirut	369	6.4	[4.6,8.7]
Bekaa	310	8.1	[5.7,11.3]
El Nabatieh	332	7.6	[5.7,9.9]
Mount Lebanon	292	35.5	[29.4,42.0]
North	423	16.8	[12.8,21.7]
South	323	11.2	[8.2,15.1]
Palestinian camps	152	1.4	[1.0,1.9]
Syrian ITS	188	3.6	[2.7,4.6]
Wealth quintile			
Lowest	731	22.8	[19.3,26.7]
Second	565	21.2	[17.8,25.0]
Middle	590	20.0	[17.2,23.1]
Fourth	563	17.8	[15.1,20.8]
Highest	540	18.3	[14.9,22.3]
Educational level			
Basic secondary or less	1613	56.1	[52.4,59.8]
Complete secondary or more	1376	43.9	[40.2,47.6]
Marital status			
Never married	1158	35.9	[32.8,39.1]
Married	1659	55.6	[52.6,58.6]
Divorced/ separated/ widowed	170	8.5	[6.6,10.7]
Currently breastfeeding a child			
Yes	94	3.6	[2.3,5.7]
No	2895	96.4	[94.3,97.7]
TOTAL SAMPLE	2989	100	

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design

3.6.2. Dietary diversity

As shown in Table 78, the mean dietary score among all NPW is 5.1, with a range of 4.0 to 5.8. The most commonly reported number of food groups consumed by NPW in the 24 hours prior to the survey is 5 (data not shown).

Approximately 56% of NPW have a minimum diverse diet, and a minimum diverse diet is associated with strata, with the highest prevalence of MDD found in Bekka (76%) and El Nabatieh (69%). As such, the women in these same strata have the lowest prevalences of severe food poverty. In contrast, the women in the Akkar and Syrian ITS strata have the lowest prevalence of MDD.

MDD is also associated with nationality, with the lowest proportion found in Syrian women 43%. Accordingly, the prevalence of severe poverty is highest — approximately 20% — amongst Syrian women.

MDD is also associated with wealth quintile, and the highest prevalence was found in the highest wealth quintile. A similar association was shown between dietary diversity and household food insecurity (access); around two-thirds of women in the food secure households achieve MDD compared to only 40% among the most insecure households. Consequently, a clear inverse association between severe food poverty and a) wealth quintile and b) food security access status is observed.

Lastly, the prevalence of severe food poverty is two times higher in divorced/separated/widowed women compared to those who were never married or married.

Table 78. Dietary diversity in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	Mean dietary score ^a	Minimum dietary diversity (consumed ≥ 5 food groups)			Moderate food poverty (consumed 3-4 food groups)		Severe food poverty (consumed 0-2 food groups)		
			% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	% ^a	[95% CI] ^b	p-value ^c
Nationality					<0.001					<0.001
Lebanese	2093	5.2	60.2	[55.7,64.5]		30.9	[27.6,34.5]	8.9	[7.1,11.1]	
Syrian	740	4.7	43.7	[36.3,51.4]		36.6	[28.8,45.1]	19.8	[15.1,25.5]	
Palestinian	124	5.8	65.2	[49.3,78.3]		20.0	[11.4,32.7]	14.8	[7.7,26.5]	
Other	32	5.7	77.6	[51.9,91.7]		22.1	[8.1,47.8]	0.4	[0.0,2.7]	
Age group (in years)					0.176					0.086
15-19	484	5.0	58.1	[51.2,64.6]		30.5	[24.6,37.0]	11.4	[8.5,15.2]	
20-29	818	4.9	51.6	[44.6,58.6]		33.3	[28.2,38.9]	15.0	[11.5,19.5]	
30-39	810	5.1	55.4	[49.3,61.3]		33.1	[28.3,38.3]	11.5	[8.6,15.3]	
40-49	877	5.3	59.6	[53.8,65.2]		31.0	[26.0,36.4]	9.4	[6.8,12.8]	
Stratum					<0.001					<0.001
Akkar	250	4.1	36.5	[28.1,45.8]		49.7	[42.9,56.5]	13.8	[9.1,20.3]	
Baalbek-Hermel	350	4.4	53.9	[46.0,61.7]		31.4	[25.9,37.5]	14.6	[9.9,21.2]	
Beirut	369	4.4	43.5	[35.3,52.0]		45.9	[37.4,54.5]	10.6	[6.8,16.3]	
Bekaa	310	5.6	76.4	[70.6,81.4]		21.1	[16.5,26.5]	2.5	[1.3,4.8]	
El Nabatieh	332	5.5	69.4	[58.6,78.4]		21.7	[15.1,30.2]	8.9	[5.4,14.5]	
Mount Lebanon	292	5.8	61.0	[51.2,69.9]		27.5	[20.4,35.9]	11.6	[8.1,16.3]	
North	423	4.4	47.0	[38.8,55.4]		40.0	[33.2,47.2]	13.0	[8.1,20.0]	
South	323	4.7	55.3	[46.3,63.9]		34.6	[28.1,41.9]	10.1	[6.3,15.8]	
Palestinian camps	152	4.7	43.2	[33.0,54.0]		22.0	[13.3,34.1]	34.8	[27.4,43.0]	
Syrian ITS	188	4.0	35.9	[28.5,44.0]		37.5	[31.1,44.4]	26.6	[19.4,35.3]	

Table continued on next page

Characteristic	N	Mean dietary score ^a	Minimum dietary diversity (consumed ≥ 5 food groups)			Moderate food poverty (consumed 3-4 food groups)		Severe food poverty (consumed 0-2 food groups)		
			% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	% ^a	[95% CI] ^b	p-value ^c
Wealth quintile					<0.001					<0.001
Lowest	731	4.7	44.6	[36.6,52.9]		35.6	[27.7,44.4]	19.7	[15.5,24.8]	
Second	565	5.0	49.7	[40.6,58.8]		36.5	[28.9,44.8]	13.8	[9.6,19.5]	
Middle	590	5.5	61.5	[54.6,67.9]		29.9	[24.6,35.7]	8.6	[5.7,12.9]	
Fourth	563	4.8	57.0	[49.9,63.9]		32.1	[26.7,38.0]	10.9	[7.1,16.3]	
Highest	540	5.5	71.4	[64.6,77.4]		24.9	[19.5,31.3]	3.7	[2.1,6.4]	
Marital status					0.495					0.030
Never married	1158	5.1	58.6	[53.1,63.9]		32.5	[28.2,37.1]	8.9	[6.9,11.5]	
Married	1659	5.1	55.1	[50.4,59.8]		32.0	[28.1,36.1]	12.9	[10.6,15.6]	
Divorced/separated/widowed	170	5.2	53.0	[40.0,65.6]		30.8	[20.2,44.0]	16.2	[9.9,25.4]	
Household food insecurity access					<0.001					<0.001
Secure	965	5.5	66.2	[60.9,71.1]		27.9	[23.7,32.5]	6.0	[3.9,8.9]	
Mild	293	5.3	67.8	[59.9,74.9]		23.8	[18.0,30.8]	8.3	[5.1,13.3]	
Moderate	908	5.1	56.3	[49.1,63.3]		33.3	[27.5,39.7]	10.3	[7.6,14.0]	
Severe	823	4.5	40.4	[33.8,47.3]		38.4	[31.6,45.7]	21.2	[16.9,26.4]	
Menstruation					0.690					0.645
Menarche	2902	5.1	56.1	[51.8,60.3]		32.2	[28.8,35.8]	11.7	[9.8,13.9]	
Pre-menarche	87	5.1	59.1	[43.9,72.8]		26.8	[16.0,41.3]	14.1	[6.2,28.9]	
TOTAL SAMPLE	2989	5.1	56.2	[51.9,60.3]		32.1	[28.7,35.7]	11.8	[9.9,13.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.6.3. Wheat flour consumption

Table 79 presents mean wheat flour consumption among NPW. Nationally, NPW in Lebanon consume about 74 grams of flour per day. Statistically significant differences were found by strata, with the highest consumption found among women in the Syrian ITS (110 grams per day), North (94 grams per day), and the Palestinian camps (87 grams per day) strata. Significant differences in wheat flour consumption were also found by educational level, and women that have a basic secondary or less education consume 10 grams per day more than women that have completed secondary or higher education. Approximately 6% of NPW consume no wheat flour, and the mean consumption is 78.4 grams per day when these women are excluded from the analysis (data not shown).

Table 79. Mean wheat flour intake (grams per day) in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Mean ^a	[95% CI] ^b	p-value ^c
Nationality ^d				0.041
Lebanese	2093	69.3	[63.0,75.5]	
Syrian	740	83.2	[72.1,94.3]	
Palestinian	124	79.9	[43.8,115.9]	
Age group (in years)				0.629
15-19	484	74.1	[63.2,85.0]	
20-29	818	67.8	[60.0,75.5]	
30-39	810	79.6	[69.6,89.7]	
40-49	877	73.0	[64.1,81.9]	
Stratum				0.045
Akkar	250	78.4	[69.7,87.2]	
Baalbek-Hermel	350	76.3	[70.0,82.6]	
Beirut	369	82.6	[71.1,94.1]	
Bekaa	310	81.6	[67.1,96.2]	
El Nabatieh	332	59.6	[52.6,66.7]	
Mount Lebanon	292	56.8	[46.6,67.1]	
North	423	93.9	[82.5,105.3]	
South	323	79.0	[58.2,99.7]	
Palestinian camps	152	86.7	[64.1,109.3]	
Syrian ITS	188	108.4	[88.6,128.2]	

Table continued on next page

Characteristic	N	Mean ^a	[95% CI] ^b	p-value ^c
Wealth quintile				0.415
Lowest	731	79.1	[69.6,88.6]	
Second	565	64.4	[53.5,75.2]	
Middle	590	68.8	[59.2,78.3]	
Fourth	563	71.8	[62.7,80.9]	
Highest	540	84.6	[71.6,97.6]	
Household food insecurity access				0.661
Secure	965	76.7	[65.7,87.7]	
Mild	293	73.5	[62.1,84.9]	
Moderate	908	67.6	[60.2,75.1]	
Severe	823	75.9	[66.8,84.9]	
Educational level				0.025
Basic secondary or less	1613	78.0	[69.8,86.2]	
Complete secondary or more	1376	68.0	[62.4,73.6]	
Working activity				0.89
No paid work	126	69.7	[55.5,83.9]	
Unskilled labor	99	71.9	[36.7,107.2]	
Skilled labor/own business	226	68.6	[56.1,81.2]	
Marital status				0.898
Never married	1158	72.7	[65.0,80.5]	
Married	1659	74.9	[68.3,81.5]	
Divorced/separated/widowed	170	67.8	[48.3,87.3]	
Currently breastfeeding				0.959
Yes	94	74.0	[60.3,87.7]	
No	2895	73.6	[67.7,79.5]	
TOTAL SAMPLE	2989	73.6	[67.9,79.3]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^d "Other" nationality subgroup excluded from analysis due to small sample size.

3.6.4. Consumption of vitamin and mineral supplements

Table 80 presents the supplement consumption among NPW. In the six months prior to the survey, iron and vitamin D were the most commonly consumed supplements and were consumed by nearly 20% of women. Of the women that reported taking these supplements, approximately 60% were still taking iron supplements, and 70% were still taking vitamin D supplements at the time of the survey. Other supplements were less common, and less than 10% of women consumed folate, vitamin B12, vitamin A, or multivitamin supplements in the past 6 months.

When examining supplement consumption by nationality (see Figure 38), significant differences ($p < 0.01$) were found with vitamin B12 and vitamin D, with the proportion of Syrian women consuming these supplements significantly lower than Lebanese and Palestinian women.

Table 80. Consumption of vitamin and mineral supplements in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Took iron tablet or syrup in past six months			
Yes	527	19.3	[17.0,21.7]
No	2448	80.1	[77.5,82.4]
Don't know	14	0.7	[0.3,1.7]
Is still taking iron^c			
Yes	319	60.3	[52.3,67.8]
No	208	39.7	[32.2,47.7]
Took folic acid supplements in past six			
Yes	125	4.1	[3.1,5.5]
No	2844	95.1	[93.6,96.3]
Don't know	20	0.7	[0.3,1.7]
Is still taking folic acid^c			
Yes	79	67.5	[53.4,79.1]
No	46	32.5	[20.9,46.6]
Took vitamin B12 supplements in past six			
Yes	220	7.3	[5.8,9.1]
No	2733	91.3	[89.1,93.2]
Don't know	36	1.3	[0.6,2.8]
Is still taking vitamin B12^c			
Yes	145	64.9	[51.8,76.1]
No	75	35.1	[23.9,48.2]
Took vitamin D tablet or syrup in past six			
Yes	564	19.5	[17.2,22.0]
No	2407	80.0	[77.5,82.3]
Don't know	18	0.5	[0.2,1.4]
Is still taking vitamin D tablets or syrup^c			
Yes	390	68.2	[61.5,74.2]
No	174	31.8	[25.8,38.5]

Table continued on next page

Characteristic	N	% ^a	[95% CI] ^b
Took vitamin A tablets or other preparations in past six months			
Yes	81	3.4	[2.4,4.8]
No	2883	95.7	[94.3,96.8]
Don't know	25	0.8	[0.4,1.7]
Is still taking vitamin A^c			
Yes	47	71.4	[54.3,84] ^d
No	32	28.6	[16,45.7] ^e
Took multivitamin tablets or other preparations in past six months			
Yes	257	8.0	[6.4,9.9]
No	2703	91.2	[89.3,92.8]
Don't know	29	0.9	[0.4,1.7]
Is still taking multivitamins^c			
Yes	163	61.5	[50.9,71.1]
No	94	38.5	[28.9,49.1]
Took fish oil supplements in past six months			
Yes	105	4.7	[3.5,6.3]
No	2857	94.2	[92.7,95.5]
Don't know	27	1.0	[0.5,2.0]
Is still taking fish oil supplements^c			
Yes	60	55.8	[39.3,71.1]
No	40	44.2	[28.9,60.7] ^f
Took drug for intestinal worms in past six			
Yes	58	2.6	[1.7,3.9]
No	2900	96.4	[95.0,97.4]
Don't know	31	1.1	[0.6,2.0]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Only includes women who answered "Yes" to previous question.

^d Data from El Nabatieh (1 observation) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup.

^e Data from Akkar (1 observation) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup.

^f Data from Baalbek-Hermel (3 observations), Palestinian camps (1 observation), and Syrian ITS (1 observation) were excluded from analysis since the small N's in these strata caused instability in the estimation of the confidence interval for this subgroup.

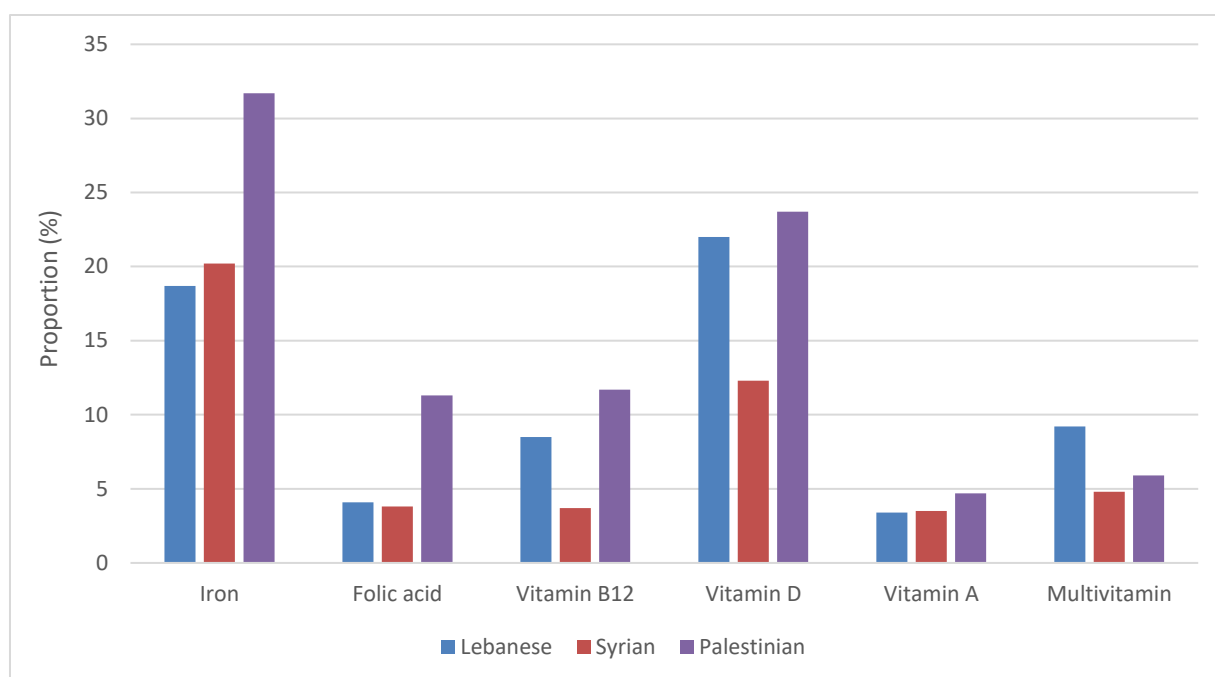


Figure 38. Mineral and vitamin supplement consumption in non-pregnant women 15-49 years of age by nationality, Lebanon 2023

3.6.5. History of cardiometabolic diseases

As shown in Table 81, one out of ten women surveyed have ever had their cholesterol or triglycerides measured. Among women who reported having their cholesterol or triglycerides measured, approximately 40% reported having raised cholesterol or triglycerides and few reported taking medication for these conditions in the past two weeks. Approximately 10% of women also reported ever having their blood sugar measured, and of those, about 26% reported ever having had raised blood sugar or diabetes. Very few women reported ever taking medication or ever seeing a traditional healer for raised blood sugar.

Table 81. History of cardiometabolic diseases in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Ever had cholesterol or triglycerides measured			
Yes	331	9.9	[8.2,12.1]
No	2658	90.1	[87.9,91.8]
Ever had raised cholesterol or triglycerides^c			
Yes	121	38.3	[29.3,48.2]
No	210	61.7	[51.8,70.7]
Took any prescribed oral medication for raised total cholesterol or triglycerides, in the past 2 weeks^d			
Yes	42	29.8	[19.1,43.4] ^e
No	78	70.2	[56.6,80.9]

Table continued on next page

Characteristic	N	% ^a	[95% CI] ^b
Ever seen a traditional/alternative healer for raised cholesterol or triglycerides^d			
Yes	24	15.6	[8.6,26.6] ^f
No	77	84.4	[73.4,91.4] ^g
Currently taking any herbal or traditional remedy for your raised cholesterol or triglycerides^d			
Yes	13	11.2	[4.5,25.3] ^h
No	93	88.8	[74.7,95.5] ⁱ
Ever had your blood sugar or other diabetes test measured			
Yes	324	9.5	[7.5,11.8]
No	2665	90.5	[88.2,92.5]
Ever had raised blood sugar or diabetes^c			
Yes	72	26.1	[19.4,34.1]
No	252	73.9	[65.9,80.6]
Currently taking any prescribed medicines, tablets or pills (other than insulin injections) for diabetes^d			
Yes	46	67.3	[47.2,82.6]
No	26	32.7	[17.4,52.8]
Currently taking prescribed insulin injection for diabetes^d			
Yes	18	25.2	[9.8,51.1]
No	25	74.8	[48.9,90.2] ^j
Ever seen a traditional/alternative healer for raised blood sugar or diabetes^d			
Yes	15	16.9	[7.7,33.0]
No	57	83.1	[67.0,92.3]
Currently taking any herbal or traditional/alternative remedy for diabetes^d			
Yes	1	3.1	[0.4,21.6]
No	71	96.9	[78.4,99.6]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Only includes women with the respective cardiometabolic disease ever measured. // ^d Only includes women ever having the respective cardiometabolic disease. // ^e Data from Syrian ITS (1 observation) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup. // ^f Data from Syrian ITS (1 observation) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup. // ^g Data from Baalbek-Hermel (10 observations) and Bekaa (9 observation) were excluded from analysis since the small N's in these strata caused instability in the estimation of the confidence interval for this subgroup. // ^h Data from Syrian ITS (1 observation) were excluded from analysis since the small N's in this stratum caused instability in the estimation of the confidence interval for this subgroup. // ⁱ Data from Baalbek-Hermel (10 observations) and Palestinian camps (4 observation) were excluded from analysis since the small N's in these strata caused instability in the estimation of the confidence interval for this subgroup. // ^j Data from Akkar (1 observation) and Syrian ITS (2 observations) were excluded from analysis since the small N's in these strata caused instability in the estimation of the confidence interval for this subgroup.

3.6.6. Smoking

As shown in Table 82, approximately 33% of women reported smoking at least one cigarette per day (self-reported). Cigarette smoking is significantly associated with age group and is more prevalent in older women. Smoking is also associated with work activity and marital status, with the highest prevalence found among women with skilled jobs and women who are divorced, separated, or widowed. The association with marital status may, however, be due to the correlation between age group and marital status (see Section 3.6.1).

Smoking is also significantly associated with stratum, and highest prevalence of NPW smokers is found in the North and Beirut strata, and lowest prevalence in the Syrian ITS stratum. Moreover, a lower proportion of Syrian women smoke compared to women of Lebanese and Palestinian nationality. Lastly, only one quarter of women living in households of the lowest wealth quintile smoke, compared to 36-43% of those in the fourth and highest wealth quintiles. While no significant difference was observed by lactation status, it is notable that approximately 30% of lactating women are smokers.

While a threshold of one cigarette per day is used to create the dichotomous variable examined in Table 82, Figure 39 illustrates that fewer than 1% of non-pregnant women smoke ≥ 10 cigarettes per day.

Table 82. Prevalence of tobacco smoking in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Smokes ≥ 1 cigarette per day ^d		p-value ^c
		% ^a	[95% CI] ^b	
Nationality				0.001
Lebanese	2093	37.0	[32.3,42.0]	
Syrian	740	22.5	[17.2,29.0]	
Palestinian	124	40.8	[26.6,56.8]	
Other	32	16.8	[5.1,42.9]	
Age group (in years)				<0.001
15-19	484	12.2	[8.0,18.2]	
20-29	818	33.3	[28.4,38.7]	
30-39	810	40.5	[33.6,47.9]	
40-49	877	37.2	[31.3,43.4]	

Table continued on next page

Characteristic	Smokes ≥ 1 cigarette per day ^d			p-value ^c
	N	% ^a	[95% CI] ^b	
Stratum				<0.001
Akkar	250	29.5	[23.9,35.7]	
Baalbek-Hermel	350	33.4	[27.3,40.1]	
Beirut	369	44.7	[35.1,54.7]	
Bekaa	310	31.0	[24.1,38.7]	
El Nabatieh	332	33.7	[21.9,47.9]	
Mount Lebanon	292	30.4	[23.6,38.2]	
North	423	45.6	[37.9,53.6]	
South	323	27.8	[18.4,39.6]	
Palestinian camps	152	24.3	[14.9,37.0]	
Syrian ITS	188	8.9	[6.1,12.9]	
Wealth quintile				0.006
Lowest	731	24.5	[19.1,30.7]	
Second	565	33.7	[26.3,42.1]	
Middle	590	31.6	[25.2,38.9]	
Fourth	563	42.6	[35.2,50.4]	
Highest	540	35.7	[29.2,42.7]	
Educational level				0.858
Basic secondary or less	1613	32.9	[28.8,37.3]	
Complete secondary or more	1376	33.4	[28.9,38.2]	
Working activity				0.013
No paid work	126	23.2	[15.9,32.5]	
Unskilled labor	99	40.6	[27.5,55.1]	
Skilled labor/Own business	226	44.2	[34.2,54.7]	
Marital status				0.001
Never married	1158	24.8	[20.4,29.8]	
Married	1659	37.8	[33.1,42.7]	
Divorced/ separated/ widowed	170	38.0	[26.3,51.3]	
Currently breastfeeding				0.623
Yes	94	29.7	[17.6,45.6]	
No	2895	33.3	[29.7,37.0]	
TOTAL SAMPLE	2989	33.1	[29.6,36.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^d Woman is considered a smoker if she smokes 1 or more of: boxed cigarettes, hand rolled cigarettes, water pipes or shisha, e-cigarettes, or IQOS daily.

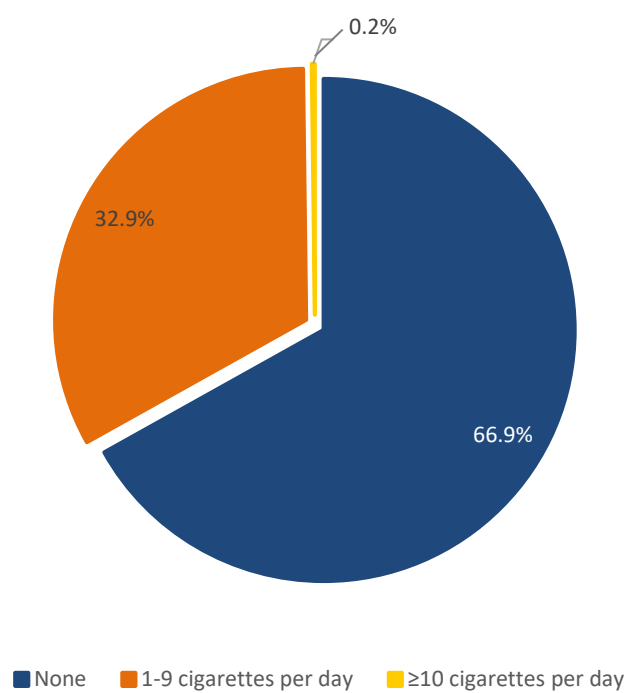


Figure 39. Number of cigarettes smoked per day in non-pregnant women 15-49 years of age, Lebanon 2023

3.6.7. Sun exposure

The results related to sun exposure practices are shown in Table 83. Almost 60% of women reported wearing a hijab. Among NPW that do not wear a hijab, approximately 27% covered their heads “sometimes” or more when outside, but less than 2% cover their head “all the time”. While coverage of arms when outside is infrequently practiced by non-hijab-wearing women, around 16% of women “always” cover their hands when outside.

Nearly 65% of women reported “never/rarely” using sunscreen, and nearly 18% reported using it “most of the time” or “all the time”. Sun exposure is common, with about 80% of women having one hour or more hours of direct sun exposure per day. In combination with the minimal covering practices, the sun exposure index shows relatively low index scores (i.e. < 10) for almost 75% of the women. About 21% (n= 605; 95% CI: 18.0, 24.1) of women have a sun exposure index score of 0 indicating no sun exposure (data not shown).

Table 83. Sun exposure patterns in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a	[95% CI] ^b
Wears hijab (veil)			
Yes	2060	59.0	[52.8,64.9]
No	929	41.0	[35.1,47.2]
Usually protects head from sun when outside^c			
Never/rarely	674	72.8	[67.2,77.8]
Sometimes	183	20.0	[15.5,25.2]
Most of the time	57	5.8	[3.5,9.4]
All the time	15	1.4	[0.7,2.8]
Usually covers arms when outside^c			
Never/rarely	695	77.2	[71.7,81.8]
Sometimes	194	20.1	[15.7,25.4]
Most of the time	32	2.4	[1.4,4.2]
All the time	8	0.3	[0.1,0.6]
Usually covers hands when outside			
Never/rarely	1734	62.0	[57.2,66.6]
Sometimes	396	13.4	[11.0,16.3]
Most of the time	259	8.8	[6.6,11.5]
All the time	600	15.8	[13.2,18.8]

Table continued on next page

Characteristic	N	% ^a	[95% CI] ^b
Approx. time on weekdays spent under the sun			
None	7	0.2	[0.01,2.1]
1-29 minutes	233	9.2	[6.8,12.3]
30-59 minutes	175	12.7	[9.8,16.2]
1-2 hours	547	26.4	[23.5,29.5]
2-3 hours	475	20.2	[17.3,23.5]
>3 hours	1026	31.2	[27.6,35.1]
Approx. time on weekends spent under the sun			
None	23	0.6	[0.3,1.3]
1-29 minutes	342	13.8	[11.0,17.1]
30-59 minutes	211	12.1	[9.7,15.1]
1-2 hours	613	28.2	[25.3,31.3]
2-3 hours	589	23.1	[20.4,26.1]
>3 hours	639	22.2	[19.1,25.6]
Usually uses sunscreen			
Never/rarely	1874	64.6	[61.6,67.6]
Sometimes	528	17.8	[15.6,20.2]
Most of the time	316	8.4	[6.8,10.2]
All the time	271	9.2	[7.5,11.1]
Respondent skin color			
Very white	57	2.3	[1.4,3.8]
White	1072	35.0	[32.1,38.1]
Olive	1627	54.2	[51.7,56.7]
Dark	210	7.7	[6.0,10.0]
Very dark	22	0.7	[0.4,1.2]
Unable to observe	1	0.0	[0.0,0.2]
Sun exposure index			
< 10	1897	74.2	[69.0,78.8]
10-20	146	8.3	[6.2,10.9]
≥ 20	349	17.5	[14.2,21.3]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Only includes women not wearing hijab.

3.6.8. Thinness, overweight and obesity

Body mass index (BMI) was used to classify NPW as underweight, normal weight, overweight, and obese. The distribution of BMI is skewed to the right, and NPW have a median BMI of 27 (Figure 40).

As shown in Figure 41, relatively few women are underweight, about 40% have a normal BMI, about one-quarter of women are overweight and one-quarter are obese. Although undernutrition is somewhat present in women, almost all women classified with underweight have BMIs between 17.0-18.4 kg/m² and, as such, are only considered “at risk” for chronic energy deficiency (Table 84).

The nutritional status of NPW is significantly associated with age. As shown in Figure 42, most women 15-19 years of age have a normal weight, and <20% are overweight or obese. The prevalences of overweight and obesity increase as age increases, and nearly 75% of women 40-49 years of age are overweight or obese. In contrast, the prevalence of underweight decreases by age group, with 12% of women 15-19 years of age underweight and <2% of women 40-49 years of age underweight. The prevalences of underweight and overweight/obesity are also associated with marital status, with the highest underweight prevalence found in women that have never been married, and the highest overweight/obesity prevalence found in women that are separated/divorced/widowed. These prevalences, however, are likely proxies for age (see Section 3.6.1).

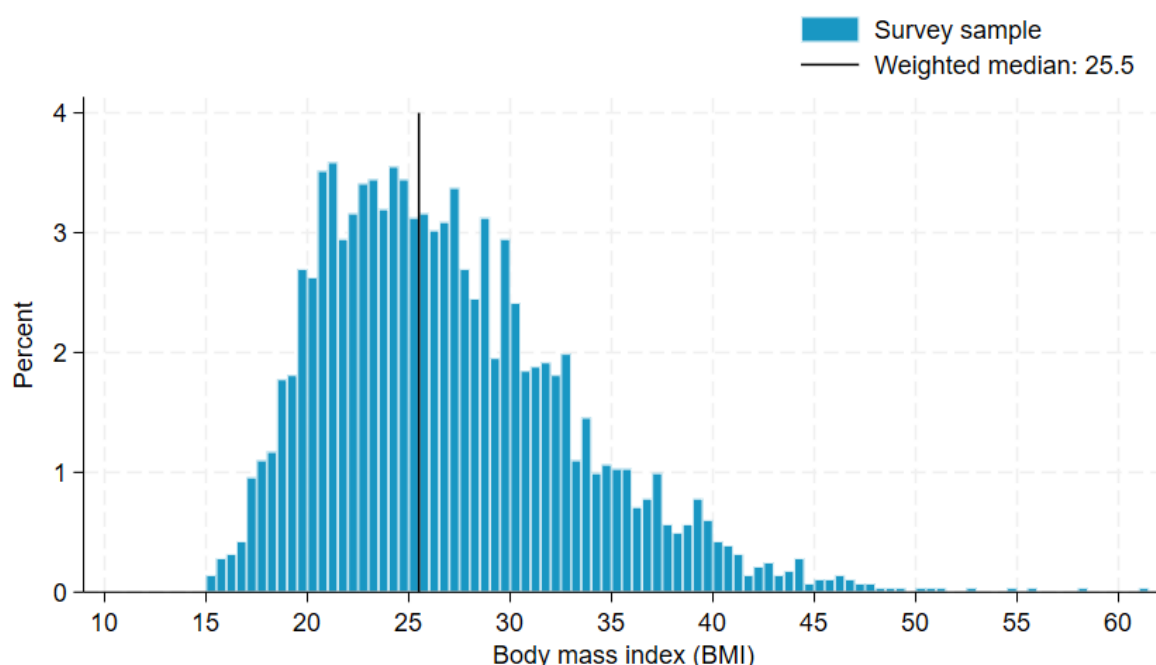


Figure 40. Distribution of BMI values in non-pregnant women 15-49 years of age, Lebanon 2023

In addition to its association with age, the prevalence of underweight is significantly associated with wealth quintile, with the highest prevalence found in women from the second quintile. The prevalence of overweight and obesity is significantly associated with education level, with a higher prevalence found among those with basic secondary education or less.

