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COSTS OF ABSENTEEISM DUE TO AIR POLLUTION AMONG PRIVATE SECTOR COMPANIES IN ULAANBAATAR, MONGOLIA

RESEARCH REPORT

IMPLEMENTED BY:
ZAIGAL RESEARCH INSTITUTE

May 2020

Costs of absenteeism due to air pollution among private sector companies in Ulaanbaatar, Mongolia

Research findings and recommendations

May 2020

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WRITTEN BY:

MANDUKHAI GANBAT	(MPH, General Director, Zaigal Research Institute)
DAVID WARBURTON	(PhD, Board member, Zaigal Research Institute, Professor at University of Southern California)
CLARENCE WIGFALL	(MPH, Board member, Zaigal Research Institute, researcher of Saban Research Institute)
NARANSTSETSEG AMARSANAA	(PhD, Supervisor, Zaigal Research Institute, Professor of Mandakh University)

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ACRONYMS

COPD	Chronic obstructive pulmonary disease
GLM	Generalized linear model
HR	Human resource(s)
MNT	Mongolian tugrik (local currency)
SO_2	Sulfur dioxide
PM10	Coarse particulate matter
PM	Particulate matter
UNICEF	United Nations Children's Fund
BRS	Baseline scenario
CA	Instances of absenteeism related to air pollution (number of)
CI	Confidence interval
EW	Equivalent wage
ME	Medical expenses

Note: *$ is used to denote United States dollars throughout this report.*

EXECUTIVE SUMMARY

Background

Ulaanbaatar, Mongolia, is both world's coldest capital city and among the world's capital cities with the highest level of seasonally polluted air during winter. Over 80 per cent[1] of this seasonal air pollution is due to domestic heating with coal stoves in residential communities known as 'ger districts' due to the prevalence of traditional nomadic housing used in these areas. This report presents the direct and indirect costs of winter seasonal air pollution due to employee absenteeism in the private sector.

In winter 2019, UNICEF convened a meeting in Ulaanbaatar, at which human resource (HR) officials and high-ranking executives from several well-known Mongolian corporations shared their opinions on how winter air pollution impacts absenteeism rates among their employees. Through this meeting, UNICEF postulated that absenteeism must be a significant driver of 'hidden' opportunity costs, affecting not only corporate bottom lines but also employee financial well-being.

Research approach

The design of the study included creating inclusion and exclusion criteria. These criteria encompassed business type, employee numbers, availability of employee attendance records, format of records, quality and completeness of records, and willingness to share records. Representatives of employers and select employees were surveyed using quantitative and qualitative instruments to characterize direct and indirect costs, and absences due to illnesses that are common during highly polluted months.

The sampling design of the study was purposeful sampling. Data from between 2015 and 2019 were analysed, from a total of eight companies and including a total of 2,764 employees. Almost all of the companies used fingerprint scanners that link each employee to a payroll number. Questionnaire data was obtained for 1,330 employees working for private sector companies spanning six economic sectors. A total of 133 people participated in 26 focus group discussions and 20 people completed individual interviews.

The main purpose of this study was to assess both direct and indirect hidden costs to private sector companies as well as individual employee costs associated with absenteeism due to air pollution in Ulaanbaatar, Mongolia.

Key conclusions

The results of the study show that the combined direct and indirect hidden costs of absenteeism identified as being related to wintertime air pollution are significant for both employees and employers in the private sector in Ulaanbaatar, Mongolia. The major drivers of direct cost to employees identified were health-care expenses, including doctor visits, medication, hospitalization and transportation, in addition to loss of earnings. Although the employees surveyed were evenly divided by gender, it was found that the cost of illness-related absences was disproportionately higher for female workers, especially those with young children. The major hidden cost drivers for employers were the number and human capital costs of employee absences.

1 World Health Organization, 'Air Pollution in Mongolia', Bulletin of the World Health Organization, vol. 97, 2019, pp. 79–80, <www.who.int/bulletin/volumes/97/2/19-020219.pdf>.

1. Female employees and employees with a young child are more likely to be absent. Companies with flexible working arrangements available to employees have much lower rates of absenteeism. Most sick absences are unpaid. To compensate for taking a sick absence, employees work at night or they work overtime to finish their assigned tasks. Additionally, a sick employee might not take leave unless they are very ill. From the employer's perspective, companies that did not have any plans for reducing absenteeism by flexible working were at a strong disadvantage.
2. Respiratory diseases account for the majority of air pollution-related illness. All participants perceived that air pollution adversely affects their health. The highest average coarse particulate matter (PM10) concentration was associated with the upper range of absenteeism. Both PM10 and sulfur dioxide (SO2) air pollution were positively associated with absenteeism. Colder temperatures and lower humidity levels were also significantly linked to increased absences.
3. The hidden cost of absences to employers was nearly $7.5 million lost due to absenteeism over the last five years among the private companies participating in this study. This loss represents a $1.4 million annual hidden indirect opportunity cost to the Mongolian economy due to air pollution. Companies without flexible working arrangements face greater rates of absenteeism, expending time in their search for substitutes and increasing the indirect cost of absenteeism. Finding substitute employees from outside the company can be difficult, particularly if specially licensed staffs are required.
4. Annual individual employee direct costs related to illness caused by air pollution totalled 875,000 Mongolian tugriks (MNT) ($317.60) for an average of three instances of three-day illness-related absences during the winter in Ulaanbaatar. This sum included diagnostic and doctor visit-related costs per instance of air pollution-related illness of MNT 65,000 (three times), medication costs per illness of MNT 70,000 (four times), and hospitalization costs per absence of MNT 200,000 (one time). Direct cost unrelated to health care (transportation) was 50,000 MNT (four times). Individual indirect cost equated to the median value of lost wages for a three-day absence, amounting to 120,000 MNT. The costs to employees may amount to as much as 10 per cent of annualized income.