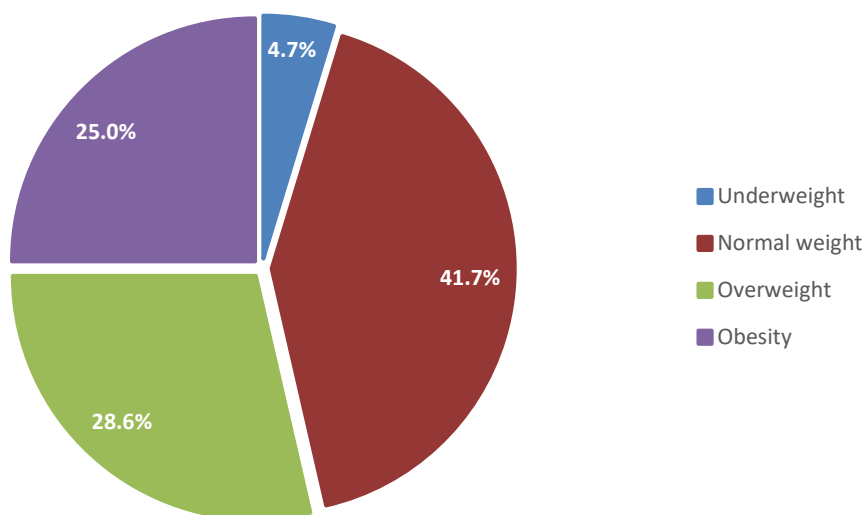


Figure 41. Prevalence of underweight, normal weight, overweight and obesity in non-pregnant women 15-49 years of age, Lebanon 2023

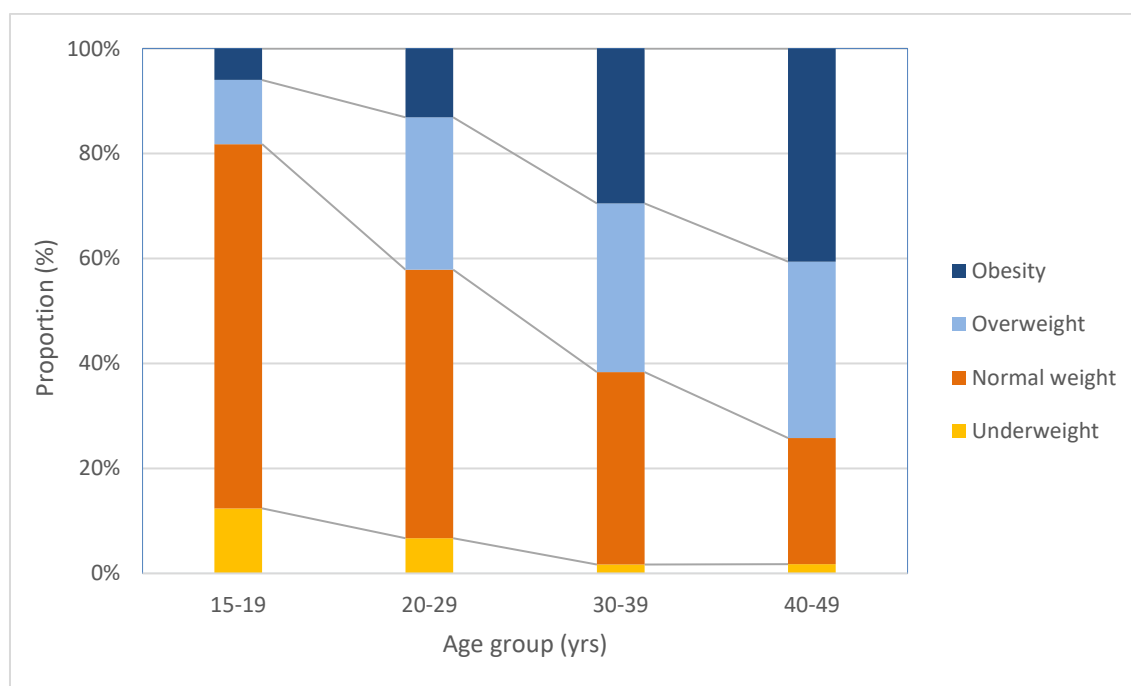


Figure 42. Prevalence of underweight, normal weight, overweight, and obesity in non-pregnant women 15-49 years of age, by age group, Lebanon 2023

Table 84. Prevalence of low and high BMI in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Mean BMI ^a	% ^a Sever	Underweight ^b % ^a Moderat	% ^a At risk	% ^a Any	p-value ^c	% ^a Normal ^b	% ^a Overwt ^b	% ^a Obese ^b	% ^a Overwt or obesity (BMI ≥25) ^b	p-value ^c
Nationality							0.014					0.502
Lebanese	2006	26.5	0.2	0.6	2.7	3.6		42.5	29.9	24.0	53.9	
Syrian	680	26.5	0.3	0.8	7.1	8.2		39.5	24.6	27.7	52.3	
Palestinian	89	27.6	0.0	0.8	2.2	3.0		30.5	33.7	32.7	66.5	
Other	31	26.0	0.0	0.0	4.6	4.6		50.2	25.7	19.5	45.2	
Age group (in years)							<0.001					<0.001
15-19	460	22.2	0.7	3.3	8.4	12.4		69.4	12.2	6.0	18.2	
20-29	757	24.9	0.3	0.4	6.0	6.7		51.2	29.1	13.1	42.2	
30-39	764	27.4	0.1	0.0	1.6	1.7		36.6	32.1	29.5	61.7	
40-49	834	29.3	0.2	0.0	1.6	1.8		24.0	33.6	40.6	74.2	
Stratum							0.280					0.459
Akkar	244	26.9	0.2	0.7	4.1	4.9		36.8	31.4	26.9	58.3	
Baalbek-Hermel	342	26.3	0.7	1.2	3.4	5.3		45.4	25.2	24.0	49.3	
Beirut	348	27.0	0.3	3.4	1.8	5.6		37.8	27.9	28.8	56.6	
Bekaa	299	26.6	0.1	0.1	4.6	4.8		38.1	34.3	22.8	57.1	
El Nabatieh	328	27.2	0.7	1.0	1.3	2.9		39.3	27.5	30.3	57.8	
Mount Lebanon	285	25.9	0.0	0.4	4.0	4.4		45.8	28.8	21.0	49.8	
North	416	27.3	0.4	0.4	1.5	2.3		39.3	29.7	28.7	58.4	
South	284	26.1	0.2	0.3	8.9	9.4		40.9	24.7	25.0	49.8	
Palestinian camps	92	28.2	0.0	0.0	7.6	7.6		31.6	23.8	37.0	60.8	
Syrian ITS	177	27.1	1.0	0.0	3.5	4.5		39.5	26.8	29.2	56.0	
Wealth quintile							<0.001					0.299
Lowest	689	26.8	0.5	0.8	3.5	4.7		41.3	25.5	28.5	54.0	
Second	520	26.1	0.3	0.8	9.2	10.4		38.9	26.0	24.8	50.8	
Middle	560	27.0	0.1	0.4	1.9	2.4		36.9	36.0	24.7	60.7	
Fourth	530	26.3	0.2	1.1	1.5	2.9		46.3	29.0	21.8	50.9	
Highest	516	26.3	0.1	0.1	2.7	2.9		46.0	26.7	24.3	51.0	

Table continued on next page

Characteristic	N	Mean BMI ^a	Underweight ^b				p-value ^c	% ^a Normal ^b	% ^a Overwt ^b	% ^a Obese ^b	% ^a Overwt or obesity (BMI ≥25) ^b	p-value ^c
			% ^a Sever	% ^a Moderat	% ^a At risk	% ^a Any						
Household food insecurity access							0.739					0.174
Secure	881	26.0	0.1	0.6	4.9	5.6		44.9	29.7	19.9	49.6	
Mild	273	27.4	0.0	0.8	2.5	3.3		37.1	28.3	31.3	59.6	
Moderate	870	26.9	0.5	1.0	2.9	4.4		38.6	28.1	28.9	57.0	
Severe	791	26.5	0.3	0.3	3.9	4.5		42.3	27.9	25.3	53.2	
Educational level							0.756					<0.001
Basic secondary or less	1501	27.3	0.4	0.4	4.2	4.9		35.9	29.0	30.1	59.1	
Complete secondary or more	1305	25.6	0.1	1.0	3.4	4.5		48.7	28.2	18.7	46.8	
Marital status							<0.001					<0.001
Never married	1087	24.3	0.4	1.7	6.6	8.8		53.0	24.3	13.9	38.2	
Married	1557	27.7	0.2	0.0	2.6	2.8		35.2	30.8	31.3	62.0	
Divorced/separated	161	28.3	0.0	0.0	0.2	0.2		35.2	32.9	31.7	64.6	
Currently lactating							0.110					0.568
Yes	87	25.3	0.0	0.0	1.6	1.6		49.9	25.4	23.1	48.5	
No	2728	26.6	0.3	0.7	3.9	4.8		41.4	28.7	25.1	53.8	
TOTAL SAMPLE	2815	26.5	0.2	0.6	3.8	4.7		41.7	28.6	25.0	53.6	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b Severe undernutrition defined as BMI < 16.0; moderate undernutrition defined as BMI 16.0-16.9; at risk of undernutrition defined as BMI 17.0-18.4; normal weight defined as BMI 18.5-24.9; overweight defined as BMI 25.0-29.9; obesity defined as BMI ≥30.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.6.9. Mid upper arm circumference in non-pregnant lactating women

Among non-pregnant *lactating* women (N=59), MUAC was used as an additional measure of nutritional status. Of these women, only 3 (10.2%; 95% CI: 3.9,23.9) have a MUAC <23 cm, denoting undernutrition. Among the 3 women with undernutrition, 1 woman is classified with severe undernutrition (MUAC < 21 cm) and 2 are classified moderate undernutrition (MUAC ≥21 & <23 cm).

3.6.10. Diabetes mellitus

As shown in Table 85, the prevalence of diabetes is low and affects less than 4% of NPW 15-49 years of age. Pre-diabetes is more common than diabetes and affects approximately 8% of women. Nearly 12% of women have elevated HbA1c (i.e., diabetes or pre-diabetes).

Diabetes, pre-diabetes, and elevated HbA1c are all significantly associated with age, marital status, and education. Significantly higher prevalences for all three conditions were found in women 40-49 years of age and in women that are divorced/separated/widowed, however, as mentioned previously (see Section 3.6.1) marital status is likely serving as a proxy for age in NPW. Regarding education, significant higher prevalences of diabetes, pre-diabetes, and elevated HbA1c were observed in women with basic secondary education or less.

Pre-diabetes and elevated HbA1c are also significantly associated with work activity and stratum, with higher prevalences found in women with no paid work in the past week and women from Bekaa and El Nabatieh. Diabetes and elevated HbA1c are also associated with current breastfeeding status, with prevalences higher in non-breastfeeding women. However, current breastfeeding may be a proxy for age, as the mean age for breastfeeding and non-breastfeeding women are 29 and 32 years, respectively (data not shown).

Table 85. Prevalence of diabetes and pre-diabetes in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^b	Diabetes ^a [95% CI] ^c	p-value ^d	Pre-diabetes ^a % ^b [95% CI] ^c	Elevated HbA1c ^a % ^b [95% CI] ^c	p-value ^d
Nationality				0.085			0.237
Lebanese	1973	4.2	[3.1,5.8]		8.4	[6.8,10.3]	12.6 [10.4,15.1]
Syrian	665	1.6	[0.6,4.5]		8.2	[5.1,13.0]	9.8 [6.4,14.8]
Palestinian	98	0.2	[0.0,1.8]		3.9	[1.7,8.9]	4.2 [1.8,9.2]
Other	29	0.0			15.3	[5.1,37.7]	15.3 [5.1,37.7]
Age group (in years)				<0.001			<0.001
15-19	453	0.4	[0.1,1.2]		1.1	[0.4,2.7]	1.4 [0.7,3.1]
20-29	745	0.6	[0.2,1.9]		2.5	[1.4,4.5]	3.2 [1.9,5.2]
30-39	746	1.0	[0.5,2.1]		7.4	[4.4,12.4]	8.5 [5.3,13.3]
40-49	831	9.2	[6.6,12.7]		17.4	[14.1,21.3]	26.6 [21.8,32.0]
Stratum				0.276			0.017
Akkar	239	1.6	[0.6,4.3]		6.5	[3.4,11.8]	8.0 [4.3,14.5]
Baalbek-Hermel	338	4.8	[3.0,7.7]		5.4	[3.1,9.3]	10.2 [7.3,14.3]
Beirut	332	1.7	[0.8,3.5]		6.8	[4.4,10.4]	8.5 [5.8,12.4]
Bekaa	296	3.8	[1.9,7.5]		11.0	[7.2,16.3]	14.8 [10.2,21.0]
El Nabatieh	329	4.2	[1.9,9.3]		16.4	[12.0,22.1]	20.7 [15.0,27.9]
Mount Lebanon	274	4.4	[2.7,7.2]		6.5	[3.9,10.6]	10.9 [7.4,16.0]
North	397	3.0	[1.2,7.0]		10.0	[6.3,15.3]	13.0 [8.1,20.0]
South	295	2.2	[1.0,4.7]		6.3	[3.7,10.4]	8.5 [5.3,13.2]
Palestinian camps	106	1.3	[0.2,9.1]		9.4	[5.0,16.8]	10.7 [5.4,20.2]
Syrian ITS	169	1.0	[0.2,4.0]		9.9	[5.2,17.9]	10.9 [6.2,18.6]
Wealth quintile				0.116			0.774
Lowest	673	3.2	[1.4,6.8]		8.0	[4.7,13.3]	11.2 [7.4,16.7]
Second	523	5.3	[2.6,10.4]		6.4	[4.2,9.4]	11.7 [8.0,16.7]
Middle	553	5.1	[2.8,8.9]		8.8	[6.0,12.7]	13.8 [10.2,18.4]
Fourth	525	1.5	[0.7,3.4]		10.3	[7.0,15.1]	11.9 [8.3,16.7]
Highest	501	1.8	[0.7,4.1]		8.3	[5.8,11.7]	10.1 [7.2,14.0]

Table continued on next page

Characteristic	N	% ^b	Diabetes ^a [95% CI] ^c	p-value ^d	Pre-diabetes ^a % ^b	[95% CI] ^c	Elevated HbA1c ^a % ^b	[95% CI] ^c	p-value ^d
Educational level				<0.001					<0.001
Basic secondary or less	1478	5.0	[3.6,7.1]		10.7	[8.4,13.5]	15.7	[12.8,19.1]	
Complete secondary or more	1287	1.4	[0.8,2.4]		5.3	[3.8,7.4]	6.7	[5.0,9.0]	
Working activity				0.407					0.047
No paid work	109	6.7	[1.2,29.1]		15.7	[7.4,30.2]	22.4	[11.5,39.1]	
Unskilled labor	94	7.3	[2.6,18.7]		3.1	[1.3,7.4]	10.4	[4.8,21.1]	
Skilled labor/Own business	203	2.3	[0.9,5.6]		6.1	[3.0,11.7]	8.4	[4.9,14.1]	
Marital status				<0.001					<0.001
Never married	1070	1.3	[0.7,2.4]		4.5	[3.2,6.3]	5.8	[4.3,7.8]	
Married	1530	3.3	[2.2,5.0]		10.3	[8.0,13.2]	13.6	[10.9,16.8]	
Divorced/separated/widowed	163	13.0	[6.7,23.6]		11.3	[6.5,18.8]	24.3	[16.6,34.2]	
Household food insecurity access				0.737					0.835
Secure	886	2.7	[1.4,5.2]		7.9	[5.8,10.8]	10.7	[7.8,14.4]	
Mild	270	3.0	[1.3,6.8]		9.7	[6.1,15.1]	12.7	[8.1,19.5]	
Moderate	850	3.5	[1.8,6.7]		9.2	[6.6,12.5]	12.7	[9.6,16.6]	
Severe	769	4.3	[2.3,7.8]		7.5	[4.6,11.9]	11.8	[8.2,16.6]	
Tobacco smoking				0.555					0.655
Yes	937	3.0	[1.7,5.2]		9.4	[7.0,12.5]	12.4	[9.3,16.2]	
No	1828	3.7	[2.5,5.3]		7.8	[5.9,10.0]	11.4	[9.1,14.2]	
Currently breastfeeding				<0.001					0.015
Yes	88	0.1	[0.0,1.1]		3.1	[0.9,10.2]	3.2	[1.0,10.2]	
No	2687	3.5	[2.6,4.8]		8.5	[7.0,10.2]	12.0	[10.1,14.2]	
TOTAL SAMPLE	2775	3.4	[2.5,4.6]		8.3	[6.9,10.0]	11.7	[9.8,13.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. // ^a Diabetes defined as HbA1c $\geq$ 6.5%, pre-diabetes defined as HbA1c 5.7-6.4%, elevated HbA1c defined as $\geq$ 5.7% [82]. // ^b Percentages weighted for unequal probability of selection. // ^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.6.11. Total cholesterol, HDL and triglycerides

Approximately 22%, 48%, and 5% of NPW have elevated triglycerides, low HDL cholesterol, and high total cholesterol, respectively (Table 86). All three indicators are associated with age group, marital status, and education status. Regarding age, the highest proportion of each indicator is found in women 40–49 years of age. The highest proportions are also found among divorced/separated/widowed women. However, in this case, marital status is likely a proxy of age (see Section 3.6.1). The prevalences of elevated triglycerides, low HDL cholesterol, and high total cholesterol are significantly higher in women with basic secondary or less education.

In addition to the above-mentioned associations, low HDL cholesterol is significantly associated with wealth quintile, household food insecurity (access), smoking status and nationality. Regarding wealth quintile, the low HDL prevalence is significantly lower in the highest quintile, while the other quintiles have similarly high (43-52%) prevalences. The prevalence of low HDL cholesterol is also lower in women residing in food secure households, among non-smokers and nationality other than Lebanese, Syrian or Palestinian.

3.6.12. Visceral/central obesity

As shown in Table 87, half of the surveyed women have visceral / central obesity, as measured using waist circumference. Visceral / central obesity is significantly associated with age and marital status. The prevalence of visceral / central obesity increases consistently with age, and is also highest among women that are divorced, separated, or widowed. Despite the latter association, it is notable that marital status is likely a proxy for age (see Section 3.6.1). The prevalence of visceral / central obesity is significantly higher in women with a basic secondary or less education compared to more educated women. Visceral / central obesity is also significantly associated with wealth quintile, with the highest prevalence found in the middle quintile. Lastly, NPW that smoke cigarettes have a significantly lower prevalence of visceral / central obesity than non-smokers.

Table 86. Prevalence with elevated triglycerides, low HDL and elevated total cholesterol levels in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Elevated triglycerides ^d			Low HDL cholesterol ^e			Elevated total cholesterol ^f		
		% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	p-value ^c
Nationality				0.145			0.012			0.403
Lebanese	2003	23.4	[19.0,28.4]		44.9	[41.1,48.7]		5.3	[4.0,7.1]	
Syrian	666	19.1	[15.0,23.9]		55.3	[48.2,62.1]		2.9	[1.0,8.2]	
Palestinian	97	11.0	[5.0,22.7]		47.4	[33.5,61.7]		3.8	[1.5,9.5]	
Other	29	13.4	[4.1,35.9]		32.8	[14.4,58.5]		6.5	[0.9,35.1]	
Age group (in years)				<0.001			<0.001			<0.001
15-19	456	16.1	[11.4,22.2]		24.3	[18.4,31.4]		1.2	[0.5,2.9]	
20-29	751	9.7	[7.0,13.1]		49.4	[42.3,56.4]		0.7	[0.3,1.7]	
30-39	754	19.5	[15.0,25.0]		49.4	[44.0,54.7]		5.2	[2.5,10.3]	
40-49	843	36.7	[30.4,43.5]		56.4	[50.5,62.1]		9.3	[6.6,12.9]	
Stratum				0.464			0.619			0.072
Akkar	241	15.6	[10.8,22.1]		44.9	[36.7,53.4]		2.1	[1.0,4.4]	
Baalbek-Hermel	346	19.3	[13.8,26.3]		48.8	[40.4,57.3]		3.3	[1.5,7.1]	
Beirut	341	22.0	[16.2,29.3]		44.1	[35.2,53.4]		4.6	[2.4,8.9]	
Bekaa	296	19.6	[13.2,28.0]		47.9	[37.2,58.9]		2.9	[1.2,6.8]	
El Nabatieh	330	28.8	[22.8,35.6]		54.4	[48.0,60.6]		5.2	[3.1,8.5]	
Mount Lebanon	274	23.6	[15.8,33.7]		45.6	[37.5,54.0]		4.3	[2.1,8.7]	
North	408	21.4	[15.5,28.9]		47.5	[41.6,53.6]		8.0	[5.3,12.1]	
South	293	19.1	[12.7,27.6]		46.7	[38.6,55.1]		4.7	[2.6,8.4]	
Palestinian camps	107	14.8	[8.5,24.4]		54.5	[43.0,65.6]		4.6	[1.8,10.9]	
Syrian ITS	168	21.1	[14.5,29.6]		57.0	[46.2,67.2]		1.0	[0.1,6.5]	
Wealth quintile				0.215			0.003			0.463
Lowest	677	18.9	[14.5,24.2]		55.4	[49.1,61.5]		4.2	[1.8,9.8]	
Second	525	27.4	[18.7,38.4]		50.0	[42.4,57.7]		6.4	[4.1,10.0]	
Middle	561	21.3	[15.1,29.3]		44.3	[38.1,50.7]		4.1	[2.5,6.6]	
Fourth	526	24.6	[18.9,31.3]		48.9	[40.9,57.1]		5.6	[3.3,9.6]	
Highest	515	17.8	[13.1,23.5]		36.8	[31.0,43.0]		3.2	[1.8,5.5]	

Table continued on next page

Characteristic	N	Elevated triglycerides ^d			Low HDL cholesterol ^e			Elevated total cholesterol ^f		
		% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	p-value ^c	% ^a	[95% CI] ^b	p-value ^c
Educational level				0.032			<0.001			<0.001
Basic secondary or less	1488	24.5	[20.2,29.4]		53.0	[47.8,58.1]		6.7	[4.7,9.5]	
Complete secondary or more	1307	18.7	[14.7,23.4]		40.5	[36.5,44.6]		2.2	[1.4,3.3]	
Working activity				0.778			0.306			0.402
No paid work	112	19.5	[10.3,33.8]		51.1	[35.2,66.7]		6.6	[1.3,27.8]	
Unskilled labor	94	22.0	[11.5,38.1]		37.2	[24.0,52.6]		1.7	[0.6,4.4]	
Skilled labor/Own business	212	17.3	[8.9,30.8]		38.1	[27.8,49.5]		4.7	[2.3,9.5]	
Marital status				0.001			<0.001			0.015
Never married	1081	16.7	[13.2,20.9]		36.1	[31.7,40.6]		1.9	[1.2,3.2]	
Married	1546	23.1	[19.7,27.0]		52.6	[48.0,57.2]		5.8	[4.0,8.2]	
Divorced/Separated/Widowed	166	35.7	[22.8,51.1]		61.2	[49.3,72.0]		9.3	[3.6,21.9]	
Household food insecurity access				0.364			<0.001			0.450
Secure	898	23.0	[17.9,28.9]		40.5	[34.9,46.3]		3.6	[2.3,5.6]	
Mild	272	27.0	[19.8,35.7]		58.2	[48.6,67.2]		5.3	[2.7,10.3]	
Moderate	859	21.5	[16.6,27.4]		47.5	[42.2,52.9]		4.5	[2.9,7.0]	
Severe	775	19.4	[15.3,24.2]		52.6	[47.3,57.9]		6.0	[3.4,10.4]	
Tobacco smoking				0.947			<0.001			0.113
Yes	949	22.1	[18.0,26.8]		43.1	[38.9,47.5]		6.2	[4.3,8.8]	
No	1846	21.8	[17.3,27.2]		55.8	[50.7,60.7]		3.9	[2.5,6.1]	
Currently breastfeeding				0.209			0.147			0.693
Yes	88	14.3	[6.7,28.0]		37.8	[25.9,51.4]		5.9	[1.8,18.0]	
No	2716	22.2	[18.7,26.1]		47.8	[44.2,51.4]		4.7	[3.5,6.2]	
TOTAL SAMPLE	2804	21.9	[18.5,25.8]		47.5	[44.0,51.0]		4.7	[3.5,6.3]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. // ^a Percentages weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. // ^d Elevated triglycerides defined as ≥ 90 mg/dL for women aged < 18 years in fasting status, ≥ 130 mg/dL for women aged < 18 years in non-fasting status, ≥ 150 mg/dL for women aged ≥ 18 years in fasting status, ≥ 200 mg/dL for women aged ≥ 18 years in non-fasting status. ^e Low HDL cholesterol defined as < 40 mg/dL for women aged < 18 years, < 50 mg/dL for women aged ≥ 18 years. // ^f Elevated total cholesterol defined as ≥ 200 mg/dL for women aged < 18 years, ≥ 240 mg/dL for women aged ≥ 18 years.

Table 87. Prevalence of visceral/central obesity in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	% with visceral/ central obesity ^{a, b}	[95% CI] ^c	p-value ^d
Nationality				0.638
Lebanese	2013	51.5	[47.9,55.1]	
Syrian	679	49.1	[42.8,55.3]	
Palestinian	90	57.4	[44.9,69.1]	
Other	31	41.6	[19.3,68.0]	
Age group (in years)				<0.001
15-19	460	15.0	[11.2,19.9]	
20-29	759	34.4	[29.2,39.9]	
30-39	769	60.5	[55.4,65.3]	
40-49	834	74.5	[69.7,78.8]	
Stratum				0.345
Akkar	247	61.3	[55.5,66.9]	
Baalbek-Hermel	343	53.4	[47.2,59.5]	
Beirut	347	56.5	[46.7,65.8]	
Bekaa	300	50.7	[39.5,61.8]	
El Nabatieh	329	54.3	[49.3,59.3]	
Mount Lebanon	286	49.7	[44.3,55.1]	
North	417	46.4	[38.6,54.3]	
South	285	47.7	[37.5,58.1]	
Palestinian camps	93	51.8	[36.1,67.1]	
Syrian ITS	175	58.2	[47.6,68.0]	
Wealth quintile				0.033
Lowest	689	52.2	[46.3,58.0]	
Second	526	46.6	[38.9,54.5]	
Middle	560	59.2	[52.6,65.5]	
Fourth	534	44.5	[39.0,50.2]	
Highest	513	50.8	[43.6,57.8]	
Educational level				<0.001
Basic secondary or less	1505	57.7	[53.5,61.9]	
Complete secondary or more	1308	42.3	[37.9,46.9]	
Working activity				0.758
No paid work	119	51.2	[40.0,62.2]	
Unskilled labor	96	44.8	[30.6,59.9]	
Skilled labor/Own business	213	46.6	[37.4,56.1]	

Table continued on next page

Characteristic	N	% with visceral/ central obesity ^{a, b}	[95% CI] ^c	p-value ^d
Marital status				<0.001
Never married	1090	32.1	[27.3,37.3]	
Married	1559	60.9	[56.8,64.8]	
Divorced/Separated/Widowed	162	65.6	[53.4,76.0]	
Household food insecurity access				0.084
Secure	881	47.5	[41.7,53.4]	
Mild	275	61.0	[52.4,68.9]	
Moderate	871	52.3	[47.3,57.2]	
Severe	795	50.2	[45.6,54.8]	
Tobacco smoking				0.003
Yes	960	48.1	[44.5,51.7]	
No	1853	56.5	[52.0,60.9]	
Currently breastfeeding				0.928
Yes	87	50.1	[35.5,64.7]	
No	2735	50.9	[47.7,54.0]	
TOTAL SAMPLE	2822	50.8	[47.9,53.8]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Visceral/central obesity defined as waist circumference ≥ 78.3 cm for women aged 15-16 years, ≥ 78.9 cm for women aged 16-17 years, ≥ 79.5 cm for women aged 17-18 years, ≥ 80.0 cm for women aged ≥ 18 years [70,120].

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.6.13. Hypertension

As shown in Table 88, less than 7% of NPW are hypertensive. Hypertension is associated with age and is low in all age groups except in women 40-49 years of age, where the prevalence is nearly 15%. Marital status is also associated with hypertension, and is highest among women that are divorced, separated, or widowed. However, in this case marital status is likely a proxy for age (see Section 3.6.1). Hypertension is also associated with stratum, and the highest prevalence is found in the Mount Lebanon and the lowest prevalence is found in Bekaa. Hypertension is also significantly higher among women with basic secondary or less education compared to their more educated peers. Lastly, the hypertension prevalence is significantly higher in women with a high sodium intake compared to women with normal sodium intake.

Table 88. Prevalence of hypertension in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	% with hypertension ^{a, b}	[95% CI] ^c	p-value ^d
Nationality				0.391
Lebanese	2021	7.3	[5.4,9.7]	
Syrian	673	5.1	[2.7,9.4]	
Palestinian	83	6.0	[1.6,20.3]	
Other	31	1.7	[0.4,7.1]	
Age group (in years)				<0.001
15-19	458	2.9	[0.9,9.0]	
20-29	756	1.2	[0.7,2.3]	
30-39	763	4.3	[2.3,7.7]	
40-49	840	14.9	[10.9,20.0]	
Stratum				<0.001
Akkar	248	1.5	[0.5,4.0]	
Baalbek-Hermel	342	7.3	[4.7,11.2]	
Beirut	346	6.1	[3.1,11.4]	
Bekaa	300	0.1	[0.0,0.6]	
El Nabatieh	329	1.2	[0.4,3.2]	
Mount Lebanon	283	10.5	[7.1,15.4]	
North	419	7.3	[5.0,10.7]	
South	293	5.4	[2.4,11.7]	
Palestinian camps	81	5.0	[1.8,12.7]	
Syrian ITS	176	2.8	[1.0,7.9]	

Table continued on next page

Characteristic	N	% with hypertension ^{a, b}	[95% CI] ^c	p-value ^d
Wealth quintile				0.106
Lowest	681	4.9	[2.7,8.8]	
Second	522	9.2	[5.2,15.8]	
Middle	563	9.5	[6.1,14.5]	
Fourth	533	5.2	[2.6,10.1]	
Highest	518	4.1	[2.3,7.3]	
Educational level				0.009
Basic secondary or less	1500	8.4	[6.1,11.4]	
Complete secondary or more	1308	4.5	[3.0,6.6]	
Working activity				0.563
No paid work	116	12.6	[4.1,32.4]	
Unskilled labor	97	7.7	[2.7,20.1]	
Skilled labor/Own business	214	6.9	[3.4,13.2]	
Marital status				<0.001
Never married	1090	2.2	[1.1,4.4]	
Married	1554	8.8	[6.8,11.3]	
Divorced/Separated/Widowed	163	11.3	[5.3,22.4]	
Household food insecurity access				0.728
Secure	882	7.8	[5.0,11.8]	
Mild	270	4.8	[2.0,10.8]	
Moderate	875	6.4	[4.1,9.7]	
Severe	790	6.0	[3.1,11.3]	
Tobacco smoking				0.835
Yes	957	6.9	[4.8,9.8]	
No	1851	6.5	[4.4,9.4]	
Excess sodium intake				0.019
Yes	1485	8.8	[6.3,12.2]	
No	1013	4.6	[2.9,7.3]	
Currently breastfeeding				0.759
Yes	92	7.7	[2.9,19.1]	
No	2725	6.6	[5.0,8.6]	
TOTAL SAMPLE	2817	6.6	[4.9,8.6]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Hypertension defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.6.14. Metabolic syndrome

As shown in Table 89, approximately 25% of NPW have metabolic syndrome. Metabolic syndrome increases with age and affects 44% of women 40-49 years of age. Metabolic syndrome is also associated with marital status, with the highest prevalence found among divorced/separated/widowed women; however, marital status in this case is a proxy for age. Education level and wealth are also associated with metabolic syndrome, with a higher prevalence found in women with a basic secondary or less education and women from in the lowest wealth quintile. A higher rate of metabolic syndrome is found in smokers.

All the components of metabolic syndrome are highly and positively associated (Table 90). To illustrate, the prevalence of visceral/central obesity is significantly higher among women with elevated HbA1c, elevated triglycerides, low HDL cholesterol, and elevated blood pressure.

Table 89. Prevalence of metabolic syndrome in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	% with metabolic syndrome ^{a, b}	[95% CI] ^c	p-value ^d
Nationality				0.667
Lebanese	1960	24.6	[21.4,28.0]	
Syrian	644	25.8	[20.9,31.4]	
Palestinian	76	27.8	[15.8,43.9]	
Other	29	14.2	[4.6,36.4]	
Age group (in years)				<0.001
15-19	445	2.0	[1.0,4.0]	
20-29	722	11.4	[8.3,15.5]	
30-39	730	28.0	[22.4,34.3]	
40-49	820	44.4	[38.7,50.3]	
Stratum				0.349
Akkar	237	20.3	[12.5,31.2]	
Baalbek-Hermel	338	21.9	[16.3,28.7]	
Beirut	326	21.9	[17.1,27.5]	
Bekaa	296	23.1	[17.7,29.5]	
El Nabatieh	326	30.6	[24.5,37.5]	
Mount Lebanon	272	26.9	[21.0,33.7]	
North	397	22.8	[15.9,31.5]	
South	286	21.4	[14.9,29.8]	
Palestinian camps	72	37.2	[24.1,52.5]	
Syrian ITS	167	27.5	[21.6,34.3]	

Table continued on next page

Characteristic	N	% with metabolic syndrome ^{a, b}	[95% CI] ^c	p-value ^d
Wealth quintile				0.002
Lowest	653	30.0	[25.1,35.5]	
Second	506	25.5	[19.8,32.2]	
Middle	544	28.0	[23.0,33.5]	
Fourth	517	22.8	[18.2,28.1]	
Highest	497	16.0	[11.6,21.7]	
Educational level				<0.001
Basic secondary or less	1446	32.7	[28.5,37.2]	
Complete secondary or more	1263	15.0	[12.0,18.4]	
Working activity				0.312
No paid work	107	26.8	[15.4,42.4]	
Unskilled labor	94	16.4	[8.6,28.9]	
Skilled labor/Own business	201	17.0	[10.8,25.8]	
Marital status				<0.001
Never married	1051	9.4	[7.2,12.2]	
Married	1495	32.2	[27.8,36.9]	
Divorced/Separated/Widowed	161	41.8	[30.1,54.6]	
Household food insecurity access				0.202
Secure	851	21.6	[17.7,26.1]	
Mild	264	28.6	[21.6,36.8]	
Moderate	841	25.9	[21.9,30.4]	
Severe	761	26.4	[21.7,31.6]	
Tobacco smoking				0.039
Yes	1789	22.9	[19.6,26.6]	
No	920	28.6	[24.1,33.5]	
Currently breastfeeding				0.091
Yes	87	12.1	[4.5,28.6]	
No	2630	25.2	[22.4,28.3]	
TOTAL SAMPLE	2717	24.8	[22.0,27.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Metabolic syndrome defined as waist circumference ≥ 80 cm plus any two of the four following factors: elevated HbA1c as $\geq 5.7\%$; elevated triglycerides defined as ≥ 150 mg/dL; low HDL cholesterol defined as < 50 mg/dL; elevated blood pressure defined as systolic blood pressure ≥ 135 mmHg and/or diastolic blood pressure ≥ 85 mmHg [109, 110].

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

Table 90. Internal association between components of metabolic syndrome in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	Elevated HbA1c ^a			Elevated triglycerides ^b			Low HDL cholesterol ^c			Elevated blood pressure ^d			Central/visceral obesity ^e		
	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g
Elevated HbA1c ^a						<0.001			<0.001			<0.001			<0.001
No				2430	24.3		2430	48.5		2384	19.5		2381	45.1	
Yes				335	68.8		335	72		327	44.5		324	89.4	
Elevated triglycerides ^b			<0.001						<0.001			<0.001			<0.001
No	1957	5.2					1981	43.6		1936	17.9		1939	38.6	
Yes	808	27.4					823	69.6		804	32.1		800	78.1	
Low HDL cholesterol ^c			<0.001			<0.001						0.023			<0.001
No	1318	6.8		1337	18.4					1312	19.4		1306	39.9	
Yes	1447	16.5		1467	40.1					1428	24.7		1433	60.2	
Elevated blood pressure ^d			<0.001			<0.001			0.026						<0.001
No	2157	8.4		2186	25.8		2186	49.4					2224	45.5	
Yes	554	23.5		554	43.2		554	57					562	68	
Central/visceral obesity ^e			<0.001			<0.001			<0.001			<0.001			
No	1269	2.5		1285	13.0		1285	40.9		1301	14.3				
Yes	1436	20.9		1454	45.9		1454	61.2		1485	29.7				

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Elevated HbA1c defined as $\geq 5.7\%$.

^b Elevated triglycerides defined as ≥ 150 mg/dL.

^c Low HDL cholesterol defined as < 50 mg/dL.

^d Hypertension as systolic blood pressure ≥ 135 mmHg and/or diastolic blood pressure ≥ 85 mmHg.

^e Visceral/central obesity defined as waist circumference ≥ 80.0 cm [70, 120].

^f Percentages weighted for unequal probability of selection.

^g Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

3.6.15. Inflammation

Table 91 presents the prevalence of inflammation among NPW. Nationally, about 43% of women have inflammation. Only about 5% of inflammation is from elevated CRP only (i.e., early convalescent), and elevated CRP *and* AGP and elevated AGP alone are found in 16% and 22% of women, respectively (Figure 43).

Inflammation is associated with age and affects nearly 50% of women 40 and 49 years of age, and 33% of women 15 and 19 years of age. Inflammation is also significantly lower among women who have never been married compared to those that are married, and divorced, separated, or widowed. Inflammation is equally prominent among Lebanese and Palestinian NPW (around 46%), and the lowest prevalence is found in Syrian women (37%). Accordingly, women living in Syrian ITS have the lowest prevalence of inflammation, while those residing in Mount Lebanon and the Palestinian camps have the highest (50%) inflammation prevalence.

When examining inflammation categories by breastfeeding status (see Figure 43), it is notable that breastfeeding women have a higher inflammation prevalence, which is characterized by higher levels of early and acute inflammation — but less convalescent inflammation — than non-breastfeeding women.

Inflammation is also highly associated with multiple cardiometabolic indicators (Table 92). Specifically, the inflammation prevalence is significantly higher in women that have diabetes, pre-diabetes, elevated triglycerides, low HDL cholesterol, elevated total cholesterol, hypertension, and central/ visceral obesity.

Table 91. Prevalence of any inflammation in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with any inflammation ^b	[95% CI] ^c	p-value ^d
Nationality				0.017
Lebanese	1998	45.6	[41.5,49.7]	
Syrian	674	37.2	[30.5,44.4]	
Palestinian	99	45.9	[30.7,61.8]	
Other	28	15.5	[6.6,32.4]	
Age group (in years)				0.012
15-19	453	33.7	[27.1,41.0]	
20-29	755	41.5	[35.0,48.3]	
30-39	758	43.0	[36.9,49.4]	
40-49	843	49.4	[43.7,55.1]	
Stratum				0.01
Akkar	247	42.3	[36.5,48.2]	
Baalbek-Hermel	343	35.1	[27.0,44.2]	
Beirut	346	34.1	[28.4,40.3]	
Bekaa	293	38.8	[32.5,45.6]	
El Nabatieh	326	46.4	[41.0,51.9]	
Mount Lebanon	267	48.7	[40.9,56.5]	
North	411	45.1	[38.2,52.1]	
South	293	37.5	[27.9,48.2]	
Palestinian camps	108	48.8	[36.5,61.2]	
Syrian ITS	175	27.6	[20.6,36.0]	
Wealth quintile				0.919
Lowest	681	41.8	[35.9,48.1]	
Second	528	44.5	[35.9,53.4]	
Middle	559	43.9	[36.9,51.2]	
Fourth	530	40.9	[34.9,47.1]	
Highest	511	44.6	[37.2,52.2]	
Educational level				0.912
Basic secondary or less	1498	43.0	[38.1,48.0]	
Complete secondary or more	1301	43.4	[38.6,48.2]	
Working activity				0.957
No paid work	114	40.7	[27.5,55.5]	
Unskilled labor	95	40.5	[26.3,56.5]	
Skilled labor/Own business	215	43.1	[31.5,55.4]	

Table continued on next page

Characteristic	N	% ^a with any inflammation ^b	[95% CI] ^c	p-value ^d
Marital status				0.030
Never married	1078	37.7	[32.9,42.9]	
Married	1553	45.5	[41.2,49.8]	
Divorced/separated/widowed	166	50.3	[38.7,61.9]	
Household food insecurity access				0.990
Secure	891	42.7	[37.2,48.5]	
Mild	272	44.5	[36.3,53.0]	
Moderate	862	42.9	[37.3,48.7]	
Severe	784	43.3	[37.3,49.6]	
Tobacco smoking				0.678
Yes	948	44.1	[39.3,49.0]	
No	1851	42.7	[38.0,47.5]	
Currently breastfeeding				0.356
Yes	90	53.7	[31.3,74.7]	
No	2719	42.8	[39.2,46.3]	
TOTAL SAMPLE	2809	43.1	[39.6,46.7]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection. // ^b Any inflammation defined as elevated CRP (> 5 mg/L) and/or elevated AGP (> 1 g/L). // ^c CI = confidence interval, calculated taking into account the complex sampling design. // ^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

Table 92. Association between inflammation and cardiometabolic indicators in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a with any inflammation ^b	[95% CI] ^c	p-value ^d
Diabetes^e				0.011
Yes	75	65.9	[47.7,80.3]	
No	2668	42.6	[39.0,46.2]	
Elevated HbA1c^f				<0.001
Yes	333	64.7	[56.2,72.4]	
No	2410	40.5	[36.6,44.5]	
Elevated triglycerides^g				<0.001
Yes	597	59.4	[51.6,66.8]	
No	2176	38.8	[35.5,42.3]	
Low HDL cholesterol^h				<0.001
Yes	1361	54.5	[49.5,59.4]	
No	1412	33.4	[29.2,37.9]	
Elevated total cholesterolⁱ				0.005
Yes	126	63.0	[48.6,75.4]	
No	2647	42.4	[39.0,45.9]	
Hypertension^j				0.011
Yes	133	59.6	[46.1,71.8]	
No	2612	42.1	[38.5,45.8]	
Central/ visceral obesity^k				<0.001
Yes	1472	57.0	[52.1,61.8]	
No	1271	28.8	[24.6,33.3]	
Metabolic syndrome^l				<0.001
Yes	669	65.9	[58.9,72.2]	
No	2019	36.1	[32.6,39.8]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection. // ^b Any inflammation defined as elevated CRP (> 5 mg/L) and/or elevated AGP (> 1 g/L). // ^c CI = confidence interval, calculated taking into account the complex sampling design. // ^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. // ^e Diabetes defined as HbA1c ≥ 6.5%. // ^f Elevated HbA1c defined as ≥ 5.7%. // ^g Elevated triglycerides defined as ≥ 90 mg/dL for women aged < 18 years in fasting status, ≥ 130 mg/dL for women aged < 18 years in non-fasting status, ≥ 150 mg/dL for women aged ≥ 18 years in fasting status, ≥ 200 mg/dL for women aged ≥ 18 years in non-fasting status. // ^h Low HDL cholesterol defined as < 40 mg/dL for women aged < 18 years, < 50 mg/dL for women aged ≥ 18 years. // ⁱ Elevated total cholesterol defined as ≥ 200 mg/dL for women aged < 18 years, ≥ 240 mg/dL for women aged ≥ 18 years. // ^j Hypertension defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg. // ^k Visceral/central obesity defined as waist circumference ≥ 78.3 cm for women aged 15-16 years, ≥ 78.9 cm for women aged 16-17 years, ≥ 79.5 cm for women aged 17-18 years, ≥ 80.0 cm for women aged ≥ 18 years [70,120]. // ^l Metabolic syndrome defined as waist circumference ≥ 80 cm plus any two of the four following factors: elevated HbA1c as ≥ 5.7%; elevated triglycerides defined as ≥ 150 mg/dL; low HDL cholesterol defined as < 50 mg/dL; elevated blood pressure defined as systolic blood pressure ≥ 135 mmHg and/or diastolic blood pressure ≥ 85 mmHg [109, 110].

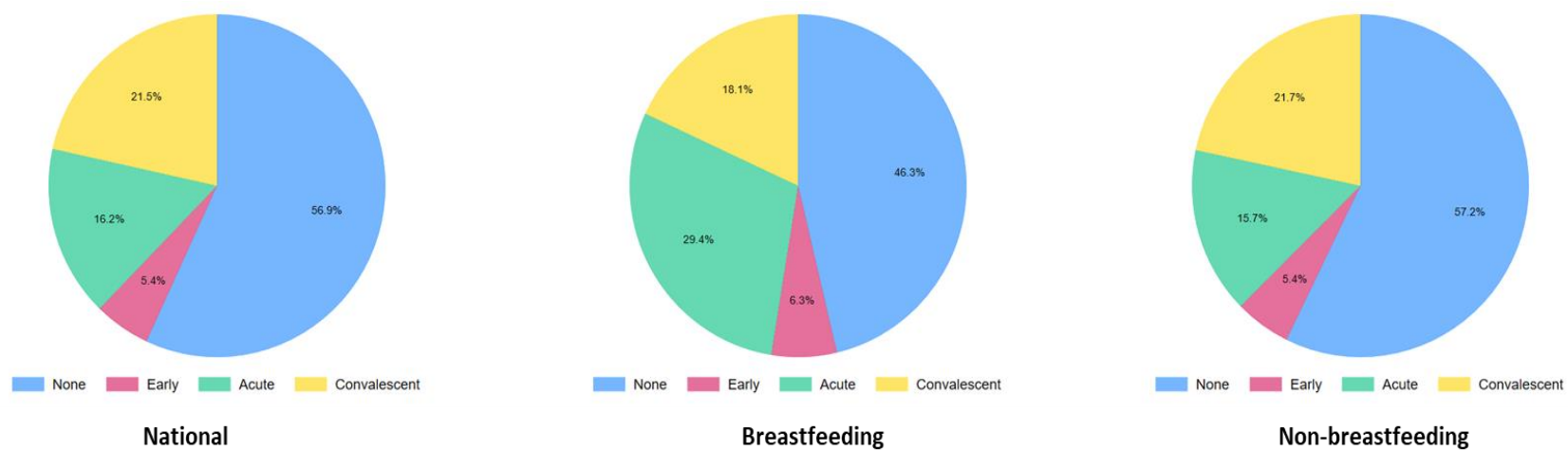


Figure 43. Inflammation categories in non-pregnant women 15-49 years of age, Lebanon 2023

3.6.16. *Anemia, iron deficiency, and iron deficiency anemia*

Valid hemoglobin measurements are available for 2799 NPW. The distribution of hemoglobin values for NPW is roughly symmetric with the majority of values above the anemia cut-off point of 120 g/L (Figure 44). The weighted mean hemoglobin concentration is 122 g/L (95% CI: 121, 123) and weighted median is 125 g/L (IQR: 116, 131) (data not shown). Nationally, about 35% of NPW are anemic (Table 93). The majority of women have mild anemia (20.3%), and severe anemia is only present in a small proportion of women (1.1%; see Appendix 8.3). According to WHO, anemia in NPW denotes a moderate public health problem [10]. Almost 39% of women are iron deficient, and ID poses a moderate public health problem according to WHO classification [102].

As shown in Figure 45, the prevalence of NPW with concomitant anemia and ID is 24%. About 11% of women have anemia without ID and the prevalence of non-anemic iron deficient women is about 14%. Approximately 69% of anemic women are iron deficient (data not shown).

Anemia, ID, and IDA are significantly associated with period bleeding, and the highest prevalences of the three indicators are found among women with severe menstrual bleeding compared to others. Anemia, ID, and IDA are also significantly associated with marital status, with the highest prevalences occurring in married women.

Anemia and IDA — but not ID — are associated with strata. Approximately 45% of NPW living in the Palestinian camps and Mount Lebanon are anemic, and about one-third of women in these two strata have IDA. The lowest prevalences of both anemia and IDA are found in the South, El Nabatieh, and Bekaa governorates.

ID is associated with age, with the highest prevalence among women between 30 and 39 years of age. A similar pattern was shown for anemia, but the variable failed to reach statistical significance. Lastly, IDA is positively associated with lactation status, with a lower IDA prevalence (11%) occurring in lactating women compared to non-lactating women (25%).

When examining anemia, ID, and IDA by nationality within each governorate (Figure 46), consistently higher prevalences for all three indicators are found Syrian women compared to Lebanese women¹².

¹² Figure 46 excludes Palestinian nationality because of the small number of Palestinian women in each governorate.

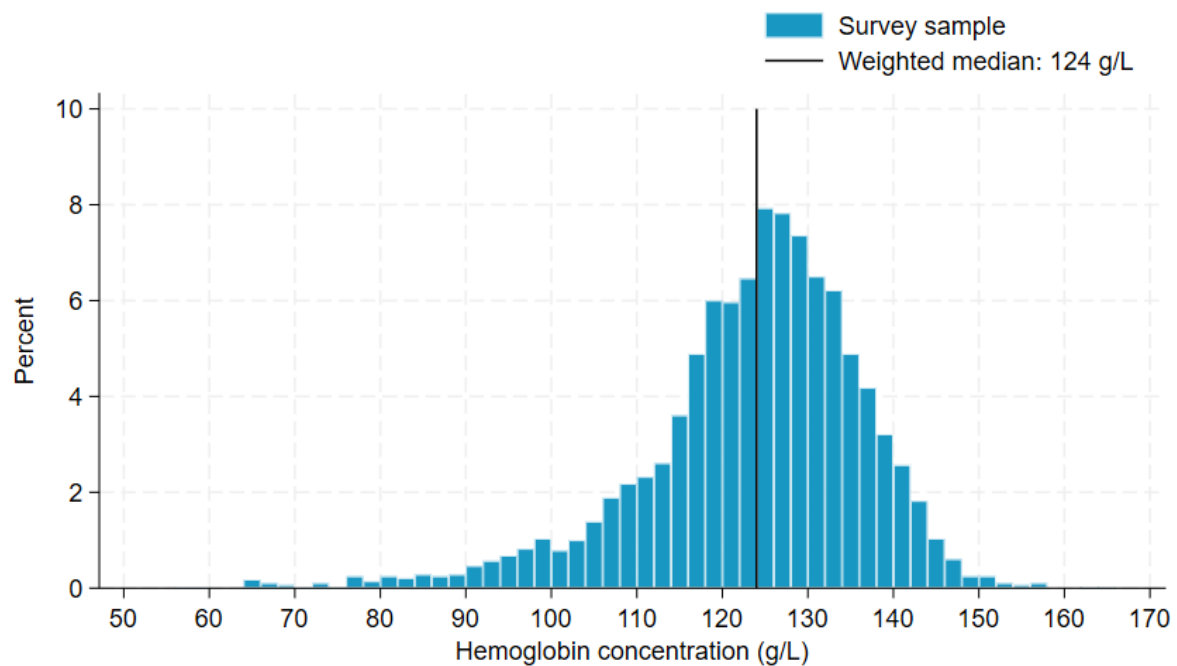


Figure 44. Distribution of adjusted hemoglobin (g/L) in non-pregnant women 15-49 years, Lebanon 2023

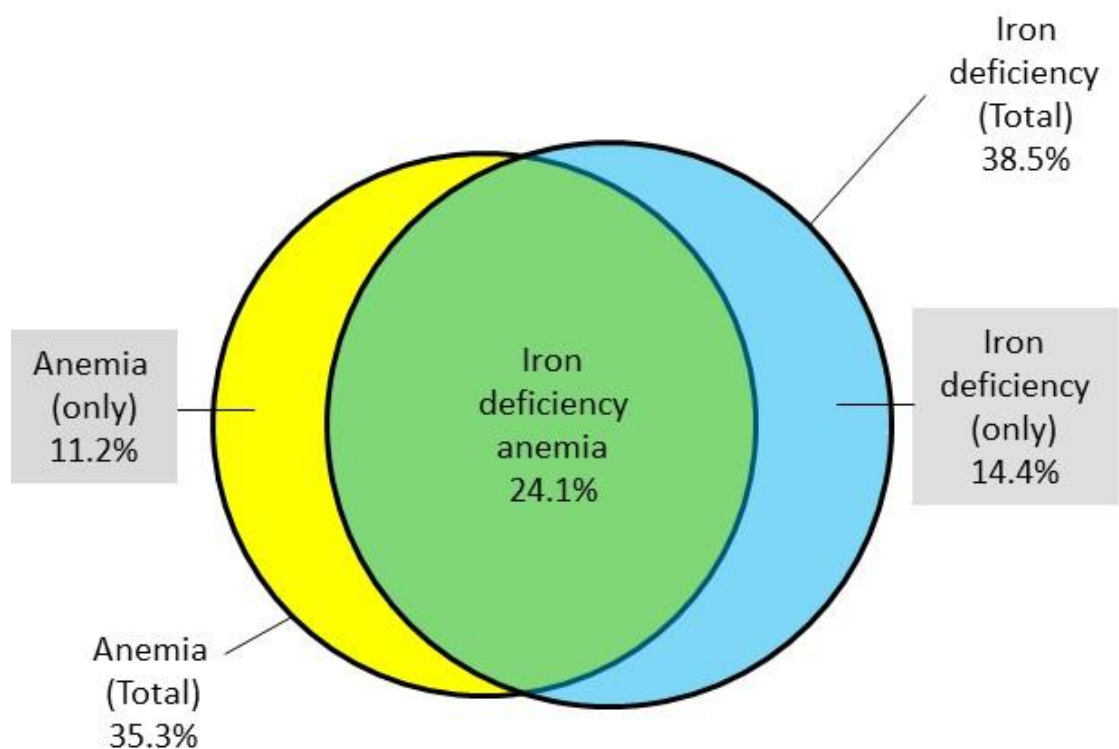


Figure 45. Venn diagram showing overlap between anemia and iron deficiency in non-pregnant women 15-49 years of age, Lebanon 2023

Table 93. Prevalence of anemia, iron deficiency, and iron deficiency anemia in non-pregnant women 15-49 years by various demographic characteristics, Lebanon 2023.

Characteristic	Anemia ^d				Iron deficiency ^e				Iron deficiency anemia ^f			
	N	% ^a	95% CI ^b	p-value ^c	N	% ^a	95% CI ^b	p-value ^c	N	% ^a	95% CI ^b	p-value ^c
Nationality				0.187				0.160				0.295
Lebanese	1995	35.1	[31.4,39.0]		1998	36.7	[33.5,40.1]		1976	22.7	[19.8,25.8]	
Syrian	667	34.5	[27.5,42.2]		674	43.1	[35.4,51.2]		656	27.3	[20.1,35.9]	
Palestinian	98	54.7	[41.4,67.4]		99	46.4	[34.6,58.6]		96	33.9	[24.0,45.4]	
Other	29	22.5	[8.1,48.7]		28	27.1	[10.9,53.1]		28	18.6	[5.6,46.8]	
Age group (in years)				0.056				0.006				0.098
15-19	455	28.4	[21.1,37.0]		453	31.3	[23.8,39.9]		449	20.3	[13.8,28.9]	
20-29	753	31.0	[25.3,37.4]		755	35.7	[29.5,42.5]		742	20.5	[16.0,25.9]	
30-39	753	39.2	[33.3,45.5]		758	47.5	[41.0,54.0]		744	29.6	[23.6,36.5]	
40-49	838	38.9	[33.1,45.1]		843	36.9	[32.6,41.3]		831	24.3	[20.2,28.9]	
Period bleeding				<0.001				<0.001				<0.001
Severe	643	48.1	[41.5,54.8]		653	51.2	[44.9,57.6]		635	37.6	[31.3,44.5]	
Moderate	1608	31.2	[26.9,35.8]		1606	35.4	[31.3,39.6]		1590	19.9	[16.5,23.7]	
Mild/minimal	385	31.2	[23.8,39.6]		387	34.5	[28.0,41.6]		380	20.9	[15.0,28.3]	
Stratum				0.007				0.090				0.001
Akkar	242	36.0	[30.2,42.4]		247	43.8	[37.4,50.5]		241	27.5	[23.3,32.3]	
Baalbek-Hermel	339	32.6	[26.5,39.4]		343	35.6	[30.4,41.2]		338	22.1	[17.7,27.3]	
Beirut	341	33.1	[27.6,39.2]		346	46.2	[39.6,52.9]		339	25.5	[20.0,32.1]	
Bekaa	296	28.6	[24.3,33.4]		293	34.2	[29.8,38.8]		293	18.4	[14.7,22.8]	
El Nabatieh	330	26.0	[21.1,31.5]		326	36.2	[29.3,43.7]		326	18.5	[13.7,24.6]	
Mount Lebanon	275	43.8	[36.0,52.0]		267	39.7	[32.1,47.7]		267	30.9	[23.8,39.0]	
North	406	31.7	[25.2,39.0]		411	37.7	[30.3,45.6]		398	19.0	[14.8,24.2]	
South	296	26.5	[19.2,35.3]		293	34.6	[29.1,40.6]		291	16.9	[11.9,23.4]	
Palestinian camps	107	44.9	[32.6,57.9]		108	46.7	[37.0,56.6]		107	35.5	[25.6,46.7]	
Syrian ITS	167	32.0	[25.3,39.7]		175	37.5	[30.4,45.2]		166	20.3	[14.9,27.0]	

Table continued on next page

Characteristic	Anemia ^d				Iron deficiency ^e				Iron deficiency anemia ^f			
	N	% ^a	95% CI ^b	p-value ^c	N	% ^a	95% CI ^b	p-value ^c	N	% ^a	95% CI ^b	p-value ^c
Wealth quintile				0.944				0.650				0.564
Lowest	674	37.4	[30.7,44.6]		681	38.7	[31.0,47.1]		664	26.2	[19.5,34.2]	
Second	527	34.4	[26.9,42.8]		528	35.7	[27.4,44.9]		519	24.0	[17.5,32.1]	
Middle	556	35.4	[28.7,42.6]		559	36.2	[30.5,42.3]		550	19.5	[14.8,25.3]	
Fourth	529	35.5	[28.1,43.6]		530	43.2	[35.8,50.9]		524	27.2	[20.0,35.8]	
Highest	513	33.2	[26.0,41.3]		511	39.3	[33.5,45.4]		509	23.5	[18.2,29.8]	
Educational level				0.927				0.606				0.703
Basic secondary or less	1486	35.1	[30.9,39.5]		1498	37.7	[33.1,42.5]		1469	23.5	[19.8,27.8]	
Complete secondary or	1303	35.4	[30.5,40.5]		1301	39.4	[35.0,44.0]		1287	24.6	[20.7,29.1]	
Marital Status				0.039				<0.001				0.015
Never married	1081	30.0	[24.7,35.8]		1078	34.0	[29.7,38.6]		1068	20.4	[16.4,25.0]	
Married	1541	39.5	[35.3,43.9]		1553	43.5	[39.1,48.0]		1521	27.6	[23.8,31.8]	
Divorced/separated/widow	165	29.6	[18.3,44.0]		166	24.9	[17.4,34.3]		165	16.6	[9.7,26.9]	
Currently lactating				0.508				0.557				0.013
Yes	88	30.5	[18.7,45.6]		90	33.0	[17.7,53.1]		88	10.8	[5.2,21.4]	
No	2711	35.4	[32.1,38.9]		2719	38.7	[35.6,41.9]		2678	24.5	[21.7,27.6]	
Household food insecurity access				0.434				0.550				0.452
Secure	899	36.6	[30.6,43.0]		891	41.2	[36.1,46.4]		887	26.6	[21.7,32.1]	
Mildly insecure	273	39.5	[30.9,48.8]		272	39.5	[33.0,46.5]		270	23.6	[17.8,30.5]	
Moderately insecure	857	31.3	[26.1,37.0]		862	36.5	[31.2,42.1]		846	21.0	[16.8,26.1]	
Severely insecure	770	36.3	[30.0,43.2]		784	37.1	[30.4,44.3]		763	24.4	[18.4,31.5]	
Household sanitation ^g				0.525				0.507				0.666
Inadequate	112	39.3	[25.8,54.6]		107	43.1	[28.6,58.8]		105	26.3	[15.4,41.2]	
Adequate	2634	34.6	[31.3,38.1]		2648	38.1	[34.9,41.3]		2608	23.6	[20.7,26.7]	
Safe drinking water ^h				0.698				0.834				0.259
Yes	2538	35.3	[31.9,39.0]		2543	38.4	[35.1,41.7]		2506	24.3	[21.4,27.6]	
No	255	33.2	[23.8,44.1]		260	39.3	[30.9,48.4]		254	19.7	[13.6,27.6]	
TOTAL SAMPLE	2799	35.3	[32.0,38.7]		2809	38.5	[35.3,41.8]		2766	24.1	[21.3,27.2]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. // ^a Percentages weighted for unequal probability of selection. //

^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. // ^d Anemia defined as hemoglobin < 120 g/L; hemoglobin adjusted for elevation and smoking [118]. // ^e Iron deficiency defined as inflammation adjusted plasma ferritin < 15 µg/L; ferritin adjusted for inflammation [88]. // ^f Iron deficiency anaemia defined as plasma ferritin < 15 µg/L and hemoglobin < 120 g/L; ferritin adjusted for inflammation [88] // ^g Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. // ^h Composite variable of the main source of drinking water and treating water to make safe for drinking.

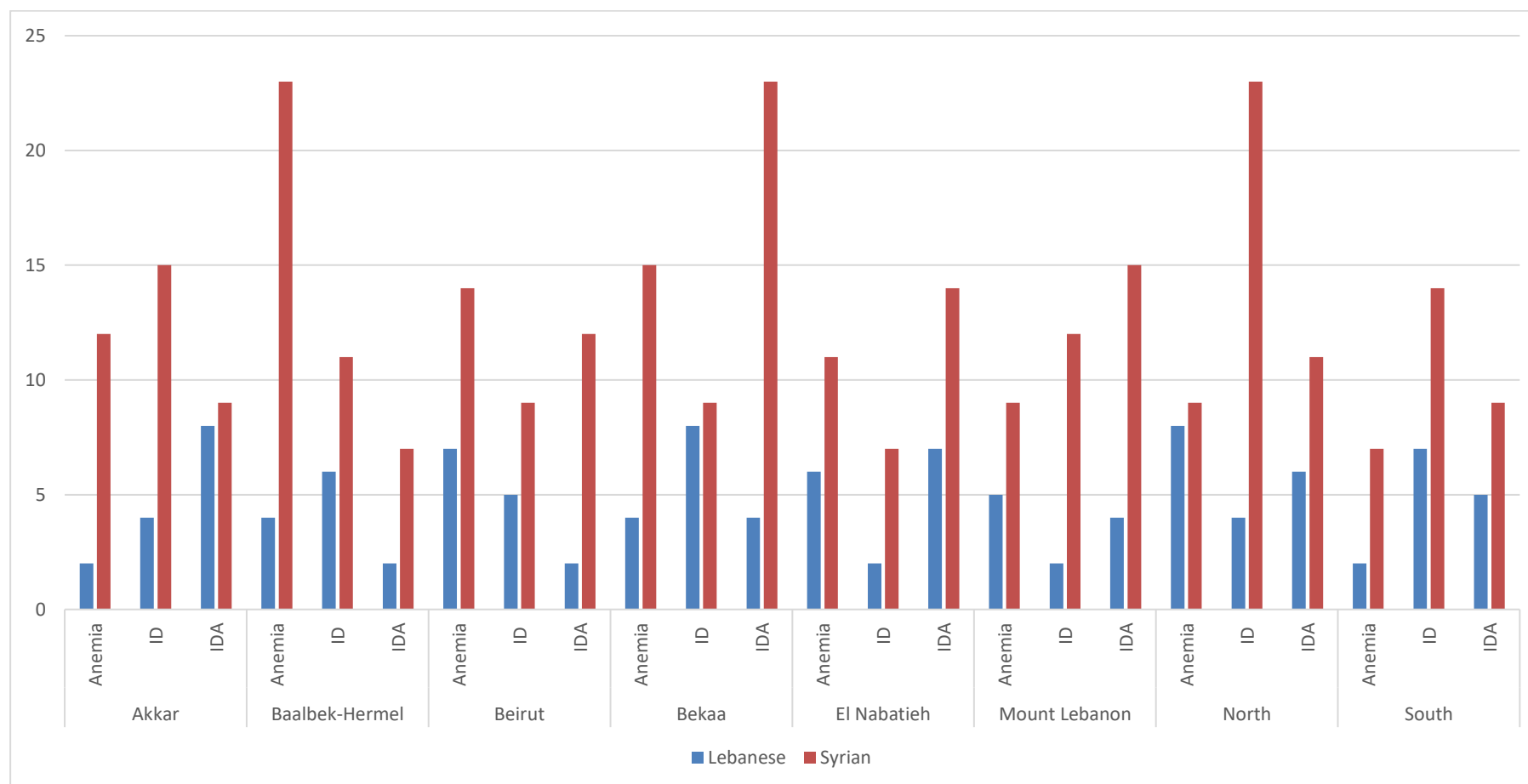


Figure 46. Anemia, iron deficiency and iron deficiency anemia prevalence by nationality in the different governorate strata (excluding Syrian ITS and Palestinian camps strata) in non-pregnant women 15-49 years, Lebanon 2023

3.6.17. Vitamin A deficiency

As shown in Table 94, the national prevalence of vitamin A deficiency among NPW is low (i.e., <2%). The highest prevalence is found among NPW of the Palestinian camps, with a prevalence of more than 7%. Vitamin A deficiency is also found in 2.9% of women residing in the South and the Syrian ITS strata. Notably, only 0.7% of the Lebanese women are vitamin A deficient compared to 3.2% of Syrian women and 3.7% in of Palestinian women.

Table 94. Prevalence of vitamin A deficiency in non-pregnant women 15-49 years by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with vitamin A deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				0.016
Lebanese	1998	0.7	[0.4,1.5]	
Syrian	674	3.2	[1.4,7.3]	
Palestinian	99	3.7	[1.2,11.4]	
Other	28	0.0	--	
Age group (in years)				0.262
15-19	453	2.5	[0.7,8.9]	
20-29	755	2.2	[1.1,4.1]	
30-39	758	0.5	[0.2,1.2]	
40-49	843	1.2	[0.4,3.9]	
Stratum				0.005
Akkar	247	1.3	[0.4,4.4]	
Baalbek-Hermel	343	0.4	[0.1,1.7]	
Beirut	346	0.4	[0.1,1.4]	
Bekaa	293	0.7	[0.1,3.3]	
El Nabatieh	326	0.7	[0.2,2.3]	
Mount Lebanon	267	1.5	[0.5,4.1]	
North	411	1.2	[0.4,3.6]	
South	293	2.9	[0.6,13.2]	
Palestinian camps	108	7.5	[3.1,17.0]	
Syrian ITS	175	2.9	[1.3,6.6]	
Wealth quintile				0.296
Lowest	681	2.4	[1.0,5.7]	
Second	528	2.2	[0.7,6.9]	
Middle	559	0.3	[0.1,1.6]	
Fourth	530	1.2	[0.4,3.8]	
Highest	511	1.0	[0.3,3.2]	
Educational level				0.650
Basic secondary or less	1498	1.6	[0.7,3.6]	
Complete secondary or more	1301	1.2	[0.6,2.4]	
Marital Status				0.162
Never married	1078	2.1	[0.9,4.7]	
Married	1553	1.2	[0.6,2.5]	
Divorced/separated/widowed	166	0.1	[0.0,0.6]	
Currently lactating				0.598
Yes	90	0.9	[0.2,4.8]	
No	2719	1.5	[0.9,2.6]	

Table continued on next page

Characteristic	N	% ^a with vitamin A deficiency ^b	[95% CI] ^c	p-value ^d
Household food insecurity access				0.087
Secure	891	2.0	[0.8,5.0]	
Mild	272	0.7	[0.2,2.4]	
Moderate	862	0.3	[0.1,1.0]	
Severe	784	2.2	[1.0,4.9]	
Household sanitation^e				0.248
Inadequate	107	0.5	[0.1,2.6]	
Adequate	2648	1.4	[0.8,2.5]	
Safe drinking water^f				0.441
Yes	2543	1.5	[0.9,2.7]	
No	260	0.9	[0.2,3.3]	
TOTAL SAMPLE	2809	1.5	[0.9,2.5]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection. // ^b Vitamin A deficiency defined as retinol binding protein (RBP) < 0.62

μmol/L. // ^c CI = confidence interval, calculated taking into account the complex sampling design. // ^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup. // ^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. // ^f Composite variable of main source of drinking water and treating water to make safe for drinking.

3.6.18. Folate and vitamin B12 deficiency

As shown in Table 95, nearly 20% of NPW are deficient in folate, and folate deficiency is significantly associated with stratum, household wealth quintile and marital status. Folate deficiency is highest among women living in Beirut and lowest among women residing in Baalbek-Hermel. Moreover, folate deficiency is highest among women who have been divorced, separated or widowed. A higher deficiency prevalence was found in women living in wealthier households compared to women residing in poor households.

As shown in Table 96, the prevalence of vitamin B12 deficiency is also about 20%. Significant differences were found by strata, with a higher vitamin B12 deficiency prevalence in women living in the Syrian ITS stratum. Similarly, the vitamin B12 deficiency prevalence in Syrian women is higher than that of Lebanese and Palestinian women. Moreover, vitamin B12 deficiency is associated with household wealth, with the smallest proportion of vitamin B12 deficient among women residing in the wealthiest households. Moreover, an inverse dose-response relationship is observed, with the prevalence decreasing progressively as household wealth increases. Vitamin B12 deficiency is also significantly associated with household food security, with higher prevalences found in women living in moderate and severe food insecure households. When examining folate and vitamin B12 deficiency prevalences by nationality within each governorate (Figure 47), consistently higher prevalences are found among the Syrian women compared to Lebanese women.¹³

¹³ Figure 47 excludes Palestinian nationality due to the small number of Palestinian women in each governorate.

Table 95. Prevalence of folate deficiency in non-pregnant women 15-49 years by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with folate deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				0.532
Lebanese	2003	17.6	[14.9,20.6]	
Syrian	666	18.4	[14.6,23.0]	
Palestinian	97	27.0	[18.7,37.3]	
Other	29	15.5	[4.6,41.2]	
Age group (in years)				0.409
15-19	456	20.5	[14.3,28.5]	
20-29	751	16.6	[12.8,21.1]	
30-39	754	20.0	[16.2,24.4]	
40-49	843	16.0	[12.8,19.9]	
Stratum				<0.001
Akkar	241	18.3	[12.7,25.5]	
Baalbek-Hermel	346	7.1	[4.1,12.0]	
Beirut	341	28.4	[22.7,35.0]	
Bekaa	296	16.5	[11.6,22.8]	
El Nabatieh	330	17.8	[12.3,25.0]	
Mount Lebanon	274	16.1	[12.4,20.7]	
North	408	18.7	[13.2,25.9]	
South	293	23.1	[16.3,31.8]	
Palestinian camps	107	20.6	[14.0,29.3]	
Syrian ITS	168	15.7	[10.8,22.2]	
Wealth quintile				0.039
Lowest	677	15.1	[11.4,19.7]	
Second	525	18.9	[14.4,24.3]	
Middle	561	13.1	[9.3,18.3]	
Fourth	526	20.5	[15.9,26.1]	
Highest	515	23.3	[17.6,30.2]	
Educational level				0.099
Basic secondary or less	1488	16.2	[13.7,19.1]	
Complete secondary or more	1307	20.1	[16.6,24.2]	
Marital Status				<0.001
Never married	1081	21.3	[17.0,26.4]	
Married	1546	13.5	[11.2,16.1]	
Divorced/separated/widowed	166	31.7	[22.4,42.8]	
Currently lactating				0.444
Yes	88	21.1	[13.8,30.9]	
No	2716	17.9	[15.7,20.2]	
Household food insecurity				0.605
Secure	898	19.5	[15.8,23.9]	
Mild	272	20.0	[13.4,28.7]	
Moderate	859	17.4	[13.2,22.6]	
Severe	775	16.0	[12.7,19.9]	

Table continued on next page

Characteristic	N	% ^a with folate deficiency ^b	[95% CI] ^c	p-value ^d
Household sanitation^e				0.183
Inadequate	113	26.2	[14.4,42.9]	
Adequate	2637	17.5	[15.3,19.8]	
Safe drinking water^f				0.111
Yes	2543	17.5	[15.4,19.8]	
No	255	24.5	[16.1,35.4]	
TOTAL SAMPLE	2804	18.0	[15.9,20.3]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Folate deficiency defined as plasma folate < 10 nmol/L.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

Table 96. Prevalence of vitamin B12 deficiency in non-pregnant women 15-49 years by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with vitamin B12 deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				<0.001
Lebanese	2003	16.7	[13.7,20.3]	
Syrian	666	32.4	[25.9,39.6]	
Palestinian	97	9.6	[4.5,19.3]	
Other	29	36.9	[14.5,66.9]	
Age group (in years)				0.319
15-19	456	23.8	[17.2,31.9]	
20-29	751	21.5	[17.0,26.8]	
30-39	754	22.5	[16.7,29.5]	
40-49	843	17.5	[14.1,21.5]	
Stratum				0.008
Akkar	241	27.1	[20.9,34.4]	
Baalbek-Hermel	346	23.3	[19.0,28.3]	
Beirut	341	21.8	[15.0,30.7]	
Bekaa	296	20.3	[14.2,28.2]	
El Nabatieh	330	17.0	[12.7,22.4]	
Mount Lebanon	274	20.7	[14.6,28.6]	
North	408	21.5	[13.8,31.9]	
South	293	12.2	[7.8,18.5]	
Palestinian camps	107	17.4	[8.8,31.6]	
Syrian ITS	168	42.5	[34.1,51.4]	
Wealth quintile				<0.001
Lowest	677	32.3	[26.2,39.1]	
Second	525	21.4	[13.6,31.9]	
Middle	561	18.4	[13.4,24.7]	
Fourth	526	18.5	[13.0,25.6]	
Highest	515	10.9	[8.0,14.6]	

Table continued on next page

Characteristic	N	% ^a with vitamin B12 deficiency ^b	[95% CI] ^c	p-value ^d
Educational level				<0.001
Basic secondary or less	1488	25.8	[21.9,30.2]	
Complete secondary or more	1307	14.4	[11.5,17.9]	
Marital Status				0.527
Never married	1081	21	[16.7,26.0]	
Married	1546	21.4	[17.8,25.4]	
Divorced/separated/widowed	166	16	[9.0,27.0]	
Currently lactating				0.669
Yes	88	22.9	[14.7,33.9]	
No	2716	20.8	[17.7,24.2]	
Household food insecurity				0.011
Secure	898	15.8	[10.7,22.8]	
Mild	272	12.7	[8.8,17.9]	
Moderate	859	24.7	[20.2,29.8]	
Severe	775	25.7	[20.1,32.2]	
Household sanitation^e				0.949
Inadequate	113	21.5	[11.6,36.4]	
Adequate	2637	21.1	[18.1,24.5]	
Safe drinking water^f				0.587
Yes	2543	21.1	[18.0,24.5]	
No	255	18.7	[11.7,28.4]	
TOTAL SAMPLE	2804	20.8	[17.9,24.2]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Vitamin B12 deficiency defined as serum vitamin B12 <150 pmol/L.

^b Percentages weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

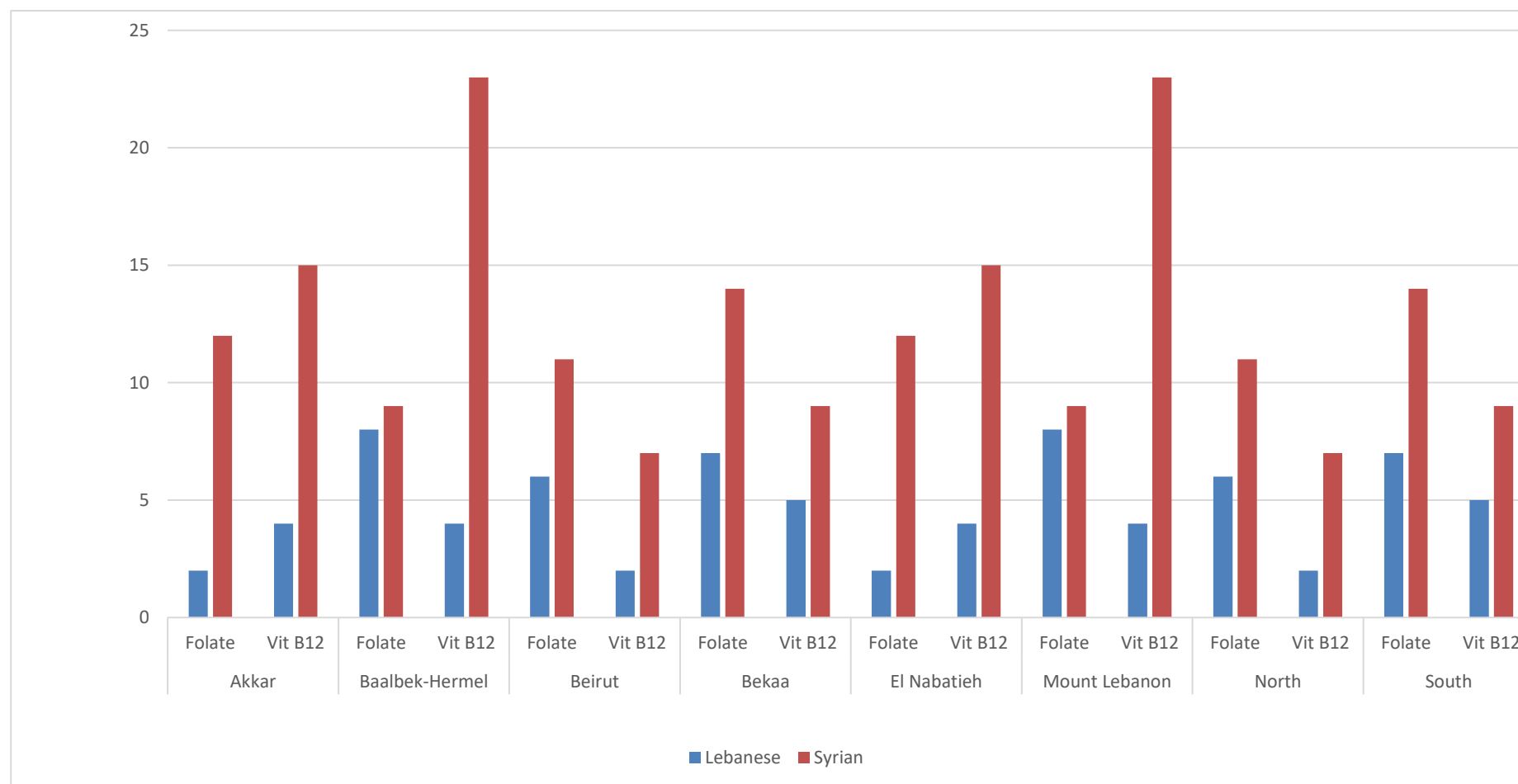


Figure 47. Folate and vitamin B12 deficiency prevalence by nationality in the different governorate strata (excluding Syrian ITS and Palestinian camps strata) in non-pregnant women 15-49 years, Lebanon 2023

3.6.19. *Vitamin D deficiency*

The prevalences of vitamin D deficiency and insufficiency are described in Table 97. Nationally, 38% and 31% of NPW are deficient and insufficient in vitamin D, respectively. When examining the prevalence of vitamin D deficiency and insufficiency together, nearly 70% of women are affected. Vitamin D deficiency and combined deficiency/insufficiency are significantly associated with age, stratum, nationality, wealth quintile, education level, household food insecurity access status, and sun exposure. Regarding age, the prevalences of vitamin D deficiency and deficiency/insufficiency is inversely associated with age, with the highest prevalence found in youngest women and the lowest prevalence found in oldest women. When examining these two indicators by stratum, the highest prevalences are found in the Syrian ITS and Palestinian camp strata, with the largest proportion in each stratum being deficient. Accordingly, the prevalences of vitamin D deficiency and deficiency/insufficiency are highest in among women with Syrian or Palestinian nationalities. Vitamin D deficiency is twice as prevalent among NPW with lower education levels as those with higher education (49% versus 24%).

Wealth quintile is inversely associated with vitamin D deficiency and deficiency/insufficiency prevalence, with nearly 60% of deficiency occurring in the lowest wealth quintile compared to 16% in the highest quintile. Similarly, an inverse association was found between vitamin D deficiency and deficiency/insufficiency prevalences and household food security access, with the prevalences decreasing in women as their households become more food secure; deficiency occurs in 54% of women in severely food insecure households and in 25% of women from food secure households.

The prevalences of vitamin D deficiency and deficiency/insufficiency are also lower among women that receive greater sun exposure as measured by the sun exposure index. Similarly, the prevalences are nearly 4 times higher in veiled compared to non-veiled women.

Table 97. Prevalence of vitamin D deficiency in non-pregnant women 15-49 years by various demographic characteristics, Lebanon 2023

Characteristic	Deficient ^a				Insufficient ^b		Deficient or insufficient		
	N	% ^c	[95% CI] ^d	p-value ^e	% ^c	[95% CI] ^d	% ^c	[95% CI] ^d	p-value ^e
Nationality				<0.001					<0.001
Lebanese	200	27.8	[24.4,31.5]		34.0	[30.5,37.7]	61.8	[57.5,65.9]	
Syrian	666	65.3	[58.4,71.6]		24.3	[18.9,30.5]	89.5	[84.7,92.9]	
Palestinian	97	57.1	[36.0,75.9]		23.1	[13.0,37.6]	80.2	[65.4,89.6]	
Other	29	35.3	[14.0,64.7]		29.5	[12.7,54.6]	64.8	[37.9,84.8]	
Age group (in years)				0.001					<0.001
15-19	456	49.9	[42.1,57.7]		31.6	[24.9,39.2]	81.5	[73.9,87.3]	
20-29	751	39.5	[33.6,45.6]		35.2	[29.1,41.8]	74.6	[69.4,79.3]	
30-39	754	37.2	[30.7,44.2]		29.0	[24.2,34.4]	66.3	[60.2,71.8]	
40-49	843	31.1	[26.4,36.1]		30.0	[25.4,35.1]	61.1	[55.3,66.6]	
Stratum				<0.001					<0.001
Akkar	241	48.6	[37.6,59.8]		30.1	[23.3,37.9]	78.7	[69.7,85.6]	
Baalbek-Hermel	346	46.8	[39.6,54.1]		34.1	[28.2,40.6]	80.9	[76.8,84.5]	
Beirut	341	37.0	[26.8,48.6]		26.6	[20.0,34.5]	63.6	[51.7,74.0]	
Bekaa	296	25.1	[18.7,32.9]		39.0	[30.8,47.9]	64.2	[56.1,71.5]	
El Nabatieh	330	32.4	[23.5,42.7]		29.9	[24.9,35.4]	62.2	[53.7,70.1]	
Mount Lebanon	274	33.6	[27.1,40.8]		34.6	[28.7,40.9]	68.1	[60.8,74.7]	
North	408	41.7	[31.4,52.8]		22.5	[17.3,28.7]	64.2	[53.8,73.4]	
South	293	36.0	[27.0,46.1]		36.7	[30.6,43.2]	72.7	[61.5,81.6]	
Palestinian camps	107	68.5	[55.3,79.2]		20.3	[12.4,31.5]	88.8	[80.0,94.0]	
Syrian ITS	168	72.2	[62.6,80.1]		22.1	[15.5,30.4]	94.3	[89.8,96.9]	
Wealth quintile				<0.001					<0.001
Lowest	677	59.4	[52.5,66.0]		25.1	[19.7,31.4]	84.5	[77.3,89.7]	
Second	525	42.1	[32.1,52.8]		36.6	[28.2,45.9]	78.7	[70.4,85.2]	
Middle	561	32.2	[25.8,39.3]		32.3	[24.6,41.1]	64.5	[56.9,71.4]	
Fourth	526	34.7	[28.6,41.2]		31.7	[26.1,37.9]	66.4	[59.4,72.7]	
Highest	515	15.8	[11.6,21.1]		31.9	[25.3,39.2]	47.7	[41.6,53.8]	
Educational level				<0.001					<0.001
Basic secondary or less	148	49.0	[43.9,54.1]		28.7	[25.5,32.3]	77.7	[73.1,81.8]	
Complete secondary or more	130	24.0	[20.5,28.0]		34.5	[30.1,39.1]	58.5	[53.5,63.2]	

Table continued on next page

Characteristic	Deficient ^a				Insufficient ^b		Deficient or insufficient		
	N	% ^c	[95% CI] ^d	p-value ^e	% ^c	[95% CI] ^d	% ^c	[95% CI] ^d	p-value ^e
Marital status				0.111					0.667
Never married	108	38.5	[33.5,43.8]		32.6	[27.9,37.7]	71.1	[65.5,76.2]	
Married	154	36.0	[32.1,40.1]		32.2	[28.3,36.4]	68.2	[63.8,72.3]	
Divorced/separated/widowed	166	47.0	[36.0,58.2]		20.1	[11.3,33.0]	67.0	[52.6,78.8]	
Currently lactating				0.148					0.066
Yes	88	47.7	[34.5,61.2]		33.0	[20.2,48.9]	80.7	[67.8,89.3]	
No	271	37.6	[34.0,41.3]		31.3	[28.5,34.2]	68.9	[65.2,72.3]	
Household food insecurity access				<0.001					<0.001
Secure	898	24.0	[20.0,28.6]		37.7	[32.1,43.6]	61.7	[56.3,66.8]	
Mild	272	35.7	[27.1,45.4]		32.1	[24.2,41.1]	67.8	[58.6,75.7]	
Moderate	859	39.3	[32.5,46.5]		29.8	[25.0,35.0]	69.0	[63.3,74.2]	
Severe	775	54.3	[48.3,60.2]		24.9	[20.3,30.1]	79.2	[72.8,84.3]	
Household sanitation ^g				0.069					0.520
Inadequate	113	54.1	[37.0,70.3]		22.1	[12.7,35.8]	76.2	[51.6,90.6]	
Adequate	263	37.5	[33.8,41.3]		31.5	[28.7,34.5]	69.0	[65.3,72.5]	
Safe drinking water ^h				0.234					0.875
Yes	254	37.5	[34.0,41.2]		31.7	[28.9,34.8]	69.3	[65.7,72.6]	
No	255	43.9	[33.4,55.1]		24.5	[17.2,33.6]	68.4	[56.5,78.3]	
Sun exposure index				<0.001					<0.001
< 10	177	46.3	[42.0,50.6]		28.6	[25.3,32.0]	74.9	[71.1,78.3]	
10-20	136	18.0	[9.8,30.7]		40.2	[26.8,55.2]	58.2	[44.1,71.0]	
≥ 20	337	7.2	[4.2,12.1]		45.4	[36.8,54.2]	52.6	[43.5,61.5]	
Woman wears hijab				<0.001					<0.001
Yes	192	55.4	[51.8,59.1]		26.4	[23.3,29.8]	81.9	[79.1,84.4]	
No	874	13.2	[9.3,18.3]		38.1	[33.2,43.2]	51.3	[44.8,57.7]	
TOTAL SAMPLE	280	37.9	[34.4,41.6]		31.3	[28.6,34.2]	69.2	[65.6,72.6]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Vitamin D deficiency defined as serum vitamin D 25(OH) < 12 ng/mL; vitamin D 25(OH) concentrations below the limit of detection (< 3 ng/mL; n=15) were recoded to 3 ng/mL. // ^b Vitamin D insufficiency defined as serum vitamin D 25(OH) 12-19.9 ng/mL. // ^c Percentages weighted for unequal probability of selection. // ^d CI = confidence interval, calculated taking into account the complex sampling design. // ^e Chi-square p-value <0.05 indicates that at least one subgroup is statistically significantly different from the others. // ^f Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. // ^g Composite variable of main source of drinking water and treating water to make safe for drinking.

3.6.20. Zinc deficiency

Zinc status was measured in a sub-sample of women, and the prevalence of zinc deficiency among all NPW is 35% (Table 98). Zinc deficiency is not significantly associated with most of the demographic indicators and is only associated with household sanitation. Surprisingly, the zinc deficiency prevalence is lower (14%) among women residing in homes with inadequate sanitation compared to those in homes with adequate sanitation (37%).

Table 98. Prevalence of zinc deficiency in non-pregnant women 15-49 years by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with zinc deficiency ^b	[95% CI] ^c	p-value ^d
Nationality				0.247
Lebanese	364	32.2	[25.1,40.3]	
Syrian	149	40.0	[24.7,57.4]	
Palestinian	24	52.9	[24.6,79.5]	
Other	7	5.5	[0.6,36.3]	
Age group (in years)				0.389
15-19	98	44.7	[29.0,61.4]	
20-29	167	27.9	[18.9,39.2]	
30-39	134	34.2	[19.3,52.9]	
40-49	146	34.1	[22.6,47.8]	
Wealth quintile				0.471
Lowest	127	44.8	[26.4,64.7]	
Second	113	31.6	[18.5,48.5]	
Middle	103	34.8	[19.9,53.4]	
Fourth	112	23.8	[15.5,34.7]	
Highest	90	36.4	[19.7,57.1]	
Educational level				0.228
Basic secondary or less	301	38.3	[28.9,48.6]	
Complete secondary or more	243	30.5	[20.4,43.0]	
Marital Status				0.670
Never married	217	36.8	[25.4,49.9]	
Married	294	35.2	[25.5,46.3]	
Divorced/separated/widowed	33	24.7	[8.3,54.2]	
Currently lactating				0.455
Yes	21	24.5	[8.3,53.9]	
No	524	35.3	[26.9,44.7]	
Household food insecurity				0.963
Secure	170	31.8	[20.2,46.1]	
Mild	50	37.7	[18.5,61.8]	
Moderate	181	38.8	[26.7,52.4]	
Severe	144	33.8	[20.4,50.3]	
Household sanitation^e				0.032
Inadequate	20	13.5	[4.1,36.2]	
Adequate	516	36.9	[28.7,46.0]	

Table continued on next page

Characteristic	N	% ^a with zinc deficiency ^b	[95% CI] ^c	p-value ^d
Safe drinking water^f				0.283
Yes	488	36.1	[27.4,45.8]	
No	56	25.3	[12.6,44.4]	
TOTAL SAMPLE	545	35.0	[26.9,44.1]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. Zinc deficiency measured in a 20% sub-sample of non-pregnant women. // ^a Percentages weighted for unequal probability of selection. //

^b Zinc deficiency defined as serum zinc < 70 µg/dL for morning samples in a fasting state, < 66 µg/dL morning sample in a nonfasting state, and < 59 µg/dL afternoon sample in a nonfasting state [80]. // ^c CI = confidence interval, calculated taking into account the complex sampling design. // ^d p-value < 0.05 indicates that at least one subgroup is statistically significantly different from the others. //

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. // ^f Composite variable of main source of drinking water and treating water to make safe for drinking.

3.6.21. Iodine deficiency

Table 99 presents the iodine status for non-pregnant *non-lactating* women. In these women, the national mUIC is approximately 108 µg/L (95% CI 105, 119), which is just above the 100 µg/L threshold indicating insufficient iodine intake [123]. Significant differences were observed by age group and strata. mUIC is significantly higher in women 15-19 years of age compared to older women where mUIC (103 µg/L) was just above the insufficiency threshold. In addition, mUIC is highest in women living in Akkar and lowest in women residing in Mount Lebanon; the mUIC of Mount Lebanon is classified as mild insufficiency.

Significant differences were also observed by household salt iodine content. Figure 48 shows that the median iodine content in women is below the WHO insufficiency threshold for those living in households with non-iodized salt *and* inadequately iodized salt; the iodine status is only considered sufficient in women in households that use salt iodized to international standards (i.e., ≥ 15 ppm iodine).

Similar findings are observed in non-pregnant *lactating* women (Table 100). Nationally, the mUIC in these women indicates iodine sufficiency, however, insufficiency occurs in multiple sub-groups, including Lebanese women, women 15-19 years of age, women in the fourth and highest wealth quintiles, women with completed secondary or higher education, and women living in food secure or mildly food insecure households. A clear dose-response trend is also observed between mUIC and household salt iodization status, with iodine insufficiency found among non-pregnant *lactating* women residing in households with non-iodized salt. However, due to the small sample size of non-pregnant *lactating* women, only household wealth is significantly associated with mUIC.

Figure 49 presents the mUIC among non-pregnant lactating and non-lactating women by nationality within each governorate. The mUICs of all sub-groups are above the insufficiency threshold, and notable differences were found in Baalbek-Hermel, where the mUIC of Lebanese non-pregnant *non-lactating* women is markedly higher than that found in Syrian women.

Table 99. Median urinary iodine concentration in non-pregnant non-lactating women 15-49 years of age, Lebanon 2023

Characteristic	N	Median UIC ^a	[95% CI] ^b	p-value ^c
Nationality				0.619
Lebanese	1737	110	[105,124]	
Syrian	592	102	[95,119]	
Palestinian	89	126	[93,145]	
Other	28	76	[51,161]	
Age group (in years)				0.004
15-19	406	138	[117,145]	
20-29	636	106	[97,124]	
30-39	666	103	[101,119]	
40-49	747	103	[97,117]	
Stratum				<0.001
Akkar	224	195	[172,201]	
Baalbek-Hermel	313	132	[119,145]	
Beirut	309	110	[107,131]	
Bekaa	280	114	[99,129]	
El Nabatieh	222	109	[103,122]	
Mount Lebanon	241	88	[74,97]	
North	398	149	[115,169]	
South	226	109	[103,124]	
Palestinian camps	95	129	[99,180]	
Syrian ITS	147	149	[122,161]	
Wealth quintile				0.567
Lowest	603	108	[99,133]	
Second	479	111	[101,131]	
Middle	494	102	[91,115]	
Fourth	444	112	[99,129]	
Highest	435	108	[101,129]	
Educational level				0.840
Basic secondary or less	1325	108	[103,124]	
Complete secondary or	1121	106	[103,119]	
Household food insecurity access				0.274
Secure	768	92	[91,115]	
Mild	222	109	[99,131]	
Moderate	755	116	[103,131]	
Severe	710	112	[107,131]	
Household salt iodization				<0.001
None (<5 ppm)	599	82	[74,93]	
Insufficient (5-14.9 ppm)	405	98	[86,113]	
Adequate (≥15 ppm)	1143	135	[122,145]	
Household sanitation ^d				0.535
Inadequate	98	95	[67,140]	
Adequate	2308	108	[105,119]	
Safe drinking water ^e				0.437
Yes	2205	106	[103,119]	
No	244	115	[99,145]	
TOTAL SAMPLE	2455	108	[105,119]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Medians weighted for unequal probability of selection; UIC = urinary iodine concentration. // ^b CI = confidence interval, calculated taking into account the complex sampling design using box-cox transformed values. // ^c Chi-square p-value <0.05 indicates that the mean of the box-cox transformed urinary iodine concentration in one subgroup is significantly different from the values in at least one other subgroup. // ^d Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field. // ^e Composite variable of main source of drinking water and treating water to make safe for drinking.

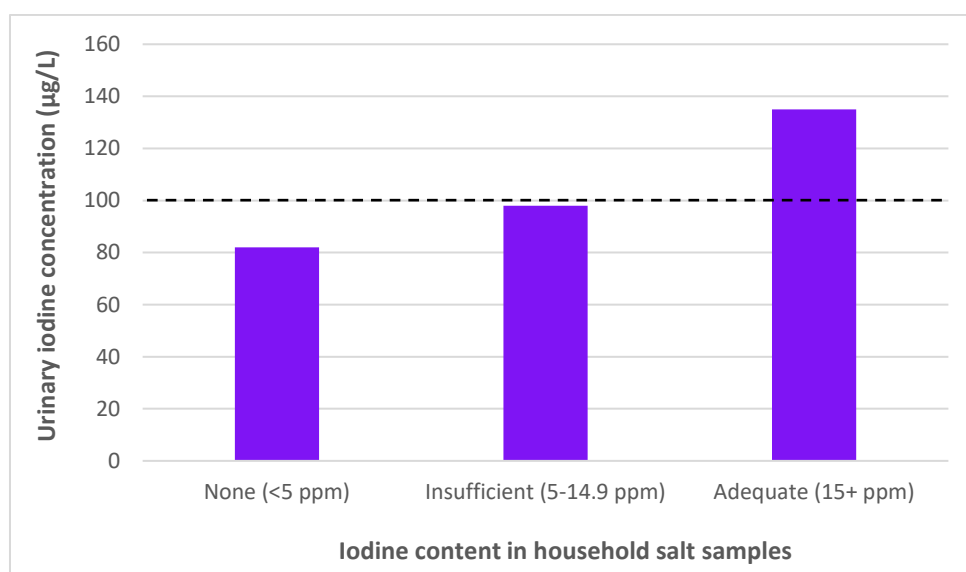


Figure 48. Iodine status of non-pregnant women by household salt iodine status, Lebanon 2023

Table 100. Median urinary iodine concentration in non-pregnant lactating women 15-49 years of age, Lebanon 2023

Characteristic	N	Median UIC ^a	[95% CI] ^b	p-value ^c
Nationality				0.111
Lebanese	33	78	[67,137]	
Syrian	51	174	[122,186]	
Age group (in years)				0.170
15-19	8	99	[78,191]	
20-29	40	105	[95,129]	
30-39	33	138	[104,169]	
40-49	4	227	[116,293]	
Wealth quintile				<0.001
Lowest	42	140	[113,180]	
Second	14	141	[72,155]	
Middle	10	190	[173,217]	
Fourth	11	57	[43,187]	
Highest	8	78	[69,102]	
Educational level				0.179
Basic secondary or less	56	141	[116,176]	
Complete secondary or	29	78	[62,143]	
Household food insecurity access				0.736
Secure	20	78	[73,152]	
Mild	4	67	[42,197]	
Moderate	25	141	[96,193]	
Severe	36	140	[103,158]	
Household salt iodization				0.210
None (<5 ppm)	21	96	[71,129]	
Insufficient (5-14.9 ppm)	10	105	[75,165]	
Adequate (≥15 ppm)	41	140	[107,173]	
TOTAL SAMPLE	85	115	[109,143]	

Note: The N's are un-weighted denominators in each subgroup; the sum of subgroups may not equal the total because of missing data

^a Median's are weighted for unequal selection probability; UIC = urinary iodine concentration

^b CI = confidence interval, calculated by bootstrapping without taking into account the complex sampling design. Actual confidence intervals are probably narrower.

^c Chi-square p-value <0.05 indicates that the mean of the natural log of urinary iodine concentration in at least one subgroup is statistically significantly different from the values in the other subgroups.

^d Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^e Composite variable of main source of drinking water and treating water to make safe for drinking.

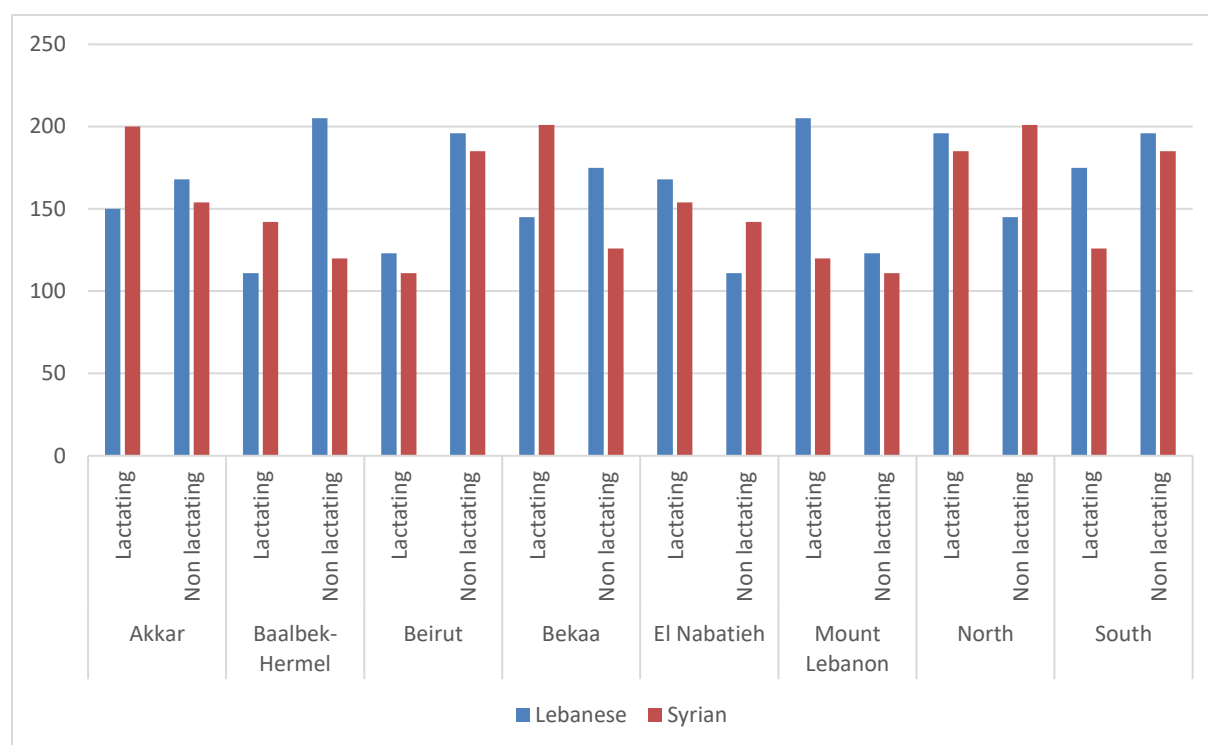


Figure 49. Median urinary iodine concentration in the different governorate strata (excluding Syrian ITS and Palestinian camps strata) in lactating and non-lactating non-pregnant women 15-49 years, Lebanon 2023

This figure excludes the Palestinian nationality because of the small sample size in each subgroup.

3.6.22. *Associations between micronutrient deficiencies and various factors*

Table 101 examines the associations between anemia and various health and nutritional risk factors. Significant associations were found between anemia prevalence and iron, vitamin A and vitamin D deficiencies. A substantial difference in anemia prevalence is observed based on iron status, where 62% of iron-deficient women are anemic, in contrast to 18% of those with adequate iron levels. Similarly, the anemia prevalence is nearly 73% vitamin A deficient women compared to 35% in women that are vitamin A replete. Lastly, anemia is about 7 percentage points higher in women with vitamin D deficiency/ insufficiency than in those women without.

Table 102 shows the associations between ID and various health and nutritional risk factors. Factors associated with ID include overweight/obesity status, and folate and vitamin D deficiency/insufficiency status. The ID prevalence of overweight or obese women is nearly 8 percentage points higher than that found in normal weight women. In addition, ID is significantly higher among folate deficient women compared to their folate-replete counterparts, and women with suboptimal vitamin D status are more likely to be anemic compared to vitamin D sufficient women.

Table 101. Correlation between various factors and anemia in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a with anemia ^b	p-value ^c
Woman had minimum dietary diversity			0.074
Yes	1507	37.6	
No	1282	32.0	
Woman took iron tablet or syrup in past six months			0.069
Yes	491	40.8	
No	2286	34.0	
Woman took folate supplement in past six			0.934
Yes	119	35.9	
No	2653	35.3	
Woman took multivitamin supplement in past six months			0.743
Yes	241	33.4	
No	2524	35.3	
Woman consumes coffee or tea during or directly after meal			0.461
Yes	1824	36.2	
No	965	33.4	
Woman underweight			0.274
Yes	121	28.3	
No	2601	35.6	
Woman overweight or obese			0.061
Yes	1527	37.7	
No	1195	32.4	
Woman had inflammation			0.180
Yes	1154	37.6	
No	1612	33.5	
Woman iron deficient			<0.001
Yes	1093	62.1	
No	1673	18.2	
Woman vitamin A deficient			0.002
Yes	37	72.9	
No	2729	34.7	
Woman folate deficient			0.132
Yes	507	40.4	
No	2280	34.2	
Woman B12 deficient			0.894
Yes	612	35.8	
No	2175	35.2	
Woman vitamin D deficient/ insufficient			0.040
Yes	1994	37.4	
No	793	30.8	
Woman zinc deficient^d			0.097
Yes	195	43.5	
No	345	31.7	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Anemia defined as hemoglobin < 120 g/L; hemoglobin adjusted for elevation and smoking [118].

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of women.

Table 102. Correlation between various factors and iron deficiency in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a with iron deficiency ^b	p-value ^c
Woman had minimum dietary diversity			0.370
Yes	1512	39.6	
No	1287	37.0	
Woman took iron tablet or syrup in past six months			0.638
Yes	492	40.4	
No	2295	38.3	
Woman took multivitamin supplement in past six months			0.336
Yes	240	34.1	
No	2534	38.9	
Woman consumes coffee or tea during or directly after meal			0.641
Yes	1825	39.0	
No	974	37.3	
Woman underweight			0.449
Yes	120	33.8	
No	2617	38.6	
Woman overweight or obese			0.016
Yes	1544	41.8	
No	1193	34.3	
Woman had inflammation			0.457
Yes	1169	37.0	
No	1640	39.7	
Woman vitamin A deficient			0.070
Yes	37	62.2	
No	2772	38.2	
Woman folate deficient			0.021
Yes	502	45.4	
No	2271	37.3	
Woman B12 deficient			0.091
Yes	608	43.9	
No	2165	37.4	
Woman vitamin D deficient/ insufficient			0.017
Yes	1981	41.1	
No	792	33.7	
Woman zinc deficient^d			0.955
Yes	197	37.7	
No	344	37.3	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Iron deficiency defined as inflammation adjusted plasma ferritin < 15 µg/L; ferritin adjusted for inflammation [88].

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of women.

Associations between vitamin A deficiency and various health and nutritional risk factors are shown in Table 103. Vitamin A deficiency is significantly associated with underweight, with the vitamin A deficiency prevalence nearly 11 percentage points higher in underweight women compared to normal weight women, who have almost no deficiency. Also, women with folate deficiency show a higher prevalence of vitamin A deficiency at 3.5%, compared to 1.0% in folate-replete women. Moreover, vitamin A deficiency highly correlated with vitamin D status; almost all vitamin A deficient women also suffer from vitamin D deficiency/ insufficiency.

Table 104 presents the associations between folate deficiency and various health and nutritional risk factors. Folate deficiency is only associated with the consumption of folic acid supplements in the past 6 months, with the prevalence of folate deficiency lower in women consuming folic acid supplements compared to those not consuming folic acid supplement (8% versus 19%). Similarly, the prevalence of vitamin B12 deficiency (Table 105) is lower among a) women that took folic acid supplements compared to those not taking the supplements (10% versus 21%) and b) women that took vitamin B12 supplements compared to those not taking the supplements (8% versus 22%). Moreover, vitamin B12 deficiency is significantly associated with vitamin D status, and the prevalence of vitamin B12 deficiency is approximately 3 times higher in women who have a suboptimal vitamin D status.

Similar to folate and vitamin B12, the prevalence of vitamin D deficiency/insufficiency is significantly associated with supplement consumption. The vitamin D deficiency/insufficiency prevalences is 23 and 40 percentage points lower in women consuming multivitamins or vitamin D supplements in the past six months compared to women not consuming these supplements (Table 106). Vitamin D deficiency/insufficiency is also associated with underweight, with a higher prevalence found in underweight women.

Associations between zinc deficiency and health and nutritional risk factors are shown in Table 107. None of the potential risk factors are significantly associated with zinc deficiency.

Table 103. Correlation between various factors and vitamin A deficiency in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a with vitamin A deficiency ^b	p-value ^c
Woman had minimum dietary diversity			0.984
Yes	1512	1.4	
No	1287	1.4	
Woman took vitamin A tablet in past six			0.495
Yes	73	0.0	
No	2705	1.5	
Woman took multivitamin supplement in past six months			0.417
Yes	240	0.7	
No	2534	1.5	
Woman underweight			<0.001
Yes	120	11.8	
No	2617	0.9	
Woman overweight or obese			0.141
Yes	1544	0.8	
No	1193	2.1	
Woman had inflammation			0.567
Yes	1169	1.2	
No	1640	1.7	
Woman folate deficient			0.029
Yes	502	3.5	
No	2271	1.0	
Woman B12 deficient			0.346
Yes	608	1.0	
No	2165	1.6	
Woman vitamin D deficient/ insufficient			0.001
Yes	1981	2.1	
No	792	0.2	
Woman zinc deficient^d			0.528
Yes	197	4.5	
No	344	2.3	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin A deficiency defined as retinol binding protein (RBP) < 0.62 µmol/L.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of women.

Table 104. Correlation between various factors and folate deficiency in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a with folate deficiency ^b	p-value ^c
Woman had minimum dietary diversity			0.384
Yes	1510	17.2	
No	1285	18.9	
Woman took folate supplement in past six			0.028
Yes	114	8.2	
No	2664	18.5	
Woman took multivitamin supplement in past six months			0.632
Yes	240	19.9	
No	2531	17.9	
Woman underweight			0.981
Yes	121	17.6	
No	2612	17.7	
Woman overweight or obese			0.469
Yes	1535	16.8	
No	1198	18.7	
Woman had inflammation			0.061
Yes	1159	15.6	
No	1614	19.6	
Woman B12 deficient			0.070
Yes	617	21.9	
No	2187	16.9	
Woman vitamin D deficient/ insufficient			0.132
Yes	2006	19.4	
No	798	14.8	
Woman zinc deficient^d			0.288
Yes	195	24.0	
No	345	17.6	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Folate deficiency defined as plasma folate < 10 nmol/L.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of women.

Table 105. Correlation between various factors and vitamin B12 deficiency in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a with vitamin B12 deficiency ^b	p-value ^c
Woman minimum dietary diversity			0.163
Yes	1510	18.8	
No	1285	23.3	
Woman took folate supplement in past six			0.021
Yes	114	10.2	
No	2664	21.3	
Woman took vitamin B12 supplement in past			<0.001
Yes	206	8.2	
No	2557	21.8	
Woman took multivitamin supplement in past six months			0.338
Yes	240	16.6	
No	2531	21.2	
Woman underweight			0.266
Yes	121	14.0	
No	2612	21.3	
Woman overweight or obese			0.416
Yes	1535	19.8	
No	1198	22.3	
Woman had inflammation			0.245
Yes	1159	19.1	
No	1614	22.3	
Woman vitamin D deficient/ insufficient			<0.001
Yes	2006	26.5	
No	798	8.2	
Woman zinc deficient^d			0.857
Yes	195	20.7	
No	345	21.8	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin B12 deficiency defined as serum vitamin B12 <150 pmol/L.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of women.

Table 106. Correlation between various factors and vitamin D deficiency in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a with vitamin D deficiency or insufficiency ^b	p-value ^c
Woman had minimum dietary diversity			0.633
Yes	1510	68.5	
No	1285	70.1	
Woman took multivitamin supplement in past six months			<0.001
Yes	240	48.4	
No	2531	70.9	
Woman took vitamin D supplement in past six months			<0.001
Yes	534	36.6	
No	2248	76.9	
Woman underweight			0.010
Yes	121	85.1	
No	2612	68.3	
Woman overweight or obese			0.187
Yes	1535	71.1	
No	1198	66.8	
Woman had inflammation			0.465
Yes	1159	70.4	
No	1614	68.1	
Woman zinc deficient^d			0.518
Yes	195	73.4	
No	345	69.0	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Vitamin D deficiency defined as serum vitamin D 25(OH) < 12 ng/mL; vitamin D insufficiency defined as serum vitamin D 25(OH) 12-19.9 ng/mL.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Zinc deficiency measured in a 20% sub-sample of women.

Table 107. Correlation between various factors and zinc deficiency in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a with zinc deficiency ^b	p value ^c
Woman's household had adequate sanitation			0.032
Yes	516	36.9	
No	20	13.5	
Woman's household had safe drinking water			0.283
Yes	488	36.1	
No	56	25.3	
Woman had minimum dietary diversity			0.287
Yes	288	38.9	
No	256	30.4	
Woman took multivitamin supplement in past six months			0.500
Yes	44	41.8	
No	495	34.7	
Woman took vitamin D supplement in past six			0.140
Yes	99	44.7	
No	443	32.8	
Woman underweight			0.976
Yes	25	34.5	
No	505	35.1	
Woman overweight or obese			0.184
Yes	280	39.9	
No	250	31.0	
Woman had inflammation			0.738
Yes	223	33.7	
No	318	36.0	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data. Zinc deficiency measured in a 20% sub-sample of women.

^a Percentages weighted for unequal probability of selection.

^b Zinc deficiency defined as serum zinc < 70 µg/dL for morning samples in a fasting state, < 66 µg/dL morning sample in a nonfasting state, and < 59 µg/dL afternoon sample in a non-fasting state [80].

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

3.6.23. *Associations between cardiometabolic risk factors and health and nutrition indicators*

The association between the components of metabolic syndrome and various nutritional factors are present in Table 108. The most consistent association is found between inflammation and the components of metabolic syndrome, with the prevalence of all components higher among women with inflammation. In addition, elevated triglycerides are associated with iron deficiency anemia and low potassium intake: a lower prevalence of elevated triglycerides is found in women iron deficiency anemia and low potassium intake. The prevalence of low HDL cholesterol is higher women with vitamin D deficiency/insufficiency and the hypertension prevalence is lower in women with minimum adequate diet and higher among women with excessive sodium intake.

Table 109 presents the associations between metabolic syndrome and various health and nutritional factors. Metabolic syndrome is significantly associated with vitamin D deficiency/insufficiency: the prevalence of metabolic syndrome is 5 percentage points higher in women with vitamin D deficiency/insufficiency compared to their vitamin D replete counterparts. Metabolic syndrome is also associated with inflammation, with the prevalence of metabolic syndrome nearly 3 times greater among women with inflammation compared to women without inflammation.

Table 108. Association between metabolic risk factors and nutrition indicators in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	Diabetes ^a			Elevated triglycerides ^b			Low HDL cholesterol ^c			Hypertension ^d			Central/visceral obesity ^e		
	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g
Minimum dietary diversity			0.364			0.672			0.039			0.837			0.358
Yes	1491	3.9		1510	21.3		1510	44.7		1517	6.8		1509	52.0	
No	1274	2.9		1285	22.8		1285	51.0		1291	6.4		1304	49.4	
Anemia			0.650			0.508			0.089			0.118			0.007
Yes	903	3.8		904	20.8		904	50.6		876	8.5		874	55.7	
No	1868	3.2		1883	22.5		1883	45.7		1858	5.8		1854	48.0	
Iron deficiency			0.431			0.002			0.843			0.999			0.249
Yes	1084	2.8		1093	17.7		1093	46.9		1079	6.5		1076	53.1	
No	1659	3.8		1680	25.0		1680	47.6		1666	6.5		1667	49.4	
Iron deficiency anemia			0.561			0.042			0.917			0.474			0.041
Yes	611	2.7		613	18.2		613	47.5		595	7.9		593	56.5	
No	2128	3.7		2147	23.4		2147	47.2		2107	6.2		2107	49.0	
Folate deficiency			0.162			0.887			0.116			0.343			0.515
Yes	504	2.0		509	21.5		509	52.4		488	5.0		492	48.1	
No	2261	3.8		2295	22.0		2295	46.4		2252	7.1		2247	51.2	
Vitamin B12 deficiency			0.501			0.679			0.160			0.362			0.492
Yes	609	2.5		617	20.8		617	51.3		601	8.0		603	48.6	
No	2156	3.7		2187	22.2		2187	46.5		2139	6.4		2136	51.2	
Zinc deficiency			0.972			0.857			0.591			0.416			0.706
Yes	192	4.1		195	22.8		191	41.1		193	2.8		193	48.9	
No	345	3.9		345	21.7		349	45.3		340	5.3		339	46.1	
Vitamin D deficiency or insufficiency			0.581			0.557			<0.001			0.672			0.066
Yes	1985	3.7		2006	21.4		2006	50.9		1953	7.0		1958	52.5	
No	780	2.9		798	23.0		798	39.8		787	6.2		781	46.6	
Excess sodium intake			0.589			0.171			0.126			0.019			0.559
Yes	1463	3.2		1483	23.5		1483	46.4		1485	8.8		1493	52.8	
No	1002	3.9		1011	19.3		1011	51.1		1013	4.6		1021	50.9	

Table continued on next page

Characteristic	Diabetes ^a			Elevated triglycerides ^b			Low HDL cholesterol ^c			Hypertension ^d			Central/visceral obesity ^e		
	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g	N	% ^f	p-value ^g
Low potassium intake			0.159			0.013			0.566			0.326			0.182
Yes	2297	3.2		2325	21.0		1718	46.5		2330	7.4		2345	51.5	
No	170	6.9		171	32.9		123	42.7		170	4.5		171	58.9	
Inflammation			0.011			<0.001			<0.001			0.012			<0.001
Yes	1146	5.2		1159	30.4		821	59.6		1140	9.0		1137	67.2	
No	1597	2.1		1614	15.9		1210	36.2		1605	4.7		1606	38.4	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Diabetes defined as HbA1c $\geq$ 6.5%.

^b Elevated triglycerides defined as $\geq$ 90 mg/dL for women aged < 18 years in fasting status, $\geq$ 130 mg/dL for women aged < 18 years in non-fasting status, $\geq$ 150 mg/dL for women aged $\geq$ 18 years in fasting status, $\geq$ 200 mg/dL for women aged $\geq$ 18 years in non-fasting status.

^c Low HDL cholesterol defined as < 40 mg/dL for women aged < 18 years, < 50 mg/dL for women aged $\geq$ 18 years.

^d Hypertension defined as systolic blood pressure $\geq$ 140 mmHg and/or diastolic blood pressure $\geq$ 90 mmHg.

^e Visceral/central obesity defined as waist circumference $\geq$ 78.3 cm for women aged 15-16 years, $\geq$ 78.9 cm for women aged 16-17 years, $\geq$ 79.5 cm for women aged 17-18 years, $\geq$ 80.0 cm for women aged $\geq$ 18 years [70,120].

^f Percentages and weighted for unequal probability of selection.

^g Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

Table 109. Association between metabolic syndrome and various factors in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	% ^a with metabolic syndrome ^b	p-value ^c
Minimum dietary diversity			0.592
Yes	1463	25.3	
No	1246	24.2	
Anemia			0.107
Yes	871	27.7	
No	1837	23.1	
Iron deficiency			0.811
Yes	1061	24.5	
No	1627	25.2	
Iron deficiency anemia			0.267
Yes	593	27.8	
No	2088	24.0	
Folate deficiency			0.554
Yes	484	22.8	
No	2233	25.2	
Vitamin B12 deficiency			0.276
Yes	598	27.5	
No	2119	24.1	
Zinc deficiency			0.364
Yes	186	30.9	
No	339	25.1	
Vitamin D deficiency or insufficiency			0.002
Yes	1946	27.5	
No	771	18.8	
Excess sodium intake			0.975
Yes	1460	25.9	
No	994	26.0	
Low potassium intake			0.180
Yes	2287	25.3	
No	169	33.8	
Inflammation			<0.001
Yes	1124	37.8	
No	1564	15.1	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Metabolic syndrome defined as waist circumference ≥ 80 cm plus any two of the four following factors: elevated HbA1c as $\geq 5.7\%$; elevated triglycerides defined as ≥ 150 mg/dL; low HDL cholesterol defined as < 50 mg/dL; elevated blood pressure defined as systolic blood pressure ≥ 135 mmHg and/or diastolic blood pressure ≥ 85 mmHg [109, 110]. // ^b Percentages weighted for unequal probability of selection. // ^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.6.24. Sodium intake and associated factors

Urinary sodium results are presented in Table 110. The mean and median sodium intake of NPW is 2.8 and 2.3 grams, respectively. When examined by strata, the lowest mean sodium intake is found in Beirut and El Nabatieh, and the highest sodium intake is found in Baalbek-Hermel. The mean and median sodium intakes exceed the threshold for excessive sodium intake (i.e., as ≥ 2 grams of sodium per day, [121]) in all subgroups. Approximately 60% of non-pregnant women have excessive sodium intake, and the prevalence of excessive sodium intake is highest in Baalbek-Hermel and lowest in Beirut.

Excessive sodium intake is significantly associated with hypertension: with a higher prevalence of excess sodium intake found among hypertensive women compared to their non-hypertensive counterparts (Table 111). The excess sodium intake prevalence is significantly higher in women normal potassium intake compared to those with low potassium intake.

Table 110. Daily estimated sodium intake and prevalence of excess sodium intake using urinary sodium excretion non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Mean sodium intake (g) ^a	Median sodium intake (g) ^a	Excess sodium intake ^d		
				% ^a	[95% CI] ^b	p-value ^c
Nationality						0.555
Lebanese	1777	2.8	2.3	59.6	[55.1,63.8]	
Syrian	633	2.8	2.5	62.2	[56.0,68.0]	
Palestinian	72	3.0	2.7	59.6	[44.4,73.2]	
Other	29	2.6	2.4	73.4	[51.8,87.6]	
Age group (in years)						0.599
15-19	414	2.6	2.2	56.0	[48.5,63.2]	
20-29	674	2.8	2.4	61.1	[53.6,68.1]	
30-39	684	2.9	2.6	62.7	[57.0,68.0]	
40-49	747	2.7	2.3	59.9	[53.8,65.7]	
Stratum						0.019
Akkar	236	2.8	2.5	60.1	[52.2,67.4]	
Baalbek-Hermel	327	3.0	2.7	68.5	[62.2,74.1]	
Beirut	316	2.4	2.1	51.3	[42.7,59.9]	
Bekaa	289	3.1	2.6	67.5	[58.5,75.3]	
El Nabatieh	227	2.4	2.2	54.9	[44.7,64.7]	
Mount Lebanon	257	2.9	2.5	63.5	[55.7,70.6]	
North	402	2.6	2.2	56.6	[49.6,63.3]	
South	231	2.6	2.2	58.1	[49.4,66.4]	
Palestinian camps	71	2.7	2.2	53.7	[41.5,65.6]	
Syrian ITS	163	3.0	2.1	54.4	[47.5,61.1]	

Table continued on next page

Characteristic	N	Mean sodium intake (g) ^a	Median sodium intake (g) ^a	Excess sodium intake ^d		
				% ^a	[95% CI] ^b	p-value ^c
Wealth quintile						0.848
Lowest	632	2.7	2.5	61.9	[56.1,67.4]	
Second	483	2.8	2.2	57.0	[48.2,65.4]	
Middle	506	2.8	2.2	61.2	[54.7,67.3]	
Fourth	451	2.8	2.4	61.0	[53.3,68.2]	
Highest	447	2.8	2.6	60.5	[53.1,67.5]	
Household food insecurity access						0.832
Secure	768	2.9	2.5	58.9	[50.8,66.6]	
Mild	234	3.0	2.5	62.8	[54.0,70.8]	
Moderate	776	2.7	2.3	59.7	[54.6,64.7]	
Severe	741	2.7	2.3	61.9	[56.2,67.3]	
Household sanitation^e						0.926
Inadequate	109	3.3	2.7	60.7	[45.5,74.1]	
Adequate	2362	2.7	2.3	59.9	[56.3,63.5]	
Safe drinking water^f						0.764
Yes	2266	2.8	2.4	60.5	[56.6,64.3]	
No	247	2.7	2.2	58.5	[46.8,69.4]	
TOTAL SAMPLE	2519	2.8	2.3	60.3	[56.8,63.7]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages, means and medians weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^d Excess sodium intake defined as ≥ 2 g/day according to WHO [121].

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab or composting toilet not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

Table 111. Associations between daily sodium intake using urinary sodium excretion and various health factors in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	Mean sodium intake (g) ^a	Median sodium intake (g) ^a	Excess sodium intake ^d		
				% ^a	[95% CI] ^b	p-value ^c
Elevated triglycerides^e						0.172
Yes	541	2.9	2.4	65.1	[57.0,72.5]	
No	1953	2.8	2.4	59.3	[55.8,62.8]	
Elevated total cholesterol^f						0.890
Yes	105	2.9	2.4	59.6	[44.1,73.4]	
No	2389	2.8	2.4	60.6	[57.3,63.9]	
Low HDL cholesterol^g						0.140
Yes	1221	2.7	2.3	58.4	[54.5,62.3]	
No	1273	2.9	2.4	62.6	[57.8,67.3]	
Diabetes^h						0.570
Yes	65	2.9	2.1	55.5	[36.6,73.0]	
No	2400	2.8	2.4	60.7	[57.4,64.0]	
Hypertensionⁱ						0.018
Yes	128	3.0	2.6	74.6	[61.9,84.1]	
No	2370	2.8	2.3	59.3	[55.8,62.7]	
Visceral obesity^j						0.533
Yes	1362	2.8	2.4	61.2	[56.3,65.9]	
No	1152	2.7	2.3	59.3	[55.0,63.5]	
Low potassium intake^k						<0.001
Yes	2348	2.6	2.2	57.7	[54.2,61.2]	
No	171	4.8	4.7	95.0	[89.8,97.6]	
TOTAL SAMPLE	2519	2.8	2.3	60.3	[56.8,63.7]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages, means and medians weighted for unequal probability of selection. // ^b CI = confidence interval, calculated taking into account the complex sampling design. // ^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other. // ^d Excess sodium intake defined as ≥ 2 g/day according to WHO [121]. // ^e Elevated triglycerides defined as ≥ 90 mg/dL for women aged < 18 years in fasting status, ≥ 130 mg/dL for women aged < 18 years in non-fasting status, ≥ 150 mg/dL for women aged ≥ 18 years in fasting status, ≥ 200 mg/dL for women aged ≥ 18 years in non-fasting status. // ^f Elevated total cholesterol defined as ≥ 200 mg/dL for women aged < 18 years, ≥ 240 mg/dL for women aged ≥ 18 years.

^g Low HDL cholesterol defined as < 40 mg/dL for women aged < 18 years, < 50 mg/dL for women aged ≥ 18 years. // ^h Diabetes defined as HbA1c $\geq 6.5\%$. // ⁱ Hypertension defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg. // ^j Visceral/central obesity defined as waist circumference ≥ 78.3 cm for women aged 15-16 years, ≥ 78.9 cm for women aged 16-17 years, ≥ 79.5 cm for women aged 17-18 years, ≥ 80.0 cm for women aged ≥ 18 years [70,120]. // ^k Low potassium intake defined as < 3510 mg/day according to WHO [122].

3.6.25. Potassium intake and associated factors

As shown in Table 112, non-pregnant women have a mean potassium intake of 2 grams per day, and intake is well below the 3.5 grams per day threshold established by WHO [87]. More than 90% of NPW have a low potassium intake, and low potassium intake is significantly associated with nationality: among the three main nationalities, the prevalence of low potassium intake is lowest in Lebanese women. Despite this significant association, it is notable that the prevalence of low potassium intake exceeds 90% in all nationality subgroups. Low potassium intake is also associated with stratum: the prevalence is >90% in all strata except Bekaa, where still 88% of NPW have low potassium intake.

Table 112. Daily potassium intake and prevalence of low intake using urinary potassium excretion in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Mean potassium intake (g) ^a	Median potassium intake (g) ^a	Low potassium intake ^d		
				% ^a	[95% CI] ^b	p-value ^c
Nationality						0.001
Lebanese	1778	2.0	1.9	91.3	[89.1,93.1]	
Syrian	634	1.8	1.7	97.5	[95.6,98.6]	
Palestinian	72	2.0	1.6	96.0	[89.0,98.6]	
Other	29	2.0	1.9	90.6	[59.0,98.5]	
Age group (in years)						0.091
15-19	414	1.7	1.5	96.3	[93.8,97.8]	
20-29	676	1.8	1.7	94.1	[88.9,97.0]	
30-39	684	2.1	1.9	93.4	[89.9,95.8]	
40-49	747	2.2	2.1	90.1	[86.5,92.8]	
Stratum						0.007
Akkar	236	2.0	1.7	93.6	[89.1,96.3]	
Baalbek-Hermel	327	2.2	2.0	91.3	[87.4,94.1]	
Beirut	316	1.7	1.4	96.8	[91.5,98.8]	
Bekaa	289	2.2	2.0	88.4	[83.5,92.0]	
El Nabatieh	227	2.0	1.8	92.2	[88.5,94.8]	
Mount Lebanon	257	2.1	1.9	91.7	[87.5,94.6]	
North	403	1.9	1.8	96.3	[93.8,97.8]	
South	231	1.8	1.7	94.5	[89.5,97.2]	
Palestinian camps	71	1.7	1.6	96.5	[89.0,99.0]	
Syrian ITS	164	1.9	1.8	92.6	[87.2,95.9]	

Table continued on next page

Characteristic	N	Mean potassium intake (g) ^a	Median potassium intake (g) ^a	Low potassium intake ^d		
				% ^a	[95% CI] ^b	p-value ^c
Wealth quintile						0.158
Lowest	634	1.9	1.7	95.1	[91.7,97.2]	
Second	483	1.9	1.8	94.2	[90.4,96.5]	
Middle	506	2.1	2.0	90.9	[86.2,94.1]	
Fourth	451	2.0	1.8	90.3	[85.1,93.8]	
Highest	447	2.0	1.9	94.1	[90.4,96.5]	
Household food insecurity access						0.250
Secure	768	2.1	1.9	91.8	[87.9,94.5]	
Mild	234	2.1	2.0	90.1	[82.2,94.7]	
Moderate	777	1.9	1.7	93.3	[90.7,95.2]	
Severe	742	1.9	1.8	95.0	[92.1,96.9]	
Household sanitation ^e						0.772
Inadequate	109	2.2	1.9	94.4	[74.6,99.0]	
Adequate	2364	2.0	1.8	92.8	[91.2,94.2]	
Safe drinking water ^f						0.92
Yes	2268	2.0	1.8	93.0	[91.3,94.4]	
No	247	1.9	1.7	92.7	[84.5,96.8]	
TOTAL SAMPLE	2521	2.0	1.8	93.0	[91.3,94.4]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages, means and medians weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^d Low potassium intake defined as < 3510 mg/day according to WHO [122].

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab or composting toilet not shared with another household. Inadequate sanitation= open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

Low potassium intake is also associated with triglyceride level, with a lower prevalence of low potassium intake found in women with elevated triglycerides (Table 113). Low potassium intake is not associated with other risk factors of metabolic syndrome, such as hypertension, visceral obesity, cholesterol status, and diabetes.

Table 113. Associations between daily potassium intake using urinary potassium excretion and various health factors in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	Mean potassium intake (g) ^a	Median potassium intake (g) ^a	Low potassium intake ^d		
				% ^a	[95% CI] ^b	p-value ^c
Elevated triglycerides^e						0.013
Yes	541	2.1	1.9	89.4	[84.5,92.8]	
No	1955	2.0	1.8	93.9	[92.3,95.2]	
Elevated total cholesterol^f						0.215
Yes	105	2.2	2.0	87.7	[72.3,95.2]	
No	2391	2.0	1.8	93.2	[91.5,94.5]	
Low HDL cholesterol^g						0.516
Yes	1222	2.0	1.8	93.6	[91.4,95.4]	
No	1274	2.0	1.9	92.3	[89.4,94.4]	
Diabetes^h						0.166
Yes	65	2.4	2.3	86.2	[67.6,94.9]	
No	2402	2.0	1.8	93.1	[91.5,94.5]	
Hypertensionⁱ						0.294
Yes	128	2.1	2.0	95.8	[89.7,98.3]	
No	2372	2.0	1.8	92.8	[90.9,94.4]	
Visceral obesity^j						0.180
Yes	1363	2.1	1.9	92.1	[89.4,94.1]	
No	1153	1.9	1.7	94.0	[91.9,95.6]	
TOTAL SAMPLE	2516	2.0	1.8	93.0	[91.3,94.4]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages, means and medians weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Low potassium intake defined as < 3510 mg/day according to WHO [122].

^e Elevated triglycerides defined as ≥ 90 mg/dL for women aged < 18 years in fasting status, ≥ 130 mg/dL for women aged < 18 years in non-fasting status, ≥ 150 mg/dL for women aged ≥ 18 years in fasting status, ≥ 200 mg/dL for women aged ≥ 18 years in non-fasting status.

^f Elevated total cholesterol defined as ≥ 200 mg/dL for women aged < 18 years, ≥ 240 mg/dL for women aged ≥ 18 years.

^g Low HDL cholesterol defined as < 40 mg/dL for women aged < 18 years, < 50 mg/dL for women aged ≥ 18 years.

^h Diabetes defined as HbA1c ≥ 6.5%.ⁱ Hypertension defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

^j Visceral/central obesity defined as waist circumference ≥ 78.3 cm for women aged 15-16 years, ≥ 78.9 cm for women aged 16-17 years, ≥ 79.5 cm for women aged 17-18 years, ≥ 80.0 cm for women aged ≥ 18 years [70,120].

3.6.26. Sodium to potassium intake ratio

As noted in Section 2.8.3, it is recommended that adults consume <2 grams / day of sodium and >3.5 grams/day of potassium [84]. This optimal consumption results in a sodium-to-potassium ratio of ≤ 1.0 . As shown in Table 114, the average sodium-to-potassium ratio in NPW is 2.6, and 88% of women have a sub-optimal ratio. Age group and nationality are associated with the proportion of women with a sub-optimal sodium-to-potassium ratio: the highest prevalence occurs in women 20-29 years of age and among Syrian women.

Table 114. Sodium to potassium (Na:K) intake ratio and prevalence of suboptimal intake ratio in non-pregnant women 15-49 years of age by various demographic characteristics, Lebanon 2023

Characteristic	N	Mean Na:K ratio ^a	Suboptimal Na:K ratio ^d		
			% ^a	[95% CI] ^b	p-value ^c
Nationality					0.008
Lebanese	1804	2.5	86.4	[83.7,88.8]	
Syrian	648	2.7	92.2	[89.2,94.4]	
Palestinian	89	2.7	86.9	[72.4,94.4]	
Other	29	2.3	91.5	[75.4,97.4]	
Age group (in years)					0.028
15-19	420	2.9	84.5	[76.7,90.0]	
20-29	691	2.9	93.3	[89.8,95.7]	
30-39	703	2.5	88.3	[83.3,92.0]	
40-49	765	2.2	85.3	[80.8,88.9]	
Stratum					0.443
Akkar	238	2.5	92.5	[88.1,95.3]	
Baalbek-Hermel	331	2.6	90.0	[86.3,92.7]	
Beirut	323	2.8	89.4	[84.5,92.9]	
Bekaa	290	2.6	88.9	[81.2,93.7]	
El Nabatieh	230	2.2	85.3	[78.2,90.4]	
Mount Lebanon	259	2.6	87.8	[83.0,91.4]	
North	403	2.6	84.7	[79.3,88.9]	
South	244	2.6	90.2	[84.6,94.0]	
Palestinian camps	97	2.9	89.8	[73.5,96.6]	
Syrian ITS	164	2.8	92.0	[85.2,95.8]	
Wealth quintile					0.416
Lowest	647	2.7	90.4	[86.4,93.4]	
Second	503	2.7	89.5	[83.4,93.5]	
Middle	515	2.4	84.5	[78.6,89.0]	
Fourth	463	2.6	87.6	[82.0,91.7]	
Highest	451	2.6	87.6	[82.2,91.5]	

Table continued on next page

Characteristic	N	Mean Na:K ratio ^a	Suboptimal Na:K ratio ^d		
			% ^a	[95% CI] ^b	p-value ^c
Household food insecurity access					0.332
Secure	803	2.5	86.4	[81.8,90.1]	
Mild	238	2.6	84.4	[78.5,88.9]	
Moderate	788	2.6	89.2	[85.0,92.3]	
Severe	750	2.6	89.9	[85.7,93.0]	
Household sanitation ^e					0.348
Inadequate	111	2.6	83.2	[68.5,91.9]	
Adequate	2420	2.6	88.2	[85.9,90.1]	
Safe drinking water ^f					0.775
Yes	2324	2.6	88.0	[85.8,89.9]	
No	249	2.6	88.8	[82.1,93.2]	
TOTAL SAMPLE	2579	2.6	88.0	[85.9,89.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

^d Recommended ratio of sodium to potassium ≤ 1 mmol according to WHO [121].

^e Composite variable of toilet type and if toilet facilities are shared with non-household members. Adequate sanitation = flush or pour flush toilet or pit latrine with slab or composting toilet not shared with another household. Inadequate sanitation = open pit, bucket latrine, hanging toilet/latrine, no facility, bush, field.

^f Composite variable of main source of drinking water and treating water to make safe for drinking.

The prevalence of a sub-optimal sodium-to-potassium ratio is also positively associated with hypertension and excess sodium intake (Table 115), with higher prevalences occurring in women with hypertension and excessive sodium intake.

Table 115. Associations between sodium to potassium intake ratio and various health factors in non-pregnant women 15-49 years of age, Lebanon 2023

Characteristic	N	Mean Na:K ratio ^a	Suboptimal Na:K ratio ^d		
			% ^a	[95% CI] ^b	p-value ^c
Elevated triglycerides ^e					0.672
Yes	546	2.5	88.8	[84.5,92.0]	
No	2002	2.6	87.8	[85.2,90.0]	
Elevated total cholesterol ^f					0.238
Yes	107	2.3	83.5	[72.6,90.6]	
No	2441	2.6	88.2	[86.0,90.1]	
Low HDL cholesterol ^g					0.189
Yes	1253	2.6	88.1	[85.0,90.5]	
No	1295	2.6	87.9	[84.3,90.8]	
Diabetes ^h					0.290
Yes	67	2.2	92.5	[82.1,97.0]	
No	2457	2.6	87.9	[85.7,89.8]	
Hypertension ⁱ					0.023
Yes	128	2.6	95.0	[89.0,97.8]	
No	2391	2.6	87.8	[85.6,89.7]	
Visceral obesity ^j					0.449
Yes	1368	2.5	87.6	[84.3,90.2]	
No	1154	2.7	89.3	[86.0,91.8]	
TOTAL SAMPLE	2548	2.6	88.0	[85.8,89.9]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

^c Chi-square p-value < 0.05 indicates that the subgroups are significantly different from each other.

^d Recommended ratio of sodium to potassium ≤ 1 mmol according to WHO [121].

^e Elevated triglycerides defined as ≥ 90 mg/dL for women aged < 18 years in fasting status, ≥ 130 mg/dL for women aged < 18 years in non-fasting status, ≥ 150 mg/dL for women aged ≥ 18 years in fasting status, ≥ 200 mg/dL for women aged ≥ 18 years in non-fasting status.

^f Elevated total cholesterol defined as ≥ 200 mg/dL for women aged < 18 years, ≥ 240 mg/dL for women aged ≥ 18 years.

^g Low HDL cholesterol defined as < 40 mg/dL for women aged < 18 years, < 50 mg/dL for women aged ≥ 18 years.

^h Diabetes defined as HbA1c $\geq 6.5\%$. ⁱ Hypertension defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

^j Visceral/central obesity defined as waist circumference ≥ 78.3 cm for women aged 15-16 years, ≥ 78.9 cm for women aged 16-17 years, ≥ 79.5 cm for women aged 17-18 years, ≥ 80.0 cm for women aged ≥ 18 years [70,120].

3.7. Pregnant women 14-49 years of age

3.7.1. Characteristics

Table 116 describes the surveyed pregnant women and girls. Overall, 223 pregnant women and girls participated in the survey. The majority are pregnant women 20-29 years of age, and pregnant girls account for only 10% of this target group. While the sample consists of both pregnant women and *girls*, heretofore this population group will be referred to as “pregnant women” for simplicity.

Approximately 42% of the pregnant women reside in households of the lowest wealth quintile and about 68% completed basic secondary school or less. The majority (42%) of pregnant women are in the second trimester of their pregnancy, and 24% and 34% are in the 1st and 3rd trimesters, respectively.

Table 116. Description of pregnant women, Lebanon 2023

Characteristic	N	% ^a
Age group (in years)		
14-19	23	10.4
20-29	115	61.4
30-39	74	25.8
40-49	11	2.4
Wealth quintile		
Lowest	102	42.4
Second	53	16.6
Middle	26	11.0
Fourth	22	15.5
Highest	20	14.6
Educational level		
Basic secondary or less	160	68.4
Complete secondary or more	63	31.6
Trimester of pregnancy		
1	65	23.5
2	82	42.2
3	59	34.3
TOTAL SAMPLE	223	100

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

3.7.2. Dietary diversity and consumption of vitamins and mineral supplements

As shown in Table 117, pregnant women in Lebanon consume 4.5 food groups on average, and about 46% of the pregnant women consume a minimum diverse diet. Nearly 44% of pregnant women reported consuming iron tablets or syrup in the past six months prior to the survey, and iron supplements were the most common supplement consumed by pregnant women. Approximately 34% of women reported consuming folic acid supplements and 30% reported consuming multivitamin supplements in the past six months.

Table 117. Dietary diversity and consumption of vitamin and mineral supplement in pregnant women, Lebanon 2023

Characteristic	N	% ^a or mean	[95% CI] ^b
Number of food groups consumed (MDD-W)			
Mean	223	4.5	[3.9,5.0]
Meet minimum dietary diversity (≥5 food groups)			
Yes	106	46.4	[33.9,59.4]
No	117	53.6	[40.6,66.1]
Consumed iron tablets or syrup in past six months			
Yes	99	43.5	[34.4,53.1]
No	124	56.5	[46.9,65.6]
Don't know	0	0	
Consumed folic tablets in past six months			
Yes	75	34.1	[24.8,44.9]
No	146	65.3	[54.6,74.7]
Don't know	2	0.5	[0.1,2.4]
Consumed multivitamin tablets in past six months			
Yes	59	29.8	[19.6,42.6]
No	163	68.7	[55.2,79.6]
Don't know	1	1.5	[0.2,10.2]

Note: The N's are the numerators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages and means weighted for unequal probability of selection.

^b CI = confidence interval, calculated taking into account the complex sampling design.

3.7.3. Mid-upper arm circumference

General nutritional status in pregnant women was measured by MUAC, and in total, MUAC measurements were provided by 184 pregnant women. Undernutrition (i.e., MUAC < 23 cm) is rare, and affects only 2.9% (95% CI: 0.9, 8.5) of pregnant women in Lebanon. Only one pregnant woman is classified with severe undernutrition (MUAC < 21 cm) and only 3 females are with moderate undernutrition (i.e., MUAC ≥21 & < 23 cm).

3.7.4. Anemia

The distribution of hemoglobin values in pregnant women is presented in Figure 49. The weighted mean hemoglobin concentration is 114 g/L (95% CI: 112, 117), and the weighted median hemoglobin concentrations is 115 g/L (IQR: 108, 121) (data not shown). The distribution shows that the majority of pregnant women are above the anemia cutoff of 110 g/L.

As shown in Table 118, approximately 25% of pregnant women in Lebanon are anemic. Pregnant women 30-49 years of age have a higher anemia prevalence than younger pregnant women. Anemia is also associated with pregnancy trimester, with anemia occurring in more than 40% of pregnant women in their 3rd trimester compared to 14-17% of anemia in pregnant women in their 1st or 2nd trimesters.

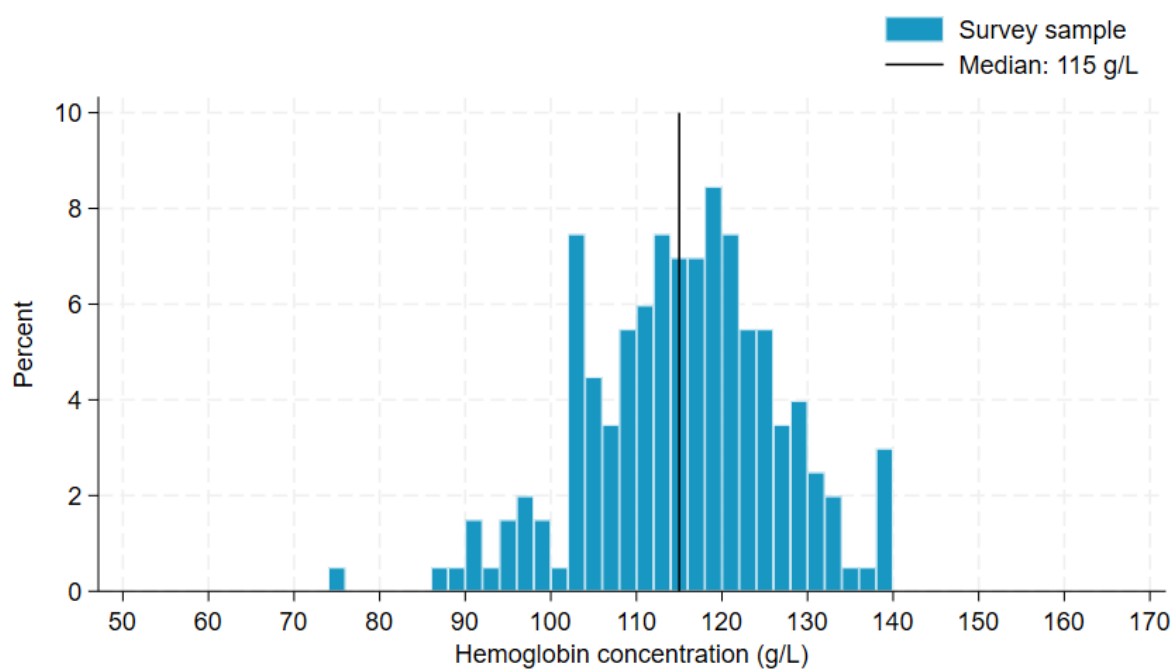
Table 118. Prevalence of anemia in pregnant women by various demographic characteristics, Lebanon 2023

Characteristic	N	% ^a with anemia ^b	[95% CI] ^c	p-value ^d
Age group (in years)				0.016
14-29	128	19.6	[12.4,29.6]	
30-49	73	41.0	[26.1,57.7]	
Wealth quintile				0.126
Lowest	97	20.2	[10.6,35.0]	
Second	47	23.8	[11.1,43.9]	
Middle	26	43.5	[17.4,73.8]	
Fourth	17	9.2	[2.6,27.6]	
Highest	14	49.7	[17.7,82.0]	
Educational level				0.372
Basic secondary or less	147	22.5	[15.2,32.0]	
Complete secondary or more	53	31.2	[16.2,51.6]	
Trimester of pregnancy				0.008
1	60	13.5	[6.4,26.4]	
2	75	16.8	[8.4,30.7]	
3	52	42.5	[26.2,60.7]	
TOTAL SAMPLE	201	24.8	[17.9,33.2]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection. // ^b Anemia defined as hemoglobin < 110 g/L for females in first and third trimester and hemoglobin < 105 g/L for females in second trimester; hemoglobin adjusted for elevation and smoking [118]. //

^c CI = confidence interval, calculated taking into account the complex sampling design. // ^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

**Figure 50. Distribution of hemoglobin (g/L) in pregnant women, Lebanon 2023**

3.7.5. Iodine deficiency

Table 119 presents the iodine status of pregnant women. The national mUIC in pregnant women is 149 µg/L, indicating an insufficient iodine status (i.e., mUIC <150 µg/L). Iodine status is also insufficient in women aged 30-49 years of age, women with basic secondary or less education, women in the first and second trimesters of pregnancy, and women who live in households using non-iodized and insufficiently iodized salt. No significant differences were observed by any of the investigated characteristics.

Table 119. Median urinary iodine concentration in pregnant women, Lebanon 2023

Characteristic	N	Median UIC ^a	[95% CI] ^b	p-value ^c
Age group (in years)				0.270
14-29	125	152	[133,187]	
30-49	74	118	[105,168]	
Educational level				0.673
Basic secondary or less	143	147	[125,177]	
Complete secondary or more	55	159	[121,205]	
Trimester of pregnancy				0.473
1	60	125	[105,165]	
2	75	143	[127,202]	
3	48	152	[98,192]	
Household salt iodization				0.106
None (<5 ppm)	21	147	[100,165]	
Insufficient (5-14.9 ppm)	11	117	[96,177]	
Adequate (≥15 ppm)	56	196	[143,238]	
TOTAL	199	149	[131,175]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Medians weighted for unequal probability of selection; UIC = urinary iodine concentration.

^b CI = confidence interval, calculated taking into account the complex sampling design using box-cox transformed values.

^c Chi-square p-value <0.05 indicates that the mean of the box-cox transformed urinary iodine concentration in one subgroup is significantly different from the values in at least one other subgroup.

3.7.6. Diabetes mellitus

As shown in Table 120, diabetes among pregnant women is very rare and occurs in 0.1% of pregnant women. In contrast, pre-diabetes occurs in nearly 5.6% of pregnant women; elevated HbA1c (i.e., both diabetes and pre-diabetes) is found in 5.7% of pregnant women.

No associations were found between diabetes and the examined demographic factors. Elevated HbA1c, however, is associated with pregnancy trimester, with elevated HbA1c occurring in 6.9% and 13.2% of pregnant women in the first and third trimesters, respectively; no pregnant women in the second trimester of pregnancy have elevated HbA1c.

Table 120. Prevalence of diabetes in pregnant women, by various demographic characteristics, Lebanon 2023

Characteristic	Diabetes ^a				Pre-diabetes ^a		Elevated HbA1c ^a		
	N	% ^b	[95% CI] ^c	p-value ^d	% ^b	[95% CI] ^c	% ^b	[95% CI] ^c	p-value ^d
Age group (in years)				0.085					0.989
14-29	12	0.0			5.6	[1.7,16.9]	5.6	[1.7,16.9]	
30-49	73	0.3	[0.0,2.0]		5.4	[1.7,16.3]	5.7	[1.9,16.2]	
Wealth quintile				0.920					0.298
Lowest	97	0.0			6.5	[1.5,23.6]	6.5	[1.5,23.6]	
Second	47	0.0			0.0		0.0		
Middle	26	0.0			8.3	[2.4,24.8]	8.3	[2.4,24.8]	
Fourth	17	0.5	[0.1,3.6]		9.6	[1.9,37.2]	10.1	[2.1,37.0]	
Highest	14	0.0			1.0	[0.1,7.4]	1.0	[0.1,7.4]	
Educational level				0.569					0.195
Basic secondary or less	14	0.1	[0.0,0.7]		6.7	[2.3,17.9]	6.8	[2.4,17.9]	
Complete secondary or more	53	0.0			2.6	[0.7,8.9]	2.6	[0.7,8.9]	
Trimester of pregnancy				0.682					0.011
1	60	0.3	[0.0,2.5]		6.9	[2.2,19.9]	7.3	[2.4,19.9]	
2	75	0.0			0.0		0.0		
3	52	0.0			13.2	[3.9,36.3]	13.2	[3.9,36.3]	
TOTAL SAMPLE	20	0.1	[0.0,0.5]		5.6	[2.2,13.7]	5.7	[2.2,13.7]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Diabetes defined as HbA1c $\geq$ 6.5%, pre-diabetes defined as HbA1c 5.7-6.4%, elevated HbA1c defined as $\geq$ 5.7%.

^b Percentages weighted for unequal probability of selection.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

3.7.7. Hypertension

As shown in Table 121, hypertension was measured in 202 pregnant women, and hypertension occurs in only 6% of pregnant women. The highest hypertension prevalence is found in pregnant women in the highest wealth quintile, however, the association between hypertension and wealth quintile is not significant. In addition, associations between hypertension and age, education, and pregnancy trimester are also not significant.

Table 121. Hypertension in pregnant women, Lebanon 2023

Characteristic	N	% ^a with hypertension ^b	[95% CI] ^c	p-value ^d
Age group (in years)				0.099
14-29	126	7.9	[1.6,30.7]	
30-49	76	1.6	[0.4,6.5]	
Wealth quintile				0.473
Lowest	95	9.8	[1.4,45.0]	
Second	47	1.1	[0.2,7.7]	
Middle	26	1.7	[0.2,12.4]	
Fourth	19	0.0		
Highest	15	14.4	[1.8,61.0]	
Educational level				0.947
Basic secondary or less	145	6.5	[1.0,32.6]	
Complete secondary or more	56	6.0	[1.0,28.5]	
Trimester of pregnancy				0.371
1	57	2.2	[0.5,8.6]	
2	75	4.2	[0.7,22.3]	
3	53	0.0		
TOTAL SAMPLE	202	6.4	[1.5,23.7]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Hypertension is defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

4. DISCUSSION

Lebanon's Integrated Micronutrient, Anthropometry and Child Development Survey (LIMA) is a national cross-sectional survey that collected data from households and individuals in all of Lebanon's governorates and among Syrians living in ITS and Palestinian camp population .

LIMA is the first national survey in Lebanon that comprehensively describes the micronutrient and nutrition status of children under 5 years of age, adolescent girls, non-pregnant and pregnant women. Specifically, the survey assessed micronutrient deficiencies and anemia, stunting, wasting, underweight and obesity, early childhood development status, dietary patterns, the underlying causes of malnutrition and developmental deprivation, prevalence of nutrition related non-communicable diseases risk factors (salt intake, smoking, lipid profile, diabetes, and blood pressure) and the effectiveness of the national salt iodization program. Because of the large number of indicators examined for each population group, the LIMA permits a wide-ranging understanding of the health and nutritional issues of the various target groups and will enable program planners in Lebanon to make informed decisions and design targeted nutrition and child development interventions. The generated evidence is of strategic importance for several reasons:

1. LIMA is the first national survey measuring micronutrient deficiencies in Lebanon.
2. The first national nutrition survey in Lebanon, offering wealth of evidence on nutritional status of adolescent girls.
3. The first national survey globally to measure nutrition and ECD outcomes during the first 2 years of life, which will enable the measurement of the associations between all forms of malnutrition and early childhood development.
4. The first time globally that ECD outcome data was collected using the newly released Global Scales for Early Development-Household Form (GSED-HF 1.0) launched in February 2023 to monitor the holistic development of children in the critical first two years of life.

4.1. Household level findings

Household-level data indicate that food security is of a significant concern. Food insecurity access was assessed using the HFIAS, and 60% of the sample population have insecure food access, with a significant variation between nationalities. Households of Syrian nationality have the highest level of food insecurity access, and among insecure households, more than 55% have severely insecure food access. Food security prevalences are 46%, 15% and 59% among Lebanese, Syrian and Palestinians, respectively.

The LIMA shows that household food security access is associated with lower levels of undernutrition and higher levels of overnutrition. Children residing in food-secure or mildly food insecure households have lower prevalences of stunting and wasting but higher prevalences of overweight or obesity. Similarly, food security seems to provide better micronutrient support; vitamin D deficiency and/or insufficiency in all target groups, and

vitamin B12 deficiency prevalence in NPW are lower among those in more food secure households.

The LIMA also found the performance of Lebanon's salt iodization program is sub-optimal, with only 49% of salt sample adequately iodized according to the international cutoff of 15 ppm and only about 8% of the salt adequately iodized according to the Lebanese standard (35.6 ppm). The Akkar stratum has a higher prevalence of adequately iodized salt (15ppm) in households (78%), followed by the Syrian ITS (63%). Iodized salt is distributed as part of food baskets to the most vulnerable population groups, but it is unclear whether this is the reason for the greater proportion of households in Akkar and the ITS strata consuming adequately iodized salt. While an analysis of the iodization status was attempted by brand, most households did not have salt in the original packaging, which prevented a thorough analysis of iodized salt coverage by brand. Thus, an in-depth analysis of the salt market is needed to explain the substantial difference in salt iodization by stratum. Prior to the LIMA, a 2013/2014 national market assessment of the salt iodization program found similar results to the LIMA, with only 44% of salt samples adequately iodized according to international standards [46]. In contrast, a 2020 hospital-based study collected salt samples from the pregnant women subjects in Bekaa and South governorates and found approximately 80% of salt was adequately iodized [47].

4.2. Breastfeeding and complementary feeding

The LIMA assessed the 17 indicators recommended by the 2021 WHO/UNICEF IYCF guidelines [59]. Regarding breastfeeding, the LIMA found that a high prevalence (>80%) of children <2 years of age were ever breastfed. The proportion of the other breastfeeding practices, however, was sub-optimal. To illustrate, only 60% of children were given breastmilk within 1 hour after birth, and only 23% of children < 6 months of age were exclusively breastfed. The LIMA found similar proportions of children who were ever breastfed and received breastmilk within the 1 hour after birth as the 2021 SMART survey [4], which reported that 85% of children were "ever breastfed", 63% had "early initiation of breastfeeding". However, the 2021 SMART survey [4] found a 30% lower proportion of children <6 months of age who were "exclusively breastfed".

Regarding complementary feeding indicators in children 6 and 23 months of age, the LIMA and the 2021 SMART [4] surveys found similar prevalences for minimum dietary diversity (26% versus 23%), minimum meal frequency (47% versus 47%), and minimum acceptable diet (11 versus 6%). The LIMA also found that the prevalence of all three aforementioned indicators increases with household wealth, reflecting the strong link between socio-economic status and the diet quality of infants and young children. This same association between household wealth and complementary feeding was also found in a multi-country analysis of five countries (including Lebanon) from the MENA region [124]. While a recent systematic review [125] indicated that dietary diversity score is oftentimes a strong predictor of micronutrient adequacy in children < 5 years of age, the LIMA results did not find similarly strong associations between minimum dietary diversity and micronutrient deficiencies.

Previous national policies and programs in Lebanon have been designed to improve IYCF practices. In 2008, a national policy related to exclusive breastfeeding was included in Law 47/2008 [126], which aims to regulate the marketing of IYCF food products and tools. In 2018, the Ministry of Public Health issued a national policy on IYCF detailing its approach to implementing and monitoring law 47/2008 [126]. While laws and legislations are clearly set in Lebanon, the political will and institutional capacity for their implementation and monitoring remain some of the important barriers against the translation of the policies into practice [127]. Another policy aimed at increasing breastfeeding practices is the national policy to introduce the baby-friendly hospital initiative (BFHI), skin-to-skin practices, and early initiation of breastfeeding. However, more community-level efforts are needed to sensitize women and families to improve their knowledge of early breastfeeding practices: a recent cross-sectional survey evaluated the knowledge and attitudes about the BFHI practices among women in Lebanon [128], and found that half the interviewed women were inadequately instructed on how to start or continue breastfeeding.

4.3. Early childhood development

It is estimated that 250 million children (43%) of children in the first five years of life living in low- and middle-income countries are off-track in their early development due to economic, biological and psychosocial risk factors [26,129]. Malnutrition is a prevalent risk factor associated with poor development [26,129]. In addition, large numbers of young children receive inadequate nurturing care input; for example, approximately only one-third of preschoolers receive adequate stimulation at home or have access to sufficient learning materials at home (e.g., picture books) and nearly two-thirds are exposed to harsh physical punishment [130]. Interventions such as early childhood care and education programs and parenting programs (designed to address both the needs of the child (e.g., health, nutrition, protection, and development needs) and to support families (e.g., caregiver wellbeing and support)) have been found to be effective in promoting early childhood development. Moreover, many advocate for holistic packages of care that promote a range of outcomes for young children including both healthy growth and development [27]. Prior program evaluations and research have demonstrated that parenting interventions (focusing on early stimulation and learning, and responsive care) can be integrated with childhood nutrition interventions delivered through community-based services, primary healthcare and preschools [27].

The LIMA survey found that 65.3% of 0-23 months old children and 69.3% of 24-59 months old children are developmentally on track. On average, 72.6% of children aged 36-59 months across 68 low- and middle-income countries were found to be developmentally on track with variability across regions [1]. Specifically, in the MENA region, percentages of children on track aged 36-59 months ranged from 79.3% in Iraq (2018) to 83.9% in Palestine (2020) [2]. However, comparing these figures to Lebanon should be done with caution given the absence of a directly comparable dataset that includes a wider age range of children, specifically those

aged 24-36 months. However, these figures suggest that early childhood development warrants public policy attention in the country.

In contexts of multiple adversities, multi-sectoral strategies are necessary. For example, the LIMA survey identified that among children 0–23 and 24–59 months of age, significant sub-group differences were observed with respect to household food security. For instance, among children 0–23 months, 74.0% in food secure households are developmentally on-track, compared to 58.6% and 69.7% in moderate and severe food insecure households, respectively. Therefore, focusing on the enrichment of the child's learning environment alone will be insufficient for children growing up in food insecure households.

With respect to feeding practices and anthropometry, significant sub-group differences were observed among the younger age group (0-23 months old) with a lower percentage of children developmentally on track if they do not meet the threshold for receiving a minimal dietary diversity or minimal acceptable diet. In this age group, a significantly lower percentage of children were found to be developmentally on track compared with non-stunted children (52.5% compared to 68.4%). Therefore, leveraging opportunities to integrate care for nutrition and care for development in the early years is imperative. Taken together, these findings further underscore the importance of adequate nutrition alongside safe and stable living conditions and early learning opportunities for better developmental outcomes. Initiating these interventions earlier can lead to better outcomes.

Finally, among older children (24-59 months old), significant sub-group differences were observed among those exposed to low birth weight with a lower percentage of children developmentally on-track (64.4%) compared with those born with normal weight (75.7%). These findings highlight the importance of a life course approach- ensuring adequate maternal health and nutrition in pregnancy is essential alongside reducing psychosocial distress in mothers that will likely impede their own and their young child's wellbeing.

4.4. Dietary diversity of adolescent girls and women

Just about half of the adolescent girls and women achieve MDD, which is similar to the results of a nationwide survey in Jordan [3]. Sub-group analyses revealed that poverty is a driver of poor diet- a well-documented association- as the lowest proportion of those with minimum dietary diversity live in households of the lower wealth quintiles or in food insecure households. Moreover, a smaller proportion of individuals with Syrian nationality reach MDD, a population group with the highest prevalence of food insecurity (access).

4.5. Chronic and acute malnutrition

The data shows a drastic increase in chronic malnutrition over the last two years, indicating a deterioration of the nutritional situation in Lebanon.

While the prevalence of short stature and thinness in adolescent girls is relatively low, the national prevalence of stunting in children < 5 years of age is 14%, denoting a medium public

health problem. Stunting prevalence is double that reported in the SMART 2021 [4] and in surveys conducted in other countries in the region [3,5]

Subgroup analysis revealed a significant difference in stunting by nationality, with a prevalence of 20% among Syrian children. Alarming, the stunting levels in children in the Syrian ITS is 39%, a very high public health concern, as classified by the WHO and 13 percentage points higher than reported by the 2021 SMART survey [4].

The Ministry of Public Health, with support from UNICEF, WHO, and nutrition sector partners are currently revising the national guideline on Prevention and Management of Wasting in Lebanon to enhance emergency preparedness measures. However, in contrast to stunting, the national wasting prevalence found by the LIMA is very low (1.3%) but reaches moderate public health significance in children 0-5 months of age (6%). Similarly low wasting prevalences were found by the 2021 SMART and are reported from other countries in the region [3,5].

Both stunting and wasting are inversely associated with wealth quintile, with prevalences decreasing as household wealth increases. In addition, stunting is also inversely associated with food security access status. Associations between household-level factors and nutritional status are well known, and malnutrition in utero has also been identified as a cause of stunting [131] However, prevalence of undernutrition as well as anemia and most micronutrient deficiencies are highest in children 12-36 months, which may be related to poor feeding and care practices during this critical age of development.

This phenomenon may be occurring in Lebanon, as a higher prevalence of stunting was found among children born with low birth weight.

4.6. Obesity and cardiometabolic risk factors

Although the prevalence of overweight and obesity in children under 5 years of age is rising in low- and middle-income countries, the overweight and obesity prevalence found by the LIMA is low and very close to the prevalence reported by the 2021 SMART survey (LIMA 4.4% versus 3.7% SMART). Despite this low prevalence, overweight and obese children have a higher inflammation prevalence compared to their normal weight counterparts. This biological process has been previously described by Singer & Lumeng [132], who indicate that metabolic stress and inflammation are prevalent among obese children and adolescents and can lead to prolonged adipose tissue dysfunction later in life.

In contrast to children, the level of overweight or obesity (30%) among adolescent girls is a high and a public health concern. Similar to children, overweight and obese girls have a higher prevalence of inflammation, which can lead to adipose tissue dysfunction later in life. In addition, overweight or obese adolescent girls are less likely to be vitamin A deficient than underweight or normal weight girls. This finding can be explained by an increased energy intake, which results in a higher intake of pro-vitamin A, and an increased fat intake, which results in better absorption of pro-vitamin A. This finding may also be due to the fact that vitamin A status was assessed using RBP, as excessive adipose tissue increases circulating RBP [133] While most metabolic abnormalities are uncommon in adolescent girls, the proportion

of girls having high triglyceride or low HDL levels is worrying. Similar results were found in a study on 969 school-age children and adolescents (8 to 18 years) in Beirut and Mount Lebanon. It revealed a prevalence of 31% of overweight or obesity, and that 27%, 7% and 13% of the sample population exhibited high triglyceride, high total cholesterol, and low HDL cholesterol levels, respectively [134].

In NPW, more than half of the sample population is overweight or obese, which denotes a high public health problem. The strongest association was found by age group, and overweight or obesity increases consistently from 18% in women 15-19 years old to 74% in women 40-49 years old. These findings likely suggest the accumulation of weight and fat mass after childbirth, which is considered a significant determinant of obesity [135]. The LIMA observed this association, with the prevalence of overweight and obesity significantly higher in women who had ≥ 3 pregnancies. In addition, around half the NPW present with visceral obesity, which also increases with age and number of pregnancies. Metabolic abnormalities among non-pregnant women contribute to a prevalence of metabolic syndrome of 25%, the prevalence also increasing with age. Diabetes, hypertension, high triglyceride, low HDL, and visceral obesity are all similar by nationality, and they vary between 3% and 50%, depending on the indicator.

All components of metabolic syndrome are correlated with each other, and all metabolic indicators are associated with inflammation. Indeed, it is well documented that the onset of a metabolic abnormality often precipitates a cascade of subsequent abnormalities initially fueled by chronic low-grade inflammation.

Iron status is affected by overweight or obesity; a higher proportion of non-pregnant women have a concomitant high BMI and iron deficiency. It is highly believed that high adiposity, in general, and visceral adiposity, in particular, through inflammation and inflammatory markers, interact with iron metabolism and inhibit iron absorption [136].

4.7. Anemia and iron deficiency

At the national level, the anemia prevalence is considered a “moderate” (i.e., 20-39%) public health problem in all target groups except pre-school children, where the prevalence denotes a “mild” (i.e., 5-19%) public health problem [10]. Compared to the prevalence of anemia in children and NPW from other countries in the region [3,137] that also used venous blood and an automated analyzer, the prevalence found in Lebanon is slightly higher but falls within the same WHO classification. The results also indicate that anemia in Lebanon is caused primarily from nutritional deficiencies. Approximately 60 to 70% of anemic participants are iron deficient, and significant associations with other micronutrient deficiencies (e.g., vitamins A, B12, & D) were observed.

In addition to nutritional factors, anemia of chronic inflammation also contributes to the anemia burden in Lebanon, particularly in children and adolescent girls. Anemia can also be caused by genetic blood disorders, which were not investigated by the LIMA. However, previous research in Lebanon has found that only 2.3% of the population is a carrier of α -

thalassemia and β -thalassemia [138]. Due to this low prevalence, it would not be possible for thalassemias to contribute substantially to the anemia prevalence observed by the LIMA.

Among children, the observed prevalence of anemia is 26 percentage points lower than the SMART survey, which reported a prevalence of 43%. This difference likely stems from the different pre-analytic methods used by both surveys. While the LIMA collected venous blood, the SMART used capillary blood. In addition, the LIMA measured hemoglobin concentration with a complete blood count (CBC) analyzer, and the SMART used a portable hemoglobinometer (HemoCue 201+). A recent systematic review and meta-analysis found systematically lower hemoglobin concentrations — and thus higher anemia prevalence — when using capillary blood samples [9]. Lastly, the hemoglobin levels in LIMA were adjusted for the altitude as recommended by the WHO for analysis of anemia in children, whereas this adjustment was not utilized by the SMART survey. In summary, the hemoglobin measurement methods used by the LIMA would minimize any measurement error or bias.

Among adolescent girls, anemia is significantly higher among those with iron and B12 deficiencies. These associations could reflect that anemia in this age group is at least partially caused by low intake of animal source foods, which contain high amounts of heme iron and vitamin B12.

As noted above, iron deficiency is likely the main cause of anemia in Lebanon, and the prevalence of iron deficiency denotes a moderate public health problem in children, adolescent girls, and women [102]. Iron deficiency is positively associated with vitamin D deficiency in all target groups. This finding is likely due to the fact that iron and vitamin D status are interrelated, as vitamin D regulates hepcidin and iron regulated vitamin D metabolism [139,140]. Iron deficiency is also associated with folate deficiency in adolescent girls and women. As there are few foods that contain both high levels of iron and folate, this concurrence of deficiencies may be attributable to generally nutrient-poor diets in certain strata (e.g., Beirut) where the prevalence of both deficiencies is high.

4.8. Vitamin A deficiency

Vitamin A plays a crucial role in maintaining normal vision, strengthening the immune system, and supporting growth and development. While the LIMA generally found a low prevalence of vitamin A deficiency in the various target groups, notable associations were observed. Specifically, higher prevalences (>10%) of vitamin A deficiency were found among children experiencing diarrhea, fever, and lower respiratory infections and about 20% of vitamin A deficiency was found in wasted children. These findings may indicate that vitamin A deficiency children are more prone to diseases and infections due to compromised immune function and that vitamin A deficiency is more common among acutely malnourished children.

The prevalence of vitamin A deficiency is low in adolescent girls and NPW and does not pose a public health problem. A similarly low vitamin A deficiency prevalence was found among women from Beirut in a representative study from 2006 [141].

4.9. Folate and vitamin B12 deficiency

Folate and vitamin B12 are water-soluble vitamins, and deficiencies in these vitamins can cause megaloblastic anemia and increase the risk of cardiovascular diseases through the alteration of homocysteine metabolism. While folate is found in many plant-based staple foods (e.g., beans, nuts, fruits, whole grains), vitamin B12 is exclusively found in animal products, such as meat, eggs, and dairy.

In adolescent girls, the prevalence of folate and B12 deficiencies is 14% and 17%, respectively. Similar prevalences were found in non-pregnant women, with 18% deficient in folate and 21% deficient in vitamin B12. Strata and household wealth are strongly associated with both deficiencies, but with differing findings. To illustrate, the Syrian ITS stratum has one of the lowest prevalences of folate deficiency and the highest prevalence of B12 deficiency in both adolescent girls and women. Similarly, as household wealth increases, the folate deficiency prevalence increases whereas vitamin B12 deficiency decreases. The differing direction of these associations is likely because folate is found in affordable plant-based foods whereas animal-source foods are typically more expensive and difficult for low-income households to afford. This is also indicated by our data, which show that a greater proportion of adolescents and women in poor households consume vegetables than in wealthier households.

4.10. Vitamin D deficiency

Vitamin D is identified as one of the most common deficiencies and often goes undiagnosed. A recent meta-analysis pooling over 300 studies from 81 countries noted that countries in the Eastern Mediterranean region have the highest prevalence compared to other regions [142]. Indeed, despite plentiful sunshine in Lebanon, vitamin D deficiency and insufficiency is a serious public health problem.

The lowest prevalences of vitamin D deficiency and insufficiency were found in children, with 5% and 24% of children deficient and insufficient, respectively. No differences were detected between boys and girls, and this finding may be due to the similar behaviors and clothing worn by young boys and girls.

In contrast, the prevalence found in adolescent girls and non-pregnant women is very high: Nearly 80% of adolescent girls and 70% of non-pregnant women have suboptimal vitamin D status (deficiency and insufficiency). Similar findings were found in a recent cross-sectional study in Beirut [44], which reported that 72% of Lebanese adults (males and females); in Beirut the LIMA found vitamin D deficiency/insufficiency in 64% of non-pregnant women.

Among adolescent girls, the prevalence of vitamin D deficiency/insufficiency is significantly higher among those with menarche. In addition, the prevalence of vitamin D deficiency is higher among veiled girls and NPW and among those with less sun exposure. These results are similar to those found in nearby Jordan, where the prevalence of vitamin D deficiency is also significantly higher in veiled women [143].

4.11. Iodine deficiency

While the LIMA found that adolescent girls, NPW, and pregnant women are iodine sufficient at the national level, subgroup analysis of mUICs by salt iodine content found significant associations. Specifically, the LIMA found a positive dose-response relationship between mUIC and salt iodization level. Moreover, iodine insufficiency was found in girls and women residing in households with non-iodized salt. Results are statistically significant for adolescent girls and non-pregnant women; the lack of statistical significance for pregnant women can be attributed to the small number of pregnant women recruited by the LIMA.

The LIMA's results are not aligned with a study performed on pregnant women in 4 different hospitals in Lebanon between 2018 and 2019, which found a mUIC of 183 µg/L in pregnant women [47]. Unlike the LIMA, however, this study was not a representative sample of the population of Lebanon.

4.12. Zinc deficiency

Zinc deficiency prevalence is surprisingly high in all population groups ranging from 35% in non-pregnant women to 38% in pre-school children and can be considered of public health importance in all population groups [7]. While the prevalence is substantially higher than reported by a national micronutrient survey conducted in Jordan [3], a high prevalence of zinc deficiency (24%) was found by a survey of adult women from six districts across Lebanon [8]. There are distinct challenges measuring zinc and no gold standard biomarker to assess zinc status has been identified so far. Although serum zinc is suboptimal for assessing zinc status of individuals, it is the best available zinc biomarker to use as part of national surveys [144] and is therefore jointly recommended by WHO, UNICEF, IAEA, and IZiNCG to assess the zinc status at the population level [145].

4.13. Sodium and potassium intake

The LIMA found that approximately 60% adolescent girls and NPW exceed their daily sodium intake [146]. A similar percentage was described by Almedawar et al [147] in their review of sodium intake in Lebanon. Moreover, the sodium intake in Lebanon is similar to the MENA region estimates produced as part of a global systematic review of sodium intake [148].

Sodium intake has been associated with increased blood pressure and metabolic changes in some populations [149–151]. Remarkably, the LIMA found that nearly 75% of non-pregnant women with hypertension have excessive sodium consumption, in contrast to 60% among non-hypertensive women. In Lebanon, processed foods have been previously identified as the main source of sodium, and approximately 50% of daily sodium intake comes from breads and cereals, processed meats, and dairy [147].

Studying sodium in reference to potassium intake provides a more comprehensive understanding of the risk factors and their impacts on health. Mean potassium intake is estimated to be 1.8 g/d in AG and 2 g/d in NPW; only 5% and 7%, respectively, meet the recommendations. Interestingly, this is consistent with a study published on school-age

children where almost all children failed to meet the recommended daily potassium intake [98]. The common assumption that the Lebanese people consume enough potassium, considering the easy access and low cost of local fruits, vegetables, and legumes, is not backed by the results of this study. There is a need for increased efforts to return to the traditional Mediterranean diet, which emphasizes consuming fresh foods.

4.14. Wheat flour intake

In Lebanon, bread accounts for 17-20% of the daily energy intake in children, adolescents, and adults [152]. In Lebanon there is an array of bread types available on the market, and Lebanese pita bread made from refined wheat flour is the most widely consumed bread. For the LIMA, the intake of wheat flour was calculated by adding up the consumption of all breads and food products that contain a high amount of wheat flour. The average wheat flour intake is approximately 75 grams per day among adolescent girls and NPW. These findings are similar to a 2001 survey in Beirut that reported an intake of 146 grams of bread per day in adults (males and females) [153]. Assuming that pita bread is the main type of bread consumed by that survey's respondent, and that around 30% of pita bread is water, this study revealed a wheat flour intake of around 88 grams per day, which is similar to the findings of the LIMA. The slightly lower intake observed by the LIMA is likely attributable to the fact that the LIMA did only include females who have lower energy requirement — and likely consume less bread — than males.

5. STRENGTHS AND LIMITATIONS

A key strength of the LIMA is the measurement of an extensive suite of biomarkers from urine and venous blood samples. The use of venous blood samples, in particular, is a key strength of the LIMA, as it removes potential preanalytical biases (e.g. dilution from interstitial fluid, small sample volume) that can occur with capillary blood sampling. There is a growing body of research that indicates that using capillary samples frequently results in lower hemoglobin concentrations and subsequently cause artificially high anaemia prevalences [9]. Also, the LIMA measured hemoglobin via complete blood count (CBC), which increases the certainty of the hemoglobin results. Furthermore, the measurement of hemoglobin using venous blood with a CBC is the method recommended in WHO's 2024 hemoglobin/anemia guidelines [10]. Another strength of the LIMA is the inclusion of early childhood development indicators and indices. Early childhood development indicators are infrequently collected as part of surveys that measure the nutritional status of children using biomarkers and LIMA is the first national survey globally assessing the associations between micronutrient and nutritional status and various developmental indicators. Moreover, the LIMA is the first survey globally that collected ECD outcome data using the newly released Global Scales for Early Development-Household Form (GSED 1.0) launched in February 2023 to monitor the holistic development of children in the critical first three years of life.

A key limitation of the LIMA is that, as a cross-sectional survey, the association between any two variables *cannot* be considered causal. Another limitation is that part of the data collection occurred during the summer months, when many residents of Lebanon move to secondary residences. This could have slightly biased some results, as households that relocated in the summer were considered "away for an extended period" and thus were not considered eligible.

6. RECOMMENDATIONS

6.1. Implement the national nutrition strategy and Scaling Up Nutrition movement

Following a rigorous multi-sectoral consultative process with key national nutrition stakeholders, Lebanon's Ministry of Public Health launched, for the first time, a National Nutrition Strategy for Lebanon (2021-2026) in 2022. This strategy comes at a critical time where the country is facing several crises that have severe impacts on the health and nutrition of people in Lebanon. The results of LIMA survey reaffirm the need to scale up coordinated, multi-sectoral nutrition programming in order to avoid exacerbation of the nutrition situation.

A multi-system approach to nutrition programming is needed to address and remedy the nutrition and health problems revealed by the LIMA survey. To successfully address nutrition-related issues, it is imperative that nutrition programs are integrated with other sectors. The national government is responsible for upholding children's and women's rights to adequate nutrition, and programming should contribute to strengthening the capacity of national food, health, social protection, education and WASH sectors. This can help ensure that all children, adolescents, and women have access to nutritious, safe and affordable foods, and benefit from adequate nutrition practices and services. While responding to immediate needs is critical, long-term development assistance efforts to strengthen the nutrition governance in Lebanon is needed for longer term improvements in the nutrition and health status of Lebanon's population.

Despite all the efforts made to date, policy makers, donors and development partners are facing an inertia to support and invest on Lebanon's nutrition agenda. To sensitize all stakeholders and partners, and to promote integrated nutrition programs, it is recommended to accelerate collaboration across various sectors and systems, including health, food, agriculture, education, WASH, and social protection. This is a national priority and can be supported by the Scaling Up Nutrition movement by establishing the National Nutrition Council to support the operationalization of the multi-sectoral component of the National Nutrition Strategy. To achieve this aim, it is imperative to mobilize commitments from multiple ministries, donors, international financial institutions, and other partners to raise the profile of nutrition in the humanitarian and development agenda.

6.2. Improve household food security access and reduce child food poverty

Addressing food insecurity in a challenging context, as in Lebanon, where poverty is dramatically increasing, requires a multidisciplinary, multisectoral approach. Both immediate and long-term programs are needed. While many agencies are already involved in food security programs and reducing poverty initiatives, efforts are still required to target people of all nationalities in the community and camps. Moreover, the large proportion of children suffering from food poverty demonstrates that the current social protection and food assistance schemes are not sensitive to the needs of children during early years. Social protection systems will have to be designed and activated that are responsive to the food and

nutrition needs of the most vulnerable population groups. Food parcels could be distributed to the most vulnerable, ensuring sufficient calories and nutritious foods. Besides, the availability and affordability of nutritious foods will have to be increased – including fruits, vegetables, eggs, fish, meat, and fortified foods for young children – by incentivizing their production, distribution, and retail. At the same time, it will be important to implement national standards and legislations to protect young children from unhealthy processed and ultra-processed foods and beverages and harmful marketing practices targeting caregivers.

Equally, integrating cash-based transfers into food assistance programs has been proven an effective modality in increasing food access and dietary diversity. Any cash and social transfer programs must be sensitive to the nutritional needs of young children to end child food poverty – particularly severe food poverty in early childhood –in response to humanitarian crises. In addition, nutritional programs that include the distribution of supplementary foods and micronutrient powders can help to improve nutritional status alongside improvements in food security status. These programs yield better outcomes through enhanced nutrition knowledge. Hence, nutrition education and awareness programs stand as foundational pillars to witness steady improvement in the community. Social protection programs can be used to improve caregivers' knowledge about child feeding and nutrition by providing education and counselling and by encouraging the use of essential nutrition services. School feeding programs providing meals and snacks to children are also shown to overcome some poverty-related obstacles and enhance food insecurity. On the other hand, long-term programs will be required for the sustainability of the approach. These interventions can include agricultural support and capacity building for farmers and/ or food producers, kitchen gardening, and other activities that foster self-sufficiency.

6.3. Improve infant and young child feeding practices

The LIMA found that some breastfeeding and complementary feeding practices are suboptimal. While the LIMA cannot determine the reason underlying these suboptimal breastfeeding behaviors, it is plausible that insufficient information and/or support are provided to women during the antenatal and postnatal period. As such, the continued expansion of Lebanon's BFHI and breastfeeding counselling can be recommended. In addition to expanding the BFHI and counseling, we could recommend greater involvement of physicians in private practices to promote breastfeeding, as they have great influence, and their engagement could facilitate and increase adherence. Moreover, it is recommended that breastfeeding promotion be established as an integral part of ante and postnatal care to raise awareness of the importance of breastfeeding. In addition, to clearly identify the barriers to optimal breastfeeding practices after birth, research about the breastfeeding support provided at hospitals/clinics and the breastfeeding-related knowledge, attitudes and practices of women who have recently given birth should be conducted. In addition, Lebanon's law 47/2008, which prohibits the marketing of breast milk substitutes for children under 6 months of age should be activated and enforced.

In addition to breastfeeding, complementary feeding indicators also must be improved in Lebanon. As complementary feeding is influenced by multiple factors across the food system a holistic approach is warranted to improve practice. Potential programs to alleviate problems with complementary feeding practices must focus on providing adequate foods to improve the children's diet, which depends on the availability, access, affordability and desirability of such foods. At the same time adequate health, nutrition, water and sanitation, and social protection services will have to be provided as they are critical for the quality of the child's diet. In addition, programs are needed that improve caregivers' knowledge, which has been shown to translate into better feeding, care and hygiene practices [11]. As the LIMA found children from in certain strata have poorer dietary diversity and meal frequency practices, geographic targeting of behavior change communication and social protections programs or integration of nutrition sensitive elements under existing social protection programs should be considered. In addition, since household wealth status is clear risk factor for sub-optimal complementary feeding practices, income support programs (e.g., cash transfers) can be targeted to children in low-wealth households. These programs can also be implemented alongside awareness campaigns that stress the importance of a diverse diet and frequent feeding of children 6–23 months of age.

6.4. Promote early child development

Promoting early childhood development in Lebanon warrants public policy attention. Children at risk of poor nutrition and growth are also likely to be at risk of poor early development with long-term detrimental impacts over the life course including academic attainment, poor adult physical and mental health, and lower productivity and human capital [26]. However, it is recognized that addressing nutritional risks alone will not be adequate to promote optimal child development (learning, social-emotional and behavioral development)[27,28]. Maternal and child health and nutrition services (e.g., antenatal care, immunization and well-baby visits) provide opportunities to integrate early stimulation, safety, and responsive care advice to promote early childhood development as well as screening and early interventions for children at-risk of developmental delays and disabilities [29–32]. Lebanon to capitalize on its experience of the *Rising Initiative* to scale up delivery of integrated nutrition and child development services utilizing multiple platforms.

The integration of stimulation and responsive care interventions in health services which reach parents and young children is essential in providing a holistic package of care to promote health, nutrition, learning and protection [154]. Multi-sectoral actions are also necessary. For example, universal programs promoting care for early development can include large scale behavioral change campaigns (e.g., using social media) that support caregiver engagement. Lebanon has several initiatives with UN agencies, local and international non-government organizations that have piloted programs to promote ECD in host and refugee communities. A review of these programs can help identify the promising programs that support multi-sectoral actions for young children.

Community-based strategies in partnership with non-government organizations can enhance access to early learning materials (e.g., book and toy libraries) to the most vulnerable groups in the populations. Training of nursery workers and preschool teachers to optimize stimulating, protective, and responsive care in group settings will also support children and their families. Supporting caregivers is essential to ensure children can thrive and be safe require actions from health, education, and social protection to ensure families have adequate resources to invest in their young children, are empowered with knowledge on child development, and have good mental health to support themselves and their young children. Increased advocacy and strong partnerships with international non-government organizations and other key stakeholders is also necessary to ensure early childhood interventions reach displaced and refugee children.

6.5. Reduce undernutrition in children

While undernutrition is not a severe problem in Lebanon, the drastic increase of stunting in children below 5 years of age from 2021 to 2023 is of concern and may indicate that current programs in Lebanon are not meeting the nutrition needs of small children. In addition, inappropriate feeding practices of infants and young children may contribute to high prevalence of stunting. Exclusive breastfeeding in the first 6 months of life should be promoted and supported to ensure adequate nutrition and protection of infants from gastrointestinal infections. The consumption of healthy, diversified diets in the complementary feeding period (6-23 months) should also be promoted to consistently improve the diversity and quality of diet for young children. Adequate feeding habits could be promoted via social protection programs by improving caregivers' knowledge about child feeding and nutrition through education and counselling and by encouraging the use of essential nutrition services. Moreover, hygiene promotion initiatives and behavior change interventions should be expanded targeting households and child hygiene practices to prevent infections, particularly given the high prevalence of diarrhea and its significant role in stunting.

6.6. Reduce the prevalence of overweight and obesity

Overweight and obesity is a serious public health problem in Lebanon with high relevance, especially among older women. Similarly, the prevalence of hypertension, diabetes and other cardiometabolic risk factors drastically increase in older women. As such, it is recommended that women above 40 years of age are routinely tested for diabetes, hypertension, elevated triglycerides, and low HDL cholesterol. In addition, given that retaining pregnancy weight after childbirth poses a major risk factor for later overweight and obesity, initiatives targeting pregnant women serve as a strategic opportunity to reduce this problem among adult women. Consequently, it is advised to include behavioral change communications and counseling for mothers to antenatal and postnatal care services. Importantly, promoting breastfeeding practices might also help lose pregnancy weight. Exclusive breastfeeding (and extended breastfeeding) has been recognized as an effective postpartum weight loss strategy, especially when combined with an adequate healthy diet.

This problem should be tackled through policy enforcement and community engagement. Modifications along the food system that can occur at the policy, private sector, public health, medical, community, or individual level are needed to promote the production and purchasing of healthy foods. Policies could include taxation measures to limit the affordability and marketing of high-sugar and high-fat foods and to promote the availability and affordability of healthy foods. At a community level, several interventions showed positive outcomes. Prevention is more straightforward and effective than treatment; this also applies to weight control. Improving nutritional knowledge by introducing the concept of healthy eating habits and encouraging physical activities are cost-effective measures that were reported to work. Initiating awareness campaigns within schools to promote healthy eating habits could serve as a starting point. Moreover, educational campaigns can be integrated into school feeding programs to educate students and school staff, including teachers and parents, about the importance of dietary diversity and nutrition-related topics for optimal nutritional practices.

Also, since media has recently become an important influencer in people's lives, leveraging it could be advantageous and reach more people in a timely manner. A platform, such as a social media page or mobile application, can be created where medical and nutritional information is shared. Other interventions can also consist of regular screening for overweight and obesity in primary care settings, facilitating early intervention and management. In addition to screening, weight management programs in community centers and healthcare facilities that offer affordable dietary counseling and follow-ups, as well as physical activity guidance, provide behavioral in a more personalized approach.

In addition, policies that promote physical activity can be established. According to the WHO, although numerous societal and environmental factors influence weight gain and retention, "dietary factors and physical activity patterns are considered to be the major modifiable factors underlying excessive weight gain that, if corrected, can serve to prevent obesity" [12].

6.7. Enforce the iodization law and establish regulatory monitoring procedures

The results from the LIMA show that the coverage of iodized salt is low, and that this low coverage is associated with poor iodine status in certain subgroups.

It is recommended to enforce the law 178/2011 and ministerial decrees [13,14] to increase the coverage of adequately iodized salt in Lebanon. Lebanon's 2016 ministerial decree requires monthly monitoring of the iodization status of all salt manufacturers, and the 2011 law stipulates the penalties for noncompliance that would be imposed by the Ministry of Public Health in collaboration with the Ministries of Industry and Economy.

In parallel with the enforcement of the iodization law, program managers should liaise with salt manufacturers to understand iodization bottlenecks and areas where technical capacity can be improved. In order for Lebanon's salt manufacturers to conform to national standards and legislation, a clear understanding of their operational and technical challenges is required. Adequate iodization is only possible when all salt producers in Lebanon have the technical and logistical capacity to control the performance of the iodization process.

Establish sustainable regulatory monitoring procedures via a partnership between the Ministry of Public Health and Ministry of Economy and Trade. Consistent regulatory monitoring is needed to ensure that quality control measures are met by the salt producers in Lebanon and are applied to salt imports. Regulatory monitoring data should be routinely collected and analyzed to document the compliance of different salt producers and importers and can be collected at the level of production and distribution. This data can also be used to further interpret the results of the LIMA survey and can provide valuable insights to the program managers of Lebanon's salt iodization program.

6.8. Address anemia and micronutrient deficiencies via fortification

Based on the findings of the LIMA, the fortification of wheat flour with multiple micronutrients can be an effective strategy to reduce the prevalence of anemia, iron deficiency, and other micronutrient deficiencies in Lebanon. Ninety-one countries mandate the fortification of wheat flour [15] and wheat flour programs have proven to be effective tools to reduce the prevalence of micronutrient deficiencies, anemia and neural tube defects [16–18]. Moreover, the WHO recommends the fortification of wheat flour with multiple micronutrients as a public health strategy to reduce the prevalence of anemia and micronutrient deficiencies [19].

The LIMA showed that wheat flour is widely consumed in Lebanon and that the daily per capita consumption is high enough (about 75 g) for wheat flour to be a viable fortification vehicle. Based on the deficiency prevalences found in children, adolescent girls, and women, the fortifications with multiple micronutrients (e.g., iron, zinc, folic acid, vitamin B12) is warranted. Any flour fortification program in Lebanon should also consider the inclusion of several B vitamins, such as vitamin B1, B2, B3, and B6, as these vitamins can be added to a fortification program with only modest cost increases [20]. However, given the relatively low prevalence of vitamin A deficiency, the addition of vitamin A to the premix is not recommended.

To ensure that a flour fortification program can be implemented, a feasibility assessment must be conducted prior to identifying relevant stakeholders, establishing the procedures for setting fortification legislation and standards, estimating program costs, and establishing monitoring and compliance procedures. Monitoring the compliance with fortification standards by manufacturers and importers is critical to ensure that a fortification program is effectively implemented. Moreover, it will be imperative to identify a coordination mechanism with the right governance to ensure that the procedures agreed upon are implemented effectively.

The LIMA also found high levels of vitamin D deficiency and insufficiency, and fortifying staple foods is also an effective approach to improve vitamin D status. Milk, dairy products, margarine, and vegetable oils are suitable vehicles for vitamin D as they all are good sources of fat, a nutrient needed for vitamin D absorption. According to the FAO's Food Balance Sheet data [21], 53 grams per day per capita of vegetable oils were consumed in 2021. Due to this level of consumption, vegetable oils should be considered for fortification. To determine if

vegetable oils are indeed a viable food vehicle for vitamin D fortification, research estimating the intake of vegetable oils is needed along with a feasibility study to identify policy changes required to initiate the fortification process.

6.9. Address anemia and micronutrient deficiencies via supplementation

Micronutrient supplementation is a common public health strategy to reduce the prevalence of micronutrient deficiencies. In Lebanon, various supplementation programs could be considered to reduce the high prevalence of certain micronutrient deficiencies.

Due to the high prevalence of vitamin D deficiency in adolescent girls and women, and the important role of vitamin D for bone health and growth in infancy, it is recommended to implement a vitamin D supplementation program targeting all population groups. The recommended dose for each population group must take into consideration national and international guidelines to guarantee optimal vitamin D status. The administration of supplement to infants should commence in the first month of life and be accompanied by parental education, which has shown to reduce non-compliance and improve vitamin D status in children [22]. While the prevalence of vitamin D deficiency is not high in children, the combined vitamin D deficiency and insufficient prevalence affects nearly 30% of children. Moreover, vitamin D supplementation is a preventative measure that is practiced by many countries with minimal risks of toxicity [155]. In addition, administering a high dose of vitamin D during pregnancy should be considered, as studies have shown a beneficial effect on the vitamin D status of newborn infants [22]. The Lebanese vitamin D guidelines launched in 2022 suggested no screening for vitamin D deficiency and no supplementation with vitamin D at a community level for the Lebanese adult population. However, the panel suggested supplementation with vitamin D among the institutionalized Lebanese adult population [23]. Despite these recommendation, immediate action in Lebanon is needed to address the high prevalence of Vitamin D insufficiency/ deficiency.

There is ample evidence that universal iron and folic acid (IFA) supplementation reduces maternal anemia and iron deficiency as well as the risk of low birth weight [24], and IFA supplementation is recognized as a high impact intervention among pregnant women to improve maternal survival and gestational outcomes and should therefore be strengthened in Lebanon. This is of particular importance in Lebanon as few women take iron, folic acid, or multivitamin supplements prior to becoming pregnant.

Supplementation may also be preferable to address micronutrient deficiencies in children, as the fortification of staple foods may not be the most appropriate approach to reach young children aged 6-23 months, as their caloric intake is limited compared to their micronutrient requirements. As such, micronutrient powders programs may be envisioned to address micronutrient deficiencies in young children. In addition, even though vitamin A deficiency in children only poses a mild public health problem, a vitamin A supplementation program can counteract the development of vitamin A deficiency while strengthening children's immune systems and reduce the risk of mortality due to measles, diarrhea, and other illnesses.

To achieve a high supplementation coverage, it is recommended that children, adolescent girls and women be targeted specifically during their Primary Healthcare Centers (PHCs) visits, the latter e.g. during their prenatal and postnatal care visits. In addition, the distribution of supplements beyond PHCs is warranted to reach children, adolescent girls and women in rural areas and ITS. Community based distribution by community health workers and midwives, as well as schools or other community platforms has proven to be an effective tool to increase supplement coverage [25]. Also, as the consumption of supplements in Lebanon is generally low across all target groups, any supplementation program must be accompanied by promotional activities and behavior change communication interventions to ensure high consumer compliance. In addition, to ensure successful distribution of supplements and achieve a high coverage the appropriate infrastructure must be in place and viable distribution channels must be identified. Awareness could be further increased by engaging the private sector and collaborating with various medical associations (e.g., dietitians, physicians).

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8. APPENDICES

8.1. ADDITIONAL CHILD TABLES

Characteristic	N	Severe anemia			Moderate anemia			Mild anemia		
		% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d
Nationality				0.670			0.839			0.085
Lebanese	738	0.0			5.8	[3.0,11.0]		8.6	[6.3,11.7]	
Syrian	728	0.1	[0.0,0.4]		5.4	[3.7,7.8]		14.2	[9.5,20.7]	
Palestinian	28	0.0			3.0	[0.4,19.5]		0.0		
Age group (in months)				0.695			0.046			<0.001
6-11	101	0.0			6.9	[3.0,15.2]		18.4	[9.8,31.7]	
12-23	253	0.3	[0.1,1.1]		7.3	[3.5,14.6]		10.1	[6.2,15.9]	
24-35	282	0.0			9.9	[4.7,19.7]		23.5	[14.0,36.9]	
36-47	415	0.0	[0.0,0.2]		4.0	[2.1,7.7]		8.8	[6.1,12.6]	
48-59	447	0.0			2.0	[0.8,4.5]		3.9	[2.3,6.5]	
Sex				0.960			0.023			0.845
Male	788	0.1	[0.0,0.4]		7.2	[4.7,10.9]		11.0	[6.8,17.4]	
Female	710	0.1	[0.0,0.2]		3.5	[2.2,5.5]		11.7	[8.4,16.2]	
Stratum				0.998			0.101			0.214
Akkar	186	0.0			3.4	[1.8,6.5]		13.2	[7.9,21.2]	
Baalbek-Hermel	158	0.0			4.4	[1.8,10.5]		14.1	[7.8,24.1]	
Beirut	123	0.0			6.0	[2.7,13.0]		11.2	[4.4,25.7]	
Bekaa	141	0.4	[0.1,1.9]		4.7	[1.8,11.9]		11.2	[6.6,18.4]	
El Nabatieh	122	0.0			3.1	[1.3,6.9]		5.1	[1.9,13.1]	
Mount Lebanon	82	0.0			5.5	[2.5,11.8]		9.9	[4.2,21.5]	
North	232	0.0			4.2	[1.9,9.0]		13.8	[10.1,18.6]	
South	109	0.0			3.8	[0.9,15.1]		7.9	[3.4,17.3]	
Palestinian camps	59	0.0			13.8	[3.8,39.4]		3.5	[0.9,13.1]	
Syrian ITS	286	0.3	[0.0,2.2]		10.9	[7.4,15.6]		17.7	[14.5,21.4]	

Table continued on next page

Characteristic	N	Severe anemia			Moderate anemia			Mild anemia		
		% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d
Wealth quintile				0.965			0.352			0.160
Lowest	689	0.1	[0.0,0.4]		6.5	[3.9,10.6]		13.4	[9.1,19.2]	
Second	271	0.1	[0.0,0.8]		5.3	[2.6,10.5]		14.8	[8.2,25.3]	
Middle	210	0.0			6.4	[2.9,13.6]		9.0	[4.5,17.3]	
Fourth	187	0.0			5.5	[1.6,17.2]		6.5	[3.1,13.3]	
Highest	141	0.0			0.4	[0.1,2.8]		6.2	[3.3,11.4]	
TOTAL SAMPLE	1498	0.1	[0.0,0.2]		5.5	[4.0,7.5]		11.3	[8.7,14.7]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Severe anemia: <70 g/L, moderate anemia: 70–94 g/L (for children aged 6-23 months) and 70–99 g/L (for children aged 24-59 months), mild anemia: 95–104 g/L (for children aged 6-23 months) and 100–109 g/L (for children aged 24-59 months); all adjusted for altitude.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

8.2. ADDITIONAL ADOLESCENT GIRL TABLES

Characteristic	N	Severe anemia			Moderate anemia			Mild anemia		
		% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d
Nationality				0.299			0.397			0.500
Lebanese	1356	0.1	[0.0,0.4]		7.0	[5.0,9.8]		11.8	[9.1,15.3]	
Syrian	601	0.4	[0.1,1.4]		9.6	[5.5,16.0]		13.2	[9.3,18.3]	
Palestinian	91	0.0			12.2	[3.8,33.2]		18.4	[9.5,32.5]	
Age group (in years)				0.288			0.004			0.007
10-12	739	0.0			4.1	[2.2,7.3]		8.1	[5.4,12.0]	
13-15	627	0.2	[0.1,1.0]		7.7	[5.1,11.5]		12.2	[9.2,16.0]	
16-19	696	0.3	[0.1,1.2]		11.6	[7.8,16.9]		16.5	[11.9,22.4]	
Menstruation				0.195			0.006			0.013
Menarche	1435	0.3	[0.1,0.7]		9.4	[6.9,12.6]		14.0	[11.1,17.5]	
Pre-menarche	620	0.0			4.0	[2.0,7.9]		8.1	[5.2,12.4]	
Period bleeding				0.635			0.060			0.029
Severe	300	0.4	[0.1,1.8]		10.9	[6.6,17.5]		22.4	[15.8,30.7]	
Moderate	924	0.3	[0.1,1.0]		9.0	[6.1,13.2]		11.6	[8.6,15.6]	
Mild/minimal	169	0.0			2.5	[1.0,5.8]		15.6	[8.2,27.6]	

Table continued on next page

Characteristic	N	Severe anemia			Moderate anemia			Mild anemia		
		% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d
Stratum				0.967			0.831			0.019
Akkar	202	0.6	[0.1,3.9]		5.2	[2.8,9.5]		14.6	[9.7,21.3]	
Baalbek-Hermel	247	0.5	[0.1,3.4]		8.8	[4.9,15.3]		11.6	[7.5,17.3]	
Beirut	220	0.0			8.8	[5.2,14.6]		15.7	[11.0,21.9]	
Bekaa	207	0.6	[0.1,3.9]		6.1	[2.6,13.8]		14.3	[8.8,22.4]	
El Nabatieh	241	0.0			6.4	[4.0,9.9]		10.3	[7.0,15.1]	
Mount Lebanon	156	0.0			7.9	[3.6,16.4]		11.5	[6.2,20.4]	
North	310	0.3	[0.0,2.5]		7.3	[5.1,10.4]		15.0	[11.0,20.1]	
South	224	0.0			11.3	[4.9,24.0]		5.5	[2.7,11.0]	
Palestinian camps	89	0.0			9.5	[3.0,26.5]		24.2	[18.4,31.2]	
Syrian ITS	166	0.7	[0.1,5.0]		6.2	[3.4,11.1]		15.2	[10.0,22.3]	
Wealth quintile				0.729			0.529			0.732
Lowest	600	0.4	[0.1,1.6]		8.4	[5.0,13.7]		11.1	[7.8,15.6]	
Second	403	0.3	[0.1,1.2]		10.0	[5.1,18.8]		10.0	[6.1,16.1]	
Middle	389	0.0			4.7	[2.9,7.6]		13.4	[7.9,21.9]	
Fourth	381	0.2	[0.0,1.6]		9.0	[4.3,17.9]		14.9	[9.7,22.3]	
Highest	289	0.0			6.6	[3.4,12.3]		13.0	[7.9,20.5]	
TOTAL	2062	0.2	[0.1,0.5]		7.8	[5.7,10.7]		12.3	[9.9,15.2]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Severe anemia: <80 g/L, moderate anemia: 80–109 g/L, mild anemia: 110–114 g/L (for girls aged 10–11 years) and 110–119 g/L (for girls aged 12–19 years); all adjusted for altitude and smoking.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

8.3. ADDITIONAL NON-PREGNANT WOMAN TABLES

Characteristic	N	Severe anemia			Moderate anemia			Mild anemia		
		% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d
Nationality				0.006			0.276			0.179
Lebanese	1995	0.7	[0.2,1.8]		13.7	[11.4,16.4]		20.7	[17.9,23.9]	
Syrian	667	2.0	[0.9,4.4]		13.8	[9.7,19.3]		18.6	[13.9,24.5]	
Palestinian	98	0.3	[0.0,1.9]		19.8	[12.2,30.6]		34.6	[21.3,50.9]	
Other	29	9.7	[1.4,45.5]		1.7	[0.3,8.5]		11.1	[3.4,30.7]	
Age group (in years)				0.063			0.163			0.181
15-19	455	0.6	[0.2,1.9]		12.6	[7.4,20.7]		15.2	[10.5,21.5]	
20-29	753	0.7	[0.2,2.4]		10.6	[7.7,14.4]		19.7	[15.5,24.8]	
30-39	838	2.0	[0.8,4.9]		13.6	[10.0,18.3]		23.2	[19.0,28.1]	
40-49	2799	1.1	[0.6,2.1]		13.8	[11.8,16.2]		20.3	[17.9,23.0]	
Period bleeding				0.076			0.077			0.013
Severe	643	1.8	[0.6,5.2]		18.9	[14.3,24.6]		27.4	[21.4,34.3]	
Moderate	1608	0.6	[0.2,1.2]		12.2	[9.5,15.7]		18.4	[15.3,21.8]	
Mild/minimal	385	2.3	[0.8,6.4]		11.8	[6.9,19.6]		17.0	[12.3,23.1]	
Stratum				0.439			0.061			0.151
Akkar	242	2.0	[0.7,5.5]		14.1	[10.7,18.5]		19.9	[15.1,25.8]	
Baalbek-Hermel	339	0.7	[0.2,2.6]		14.5	[10.9,19.1]		17.4	[12.8,23.4]	
Beirut	341	0.6	[0.1,2.8]		8.7	[5.3,14.0]		23.8	[18.4,30.2]	
Bekaa	296	0.6	[0.1,3.3]		9.6	[7.1,12.9]		18.3	[14.1,23.4]	
El Nabatieh	330	0.4	[0.1,2.2]		10.8	[7.7,15.1]		14.7	[11.4,18.7]	
Mount Lebanon	275	1.8	[0.6,5.1]		17.6	[12.7,23.9]		24.4	[19.2,30.6]	
North	406	0.3	[0.0,2.0]		11.6	[8.8,15.1]		19.8	[13.5,28.0]	
South	296	0.8	[0.3,2.3]		12.8	[8.9,18.0]		12.9	[8.5,19.2]	
Palestinian camps	107	1.1	[0.2,4.8]		22.3	[10.1,42.4]		21.5	[12.0,35.7]	
Syrian ITS	167	1.2	[0.3,4.6]		11.3	[8.3,15.3]		19.5	[13.2,27.7]	

Table continued on next page

Characteristic	N	Severe anemia			Moderate anemia			Mild anemia		
		% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d	% ^{a, b}	[95% CI] ^c	p-value ^d
Wealth quintile				0.596			0.371			0.817
Lowest	674	1.1	[0.5,2.9]		17.2	[12.6,23.0]		19.1	[14.6,24.5]	
Second	527	1.7	[0.6,4.4]		12.6	[8.6,18.1]		20.2	[14.3,27.6]	
Middle	556	0.7	[0.2,3.1]		10.8	[7.0,16.4]		23.8	[16.9,32.6]	
Fourth	529	0.4	[0.1,1.5]		16.3	[9.6,26.2]		18.8	[13.6,25.5]	
Highest	513	1.4	[0.2,7.5]		12.0	[8.8,16.1]		19.8	[14.0,27.3]	
TOTAL	2799	1.1	[0.6,2.1]		13.8	[11.8,16.2]		20.3	[17.9,23.0]	

Note: The N's are the denominators for a specific subgroup; the sum of subgroups may not equal the total because of missing data.

^a Percentages weighted for unequal probability of selection.

^b Severe anemia: <80 g/L, moderate anemia: 80–109 g/L, mild anemia: 109–119 g/L; all adjusted for altitude and smoking.

^c CI = confidence interval, calculated taking into account the complex sampling design.

^d Chi-square p-value < 0.05 indicates that the proportion in one subgroup is significantly different from the values in at least one other subgroup.

8.4. COMPARING PLASMA RETINOL AND PLASMA RETINOL BINDING PROTEIN

The biomarker used by the LIMA to measure vitamin A status is plasma retinol-binding protein (RBP). Because RBP is not a WHO-recommended biomarker for the assessment of vitamin A status [30], serum specimens from preschool children 6–59 months of age (PSC) and non-pregnant women (NPW) were analyzed for serum retinol to compare and validate the RBP measurements. Analysis of RBP was conducted at VitMin Lab (Freiburg, Germany), and the analysis of serum retinol was undertaken by Khatib Micronutrient Laboratory (Amman, Jordan). Both service laboratories have a demonstrable external quality assurance track record of analyzing plasma retinol.

Figure 51 below presents the correlation plot and regression equation comparing retinol and RBP for both PSC and NPW combined (n=224; 77 PSC, 147 NPW). We found a fair correlation between the RBP and plasma retinol values ($R^2=0.64$). The estimated slope was 0.7871, showing that the RBP values were more frequently lower than their serum retinol counterparts.

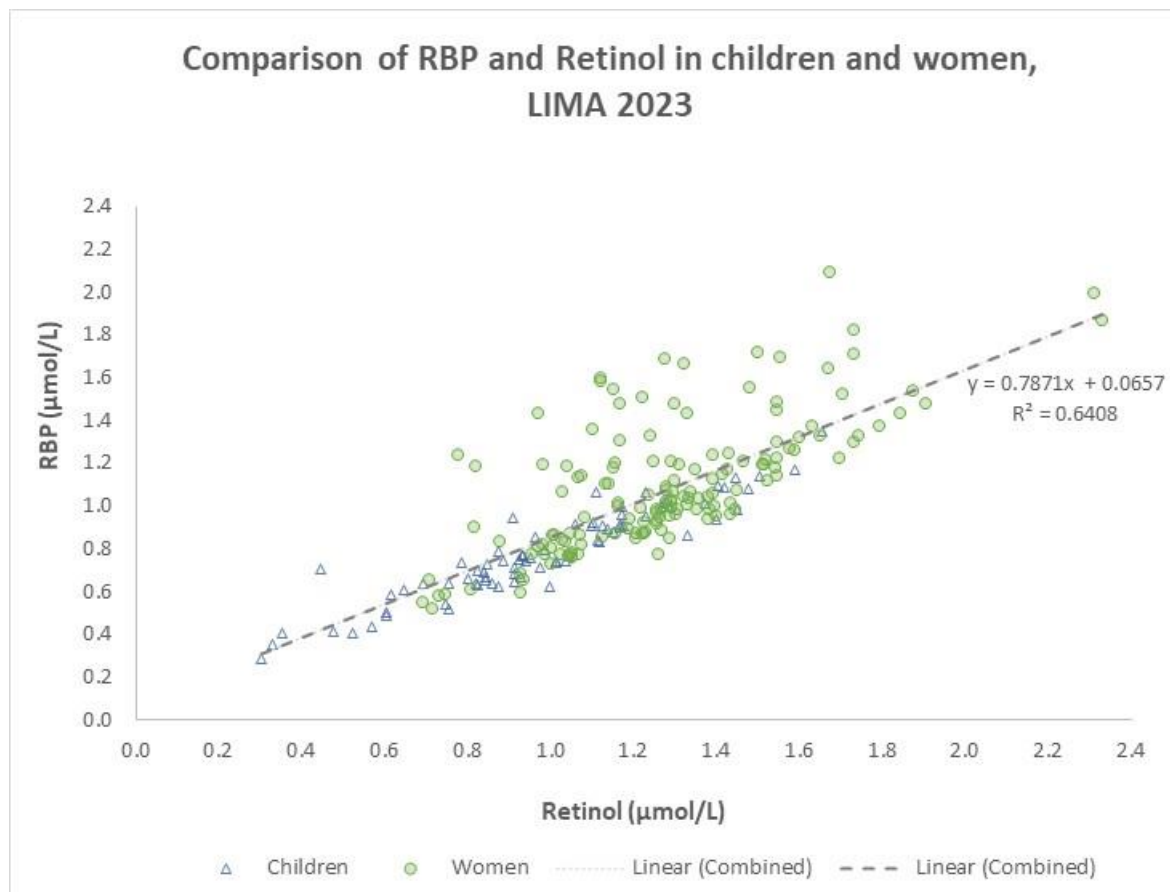


Figure 51. Comparison of retinol and retinol-binding protein concentrations in preschool children (PSC) and non-pregnant women (NPW), Lebanon 2023

Based on these results, the vitamin A deficiency cut-off was adjusted for RBP. Using the WHO-recommended cut-off for retinol of 0.7 $\mu\text{mol/L}$ [30] and the regression equation in Figure 14 above, the RBP cut-off was calculated to be **0.61667 $\mu\text{mol/L}$** $[(0.7871 \times 0.7) + 0.0657 =$

0.61667]. This cut-off value was subsequently used to classify both children and women with vitamin A deficiency.

Figure 51 above was produced after removing potential outliers that could have been due to labelling errors. To identify potential outliers, a Bland–Altman plot (Figure 52) was made; due to the systematically higher retinol concentrations, the difference was calculated as the retinol concentration minus the RBP concentration. Based on this analysis, we removed: a) any values with a difference of >0.5 and <-0.5 , and b) any negative difference values. Subsequently, 53 retinol/RBP pairs were excluded from the analysis.

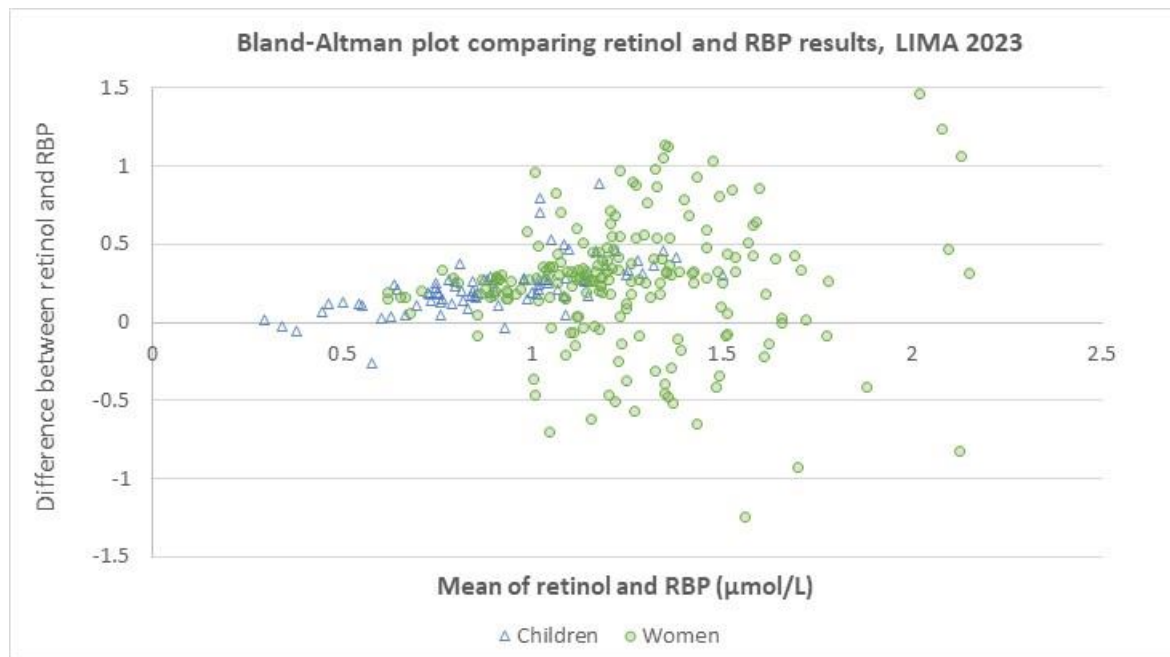


Figure 52. Bland-Altman plot comparing retinol and retinol-binding protein concentrations in preschool children (PSC) and non-pregnant women (NPW), Lebanon 2023

Lastly, it is notable that a similar cut-off for vitamin A deficiency (i.e. $0.61081 \mu\text{mol/L}$) was obtained when a regression equation was calculated for RBP and retinol measurements $<1.2 \mu\text{mol/L}$. This restricted analysis can be employed to ensure that the calculated cut-off for RBP reflects the results directly below and above the $0.7 \mu\text{mol/L}$ retinol cut-off. As the cutoff based on a restricted analysis is very close to the **$0.61667 \mu\text{mol/L}$** cutoff mentioned above, we can be confident that the greater variability between the sample pairs with higher retinol/RBP concentrations does not affect the analysis.

8.5. A PRIORI SAMPLE SIZE CALCULATIONS

Estimated number of individuals providing interview data, anthropometry measurements and blood sample, by target group and stratum

Strata	Children 0-59 months			Adolescent girls 10-19 years ²			Non-pregnant women 20-49 years ²			Pregnant women		
	Eligible	Interview/ anthropometry	Blood sample ¹	Eligible	Interview/ anthropometry	Blood sample	Eligible	Interview/ anthropometry	Blood sample	Eligible	Interview/ anthropometry	Blood sample
Akkar	295	265	212	196	176	167	305	290	275	31	29	28
Baalbek-Hermel	230	207	166	190	171	162	296	281	267	30	28	27
Beirut	254	228	183	273	246	232	426	404	383	43	40	38
Bekaa	262	236	189	233	209	198	363	345	327	36	34	33
El Nabatieh	225	202	162	197	177	168	307	292	277	31	30	28
Mt Lebanon	207	195	156	214	192	182	333	317	300	33	31	30
North	293	264	211	260	234	221	406	385	365	41	39	37
South	263	237	189	230	207	196	359	341	324	36	34	33
Syrian ITS	312	281	225	139	125	118	216	206	195	22	21	20
Palestinian camps	277	249	199	187	168	159	292	277	263	29	28	27
National	2616	2364	1892	2119	1905	1803	3303	3138	2976	332	314	301

¹ children 6-59 months

² Females aged 10-14 years part of adolescent girls and non-pregnant women target group

8.6. ETHICAL APPROVAL



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APPROVAL OF RESEARCH

July 7, 2023

Omar Obeid, PhD
American University of Beirut
Email Address: oo01@aub.edu.lb

Dear Dr. Obeid,

On July 7, 2023, the IRB reviewed the following protocol:

Type of Review:	Follow-up, Expedited
Project Title:	Lebanon Integrated Micronutrient and Anthropometry Survey 2023 (LIMA 2023)
Investigator:	Dr. Omar Obeid
IRB ID	BIO-2023-0106
Documents reviewed:	Received on July 5, 2023: - The clean and tracked copies of the modified protocol. Received on July 4, 2023: - The clean and tracked copies of the modified IRB Application. Received on June 23, 2023: - Documentation of the drafted agreements between AUB and Groundwork, as well as the Data Service Agreement performed between AUB and Mercy USA. Received on June 21, 2023: - Documentation of the letter prepared to the Ministries of Defense and Interior indicating that the study is being done by the Ministry of Public Health to assess the prevalence of malnutrition in Lebanon.

Upon assessing documents provided on **June 21, 2023, and June 23, 2023**, respectively, the IRB determined that the study fulfills the below criteria for Public Health Surveillance Activity. The engagement of AUB site is for storage and analysis of data and samples collected only.

- The activity must be a public health surveillance activity.
AND
- The activity must be conducted, supported, requested, ordered, required, or authorized by a public health authority.
AND
- The activity must be limited to that necessary to allow a public health authority to identify, monitor, assess, or investigate potential public health signals, onsets of disease outbreaks, or



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conditions of public health importance (including trends, signals, risk factors, patterns in diseases, or increases in injuries from using consumer products).

Based on the above, this is to grant you approval to **store and analyze data and samples** collected for the public health surveillance as mandated by the MOPH; from **July 7, 2023**, to **July 6, 2024, inclusive**.

Before **May 6, 2024**, or within 30 days of study close, whichever is earlier, you are to submit a completed "FORM: Continuing Review Progress Report" and required attachments to request continuing approval or study closure.

If continuing review approval is not granted before the expiration date of **July 7, 2024**, approval of this research expires on that date.

Kindly note that this approval does not grant permission for contacting patients who were enrolled in previous studies, unless it is specified in the signed consent form or if the principal investigator or research team member has a primary patient-physician relationship. In all other circumstances, the IRB needs to grant approval for alternative mechanisms.

Please find attached the approved documents:

- The IRB Application (version received on July 4, 2023).
- The proposal (version received on July 5, 2023).

Please note that this determination applies to the activities described in **this IRB submission only** and does not apply should any changes be made. Therefore, please submit a request for re-determination of the status of the activity should you make any changes to the information reviewed by the IRB, including future submissions using this dataset.

Any publication resulting from this submitted project should acknowledge that the Ministry of Public Health mandated the activity and that AUB-IRB approval only governs the storage and analysis of samples collected as part of this activity. Furthermore, any analysis of the samples or data for future research questions, would require a separate review by AUB IRB.

HRPP/IRB Compliance and Auditing office will be auditing all clinical trials, and randomly selected other studies, on a quarterly basis to comply with the updated JCI standards regarding the Human Research Protection for accreditation as an Academic Medical Center.

Only these IRB approved documents can be used for this research study.

Thank you.

The American University of Beirut and its Institutional Review Board, under the Institution's Federal Wide Assurance with OHRP, comply with the Department of Health and Human Services (DHHS) Code of Federal Regulations for the Protection of Human Subjects ("The Common Rule") 45CFR46, subparts A, B, C, and D, with 21CFR56; and operate in a manner consistent with the Belmont report, FDA guidance, Good Clinical Practices under the ICH guidelines, and applicable national/local regulations.

Sincerely,

Abeer Dakik, MSc, CIM
Biomedical IRB Administrator

Cc: Rami Mahfouz, MD, MPH
Professor of Pathology and Laboratory Medicine
Chairperson of the IRB

Ali K. Abu-Alfa, MD, FASN, FASH

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8.7. INFORMATION SHEET



Lebanon Integrated Micronutrient, Anthropometric, and Child Development Survey 2023 (LIMA 2023) Information Sheet

The multi-layered crisis in Lebanon is believed to have compromised the nutritional status of infants, young children, adolescents, and pregnant and non-pregnant women. The devaluation of the currency has impacted the purchasing power of most people and consequently altered eating habits by increasing the consumption of low-cost foods. It is believed that the consumption of high-cost foods (e.g., meat, poultry, and dairy products) has been reduced and that this has led to an increased prevalence of anemia and micronutrient deficiencies.

To better understand the current nutritional situation of Lebanon's population, the MOPH and the Lebanon Nutrition Sector are performing a study (LIMA) to determine the nutritional, micronutrient, and children development status of the population.

Specifically, the LIMA will generate results on a representative sample of preschool children (0-59 months), adolescent girls (10-19 years), non-pregnant women (20-49), and pregnant women. The assessment will determine the prevalence of malnutrition, vitamin and mineral deficiencies (e.g., iodine, iron, vitamin A, vitamin D, zinc, folate, vitamin B12), diabetes, high cholesterol, high blood pressure, metabolic syndrome, and inflammation. It will also estimate sodium and potassium intake (based on urinary excretion), collect salt samples for iodine analysis, and will assess the development of preschool children.

To collect data for the LIMA, a team will visit your home, and all data will be collected during one visit. To start, you will first be informed about the survey protocol and experimental procedure. After your consent, a household questionnaire will be administered to the head of the household or another knowledgeable adult. The household questionnaire will be used to assess the household's demographics and socio-economic level, and the coverage of Lebanon's salt iodization program via the collection of a salt sample. Following the household questionnaire, all preschool children, adolescent girls, and pregnant women will be recruited for the survey. Non-pregnant women will be also recruited from 1/2 of the households. Written consent will be sought for all individuals prior to administering individual questionnaires. The individual questionnaires will collect data on dietary patterns and health status by asking a few questions. Following the completion of the questionnaires, we will request to take anthropometric measurements (e.g., height, weight, waist circumference) to assess each participant's nutritional status. Blood pressure measurement and urine samples (50 ml) will also be requested from adolescent girls, non-pregnant women, and pregnant women. A phlebotomist will also ask to collect a blood sample (8 ml) from the veins. Blood samples will not be taken from children <6 months of age.

The information collected by the LIMA will be used to stimulate and improve Lebanon's nutrition and health policies and programs. There is no direct benefit, however, all blood test results of all performed analyses will be sent for free.

8.8. CONSENT FORMS

Separate consent/assent forms were used for each target group in both Arabic and English. Links to the various consent/assent forms are provided below.

Household consent forms:

[Arabic](#)

[English](#)

Preschool child consent forms:

[Arabic](#)

[English](#)

Adolescent girl assent forms:

[Arabic](#)

[English](#)

Adolescent girl consent forms:

[Arabic](#)

[English](#)

Non-pregnant and pregnant woman consent forms:

[Arabic](#)

[English](#)

8.9. AUTHORIZATION LETTERS

Survey teams were provided with ID cards that contained the below QR code, which linked (currently deactivated) to authorization letters from the Ministry of Health and the Ministry of the Interior. All team members were also provided with laminated copies of the official letters.

[All letters are compiled and can be accessed with this link.](#)



8.10. TEAMS. TEAM MEMBERS. AND SUPERVISORS

Stratum	Supervisors	Team Number	Team leader	Listers	Interviewers	Anthropometrist	Phlebotomist
Akkar	Wassim Baghdadi	1	Sawsan Abed Al Razak Goufran Al Naboulsi	Youssef Al Masri Walid Said	Jana Chahoud Nour Al Houda Kraydi Israa Al Naboulsi Diana Chkhaydem	Raghida Taleb	Mariam Ali
North	Wassim Baghdadi	2	Chadi Akra	Ouday Al Khatib Paul Sleiman	Maroun Khattar Layla Atrach Madona Hassan Nour Hallab	Nour Al Houda Trad	Mayada Al Lababidi
Mount Lebanon	Mahmoud Merheb	3	Samira Khalil	Margretta Chedid Mark El Ramy	Dana Malaeb Carla Younes Farah Bou Khzam Joelle Chaer	Rhea Fahd	Radiya El Mawla Rami Khachfeh
Mount Lebanon	Abir Abdo	4	Rawan Zaarour	Aalaa Taha Kassem Choucair	Rawan Mafhouz Jamil Haidar Souad Ghazal Rayan Taha Hanane Al Hawli	Rim Makki	Haya Srour
Beirut	Melissa Abi Nakhle	5	Fares Saliby	Ghida Chiha Ahmad Darwish	Judy Hassan Jana Amasha Maya Al Farran Lamees Kashmar	Sally Bou Karroum	Hussein Fakih Ali Hellani
Beirut	Melissa Abi Nakhle	6	Neamat Haj Hassan	Mahmoud Nouredine Jinan Al Jiblawie	Amal Haidar Manal Znait Hadi Al Sibai Ashwaq Abou Diab	Dina Mansour	Ali Krayani
South	Abbas Hussein	7	Hussein Ezedin	Nour Bdeir Hussein Hadid	Nour Ez Eddine Hadi Ezedine Alaa Hijazi Mira Al Chami	Rasha Ez Aldin	Ahmad Hamed

Stratum	Supervisors	Team Number	Team leader	Listers	Interviewers	Anthropometrist	Phlebotomist
South	Abbas Hussein	8	Reem Hussein Merhi	Haidar Alayan Hadi Khalil	Afif Alayan Yara Azkoul Abbas Hawi Adam Khalil	Dana El Jamal	Jinan Alayan
Baalbek-Hermel	Al Sayed Mohsen El Moussawi	9	Fatima Tlais	Rola Al Mkahal Zahraa Dalloul	Wafaa Tleys Faten Al Moussawi Nour Akil Zeina Kassas	Khawla Nasreddine	Sanaa Tlais Yamama Elnemer
Bekaa	Mohamad El Haj Omar	10	Bader Sahloul Fadi Hanna	Antoine Al Tairy Khaled Al Ayoubi	Souline Abou Dib Rana Hamed Lara Al Ayoubi Fadi Hanna	Lamis Okasha	Nagham Al Chaar Ranim El Haris
Nabatieh	Abbas Hussein	11	Ali Ezedine	Karin Awada Hamza Koubaissy	Fatima Badran Ahmad Jaber Joelle Saleme Zeinab Badran	Jana Daher	Nour Hamze
Syrian ITS	Al Sayed Mohsen El Moussawi	12	Rola El Hawi	Jafar Shames Bassel Harb	Fatima Moussawi Ayat Saleh Maryam Yazbek Douaa Al Houjayri	Asmaa Al Shahab	Abdallah Safye
Palestinian camps	Abir Abdo	13	Ali Abed El Ghani	Abed Alrahman Said Souad Hussein	Hussein El Enien Shirin Fathallah Ahmmad El Enien Yasser Abed El Ghani	Fatmi Said	Khairieh Assaka Hana Moulla Sara Habet

8.11. SURVEY QUESTIONNAIRES

The hyperlinks to the questionnaires used for the LIMA survey are below. The household and individual questionnaires were programmed in KoboCollect as part of the same questionnaire “form, which was prepared in both Arabic and English. The biological forms were programmed only in English as the biological form did not contain any questions for the respondents and was only used by the survey personnel (e.g., interviewers, anthropometrists, phlebotomists) who all read and spoke English.

Arabic questionnaire

[Household and individual questionnaire](#)

English questionnaires

[Household and individual questionnaire](#)

[Biological form for preschool children](#)

[Biological form for adolescent girls and women](#)

8.12. REFERRAL FORM

REFERRAL FORM – LIMA 2023

Individuals receiving this referral form should visit a nearby health facility for further diagnosis and treatment, if required.

The Ministry of Public Health, UNICEF, Lebanon Nutrition Sector, and AUB are conducting the Lebanon Integrated Micronutrient Assessment (LIMA) to better understand the nutritional and micronutrient status of children 0-59 months old, adolescent girls (10-19 years), women of reproductive age (20-49 years old), and pregnant women. The LIMA assesses anemia status, hypertension, malnutrition based on anthropometric measures, and glycemic indicators.

This form will be provided to individuals that have been identified as having the following conditions:

- Severe anemia: Hb < 70 g/L for pregnant women and children; < 80 g/L for non-pregnant women and adolescent girls
- Hypertension: ≥ 140 mmHg (systolic) and/or ≥ 90 mmHg (diastolic) for all women and adolescent girls
- Severe malnutrition: weight-for-height Z-Score of ≤ -3 for pre-school child; BMI-for-age Z-score of ≤ -3 for adolescent girls; BMI ≤ 16 kg/m² for non-pregnant women; MUAC < 21 cm for pregnant women
- Diabetes: HbA1c $\geq 6.5\%$ for all women*

*For pregnant women in the second and third trimester, HbA1c can only be used for screening purposes, and more comprehensive measures of gestational diabetes should be used (e.g., oral glucose tolerance test).

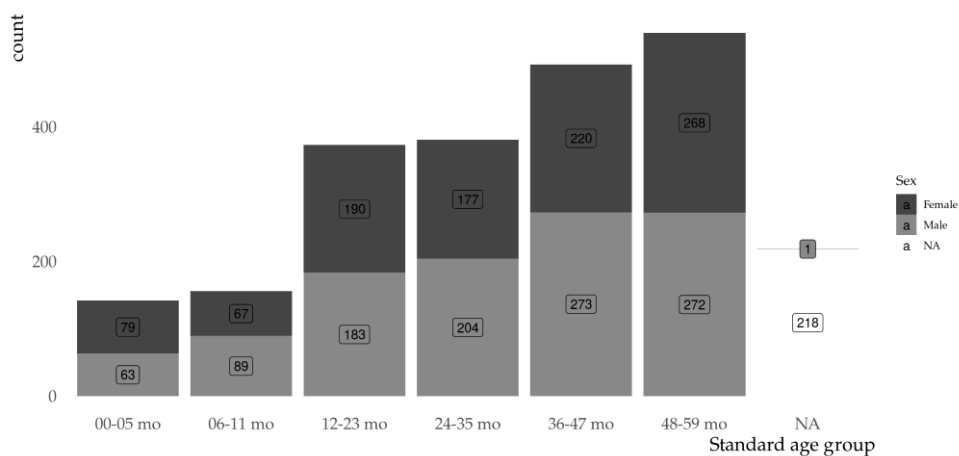
Person's Name: _____		Date of blood collection or blood pressure measurement: (DD/MM/YY): _____	
Person is a (check one box): Pre-school child ☐ Adolescent girl ☐ Non-pregnant woman ☐ Pregnant woman ☐	ALL	Hemoglobin concentration = _____ g/L	
	NPW, PW, AG	HbA1c %:	
		Blood pressure (mmHg): Systolic: Diastolic:	
	NPW	BMI: _____ kg/m ²	
	PW	MUAC: _____ cm	
	PSC	Weight for Height Z-Score: _____	
	AG	BMI for age Z-Score: _____	
Referring phlebotomist, anthropometrist, team leader, or laboratory technician:		Name: _____	
		Mobile number: _____	
Date this form is provided to the participant		DD/MM/YY: _____	

8.13. ANTHROPOMETRY – LIMA: ENA PLAUSIBILITY CHECK REPORT

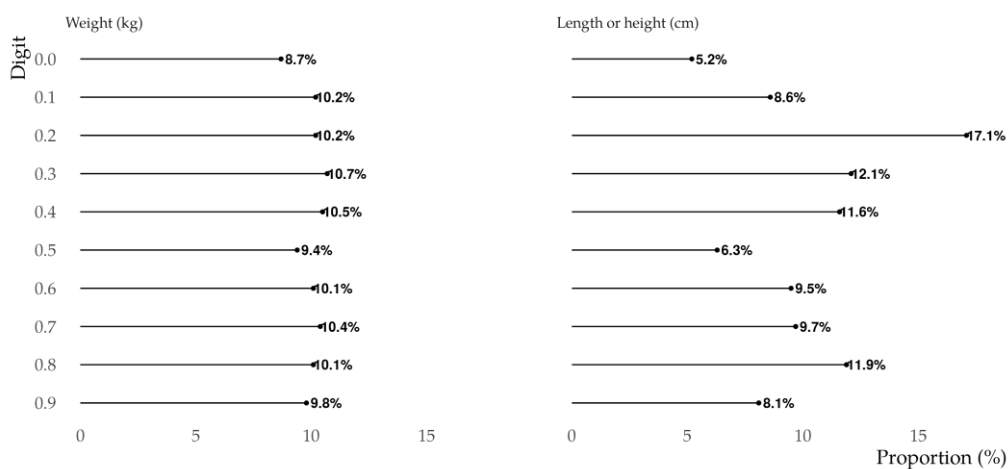
1. Duplicate entries

There were no duplicate entries.

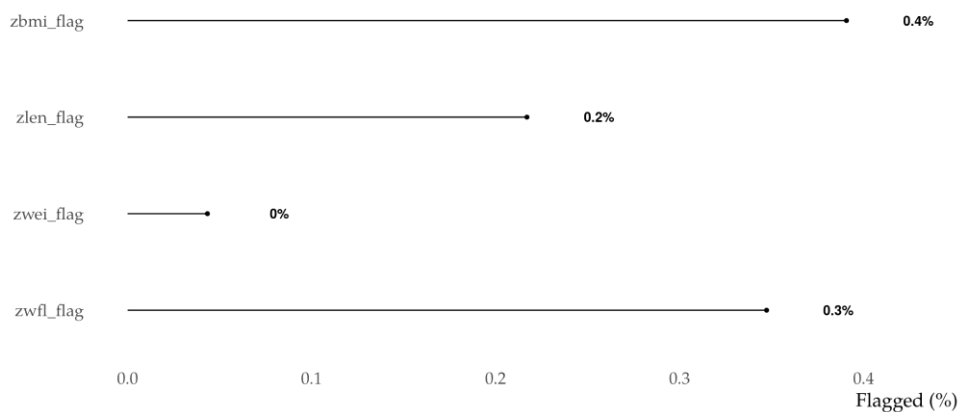
2. Distribution by standard age grouping and sex



3. Digit preference for weight and length/height



4. Percentage of flagged z-scores based on WHO flagging system by index



5. Z-score distribution of unweighted summary statistics for length/height-for-age (zlen) and weight-for-age (zwei)

Group	Unweighted N	Mean (zlen)	Standard deviation (zlen)	Skewness (zlen)	Kurtosis (zlen)	Mean (zwei)	Standard deviation (zwei)	Skewness (zwei)	Kurtosis (zwei)
All	2304	-0.81	1.32	0.25	4.38	-0.28	1.15	0.17	4.26
Age group (months)									
00-05	142	-0.51	1.55	-0.09	3.43	-0.25	1.20	-0.46	3.55
06-11	156	-0.54	1.56	0.99	5.41	-0.14	1.21	0.17	2.68
12-23	373	-1.10	1.42	0.24	3.45	-0.30	1.22	-0.02	4.04
24-35	381	-0.94	1.33	0.34	5.34	-0.26	1.16	0.13	3.62
36-47	493	-0.91	1.18	-0.16	3.64	-0.40	1.08	-0.01	4.84
48-59	540	-0.59	1.17	0.29	3.73	-0.22	1.10	0.68	5.17
Sex									
Male	1085	-0.85	1.39	0.22	4.44	-0.28	1.17	0.14	4.08
Female	1001	-0.78	1.24	0.32	4.12	-0.28	1.12	0.20	4.48

6. Z-score distribution of unweighted summary statistics for body-mass index (zbmi) and weight for length (zwfl)

Group	Unweighted N	Mean (zbmi)	Standard deviation (zbmi)	Skewness (zbmi)	Kurtosis (zbmi)	Mean (zwfl)	Standard deviation (zwfl)	Skewness (zwfl)	Kurtosis (zwfl)
All	2304	0.34	1.09	0.15	4.36	0.26	1.09	0.07	4.46
Age group (months)									
00-05	156	0.24	1.33	-0.25	4.13	0.28	1.28	-0.20	3.59
06-11	373	0.55	1.16	0.01	3.52	0.32	1.18	-0.16	4.60
12-23	381	0.49	0.98	0.16	4.09	0.33	0.98	0.28	4.02
24-35	493	0.28	1.00	0.23	4.89	0.20	0.99	0.09	4.37
36-47	540	0.23	1.02	0.73	5.07	0.18	1.03	0.65	4.70
48-59	156	0.24	1.33	-0.25	4.13	0.28	1.28	-0.20	3.59
Sex									
Male	1085	0.38	1.10	0.12	4.45	0.27	1.11	0.01	4.77
Female	1001	0.30	1.07	0.18	4.26	0.24	1.08	0.13	4.09

8.14. DESIGN EFFECTS OF MAJOR OUTCOMES

Variable	Number in analysis	Design effect
Children 0-59 months of age (unless otherwise indicated)		
Low birth weight	1815	3.98
Ever breastfed (0-23 months)	671	3.00
Early initiation of breastfeeding (0-23 months)	671	2.80
Exclusive breastfeeding for first two days after birth (0-23 months)	671	2.86
Minimum dietary diversity (6-23 months)	528	3.92
Minimum meal frequency (6-23 months)	528	2.20
Minimum acceptable diet (6-23 months)	528	2.13
Bottle feeding in the past 24h (6-23 months)	670	2.68
Stunting	1916	2.44
Wasting	1899	1.20
Overweight or obese	1899	2.21
Underweight	1916	2.46
Small head circumference	1912	1.69
Anemia	1498	3.28
Iron deficiency	1496	4.26
Iron deficiency anemia	1448	4.90
Vitamin A deficiency	1496	1.70
Vitamin D deficiency	1526	3.30
Vitamin D deficiency or insufficiency	1526	5.58
Zinc deficiency (sub-sample)	280	4.04
Adolescent girls (10-19 years)		
Meets minimum dietary diversity	2247	4.84
Short stature	2130	2.43
Thinness	2128	2.74
Overweight	2128	3.06
Obese	2128	3.43
Overweight or obese (combined)	2128	3.02
Anemia	2062	5.80
Iron deficiency	2073	4.98
Iron deficiency anemia	2036	6.01
Vitamin A deficiency (sub-sample)	2073	2.80
Folate deficiency	2062	6.14
Vitamin B12 deficiency	2060	4.71
Vitamin D deficiency	2060	5.61
Vitamin D deficiency or insufficiency	2060	4.18
Zinc deficiency (sub-sample)	405	4.78
Elevated HbA1c (diabetes or pre-diabetes)	2047	1.78
Elevated triglycerides	2062	4.19

Table continued on next page

Variable	Number in analysis	Design effect
Low HDL cholesterol	2062	2.25
Elevated total cholesterol	2062	4.31
Visceral/central obesity	2130	2.93
Hypertension	2062	5.41
Metabolic syndrome	1961	2.26
Excess sodium intake (based on excretion)	1845	3.54
Low potassium intake (based on excretion)	1849	2.04
Non-pregnant and lactating women (15-49 years)		
Meets minimum dietary diversity	2989	5.55
Underweight	2815	3.45
Overweight or obese (combined)	2815	3.41
Anemia	2799	3.60
Iron deficiency	2809	3.18
Iron deficiency anemia	2766	3.38
Vitamin A deficiency	2809	3.16
Folate deficiency	2804	2.41
Vitamin B12 deficiency	2804	4.42
Vitamin D deficiency	2804	3.96
Vitamin D deficiency or insufficiency	2804	4.17
Zinc deficiency (sub-sample)	545	4.74
Diabetes	2775	2.28
Pre-diabetes	2775	2.35
Elevated HbA1c (diabetes or pre-diabetes)	2775	2.88
Elevated triglycerides	2804	5.66
Low HDL cholesterol	2804	3.63
Elevated total cholesterol	2804	3.01
Excess sodium intake (based on excretion)	2519	3.25
Low potassium intake (based on excretion)	2521	2.33
Visceral/central obesity	2822	2.61
Hypertension	2817	3.75
Metabolic syndrome	2717	3.29
Pregnant women		
Meets minimum dietary diversity	223	3.86
Undernutrition (low MUAC)	184	1.71
Anemia	201	1.65
Diabetes	201	0.14
Pre-diabetes	201	2.63
Elevated HbA1c (diabetes or pre-diabetes)	201	2.61
Hypertension	202	7.14