Recommendations

- Since the impact of absences related to air pollution falls disproportionately on female employees, especially those with small children, female gender-responsive action is justified and would be expected to pay significant dividends for employers. Flexible working arrangements appear to be particularly effective in this regard. Mobilization at all levels for social transformation on gender equality issues, and for the implementation of gender and female empowerment policies specific to both the state and private sectors, appears to be warranted.
- A commonly stated reason for absences was symptoms of respiratory illness in the employee or the employee's sick child. Thus, employers can support families with children by incorporating flexible policies into their workplace, which would contribute to lower absenteeism and support higher productivity.
- Companies should explore more flexible work arrangements such as flexible time, job sharing, a compressed workweek, part-time employment and voluntary reduced work time. The most practical new management tool might be flex-place-telecommuting, which allows employees to work from home or at a satellite worksite, where they are connected to their offices by computer and/or telephone.
- Illness-related absences were significantly associated with increases in air pollution, cold

temperatures and reduced humidity. Companies should be committed to supporting the well-being of their employees and providing appropriate support in relation to their health and attendance at work during winter periods of air pollution.

- Managers should be supportive of employees when managing illness-related absences and ensure that they are addressed in a caring and sensitive manner, and with a fair and consistent yet flexible approach.
- The major identified drivers of costs to employees are health-care costs, including doctor visits, medication, hospitalization, transportation and loss of earnings. Employers also consider that time is money, and an employee spending the entire morning at the doctor's office represents a loss to the company because they are paying for work that is not being done. Medicine can get expensive, especially when bought frequently during illnesses
- Companies face difficulties quantifying the causes of and devising solutions for absenteeism. Employers should be aware of how often their employees are absent from work so they can better manage its effect on their business and increase productivity.
- Policymakers who examine the policy options affecting air quality management at the individual and company level, as well as societal levels, need to take into account the impacts of pollution on public health, as well as the benefits and costs of measures to reduce pollution.

1. BACKGROUND

Ulaanbaatar, Mongolia, is the coldest capital city on earth in winter, while the second coldest is Ottawa, Canada. Over the past 20 years or so, inbound migration from nomadic communities to the capital has expanded the city's population from about 530,000 before 1991 to over 1 million at present. About 400,000 of the city's residents live in purpose-built apartment blocks that are centrally heated with steam generated by four coal-fired power plants located on the edge of the built-up city. These power plants have been renovated and are relatively efficient. City traffic, and vehicle ownership in particular, has increased to match population growth. However, combined with power plant emissions, automobile pollution accounts for less than 15 per cent[2] of wintertime pollution.

More than 80 per cent of winter pollution can be attributed to coal burning to heat over 250,000 household domestic stoves. Each of these households burns three to four tons of coal per season, over four months between November and February. Despite the recent enactment (62nd indication of Mongolian Law 2018) of a ban on burning raw brown coal, paired with its substitution by compressed coal dust briquettes branded as 'sain' (healthy) or improved coal, and notwithstanding a previous stove replacement project, ambient pollution of PM10, PM2.5, SO_2, and carbon monoxide remain many times greater than World Health Organization or even Mongolian safety standards.

Previous studies have identified significant associations between the levels of winter air pollution seen in Ulaanbaatar and various medical and public health morbidity impacts including cardio/respiratory illnesses, infertility, fetal loss, rising cancer rates and more. The following study was designed to collect data to test the hypothesis that the increased rates of illness related to winter air pollution cause absences that represent a significant to cost employers and employees. The objectives were:

1. To analyse absenteeism data in terms of reasons for absenteeism disaggregated by socioeconomic status, and to assess the current coping mechanisms of companies and organizations suffering from absenteeism.
2. To analyse the relationship between Ulaanbaatar air pollution levels and absenteeism among the private companies selected for the study.
3. Assessment of both direct and indirect costs due to absenteeism for the private companies selected for the study.
4. Assessment of an individual's direct and indirect costs due to absenteeism during periods of high air pollution.

2 World Health Organization, 'Air Pollution in Mongolia', Bulletin of the World Health Organization, vol. 97, 2019, pp. 79–80, <www.who.int/bulletin/volumes/97/2/19-020219.pdf>.

2. LITERATURE REVIEW

Definition and causes of absenteeism

Løkke (2008) defined absenteeism as withdrawal behaviour due to an undesirable working environment.[1] Osilla and colleagues (2010) defined three main categories of absence: sick leave, authorized absence and unauthorized absence. An employee is given sick leave when they are absent due to a reported illness, whether or not the illness is real or fake.[2] De Klerk and Mostert (2010) described absenteeism in organizations in two thematic ways: frequent and long-term absenteeism. The first type of employee absence often falls on a Monday or a Friday, and the employee is frequently absent one or two days, which results in collecting a high number of so-called 'attitudinal' absences. A temporary break from work generally shows a preference to do something other than spending eight hours in the office.

Meanwhile, long-term absenteeism mostly has nothing to do with the employee's ethics or personal values and is not intentional or planned. It may result from a work or non-work injury.[3] Dew, Keefe and Small (2005) distinguish between involuntary absence and voluntary absence. Involuntary absence is caused by certified illness or funeral attendance and is beyond the employee's direct control, while voluntary absence is associated with uncertified illness and shirking, which are under the direct control of the employee. Voluntary absence is often based on personal aims.[4]

About 2.3 per cent of all scheduled working hours are lost because of unplanned absences in the service sector of the United States of America alone. However, in some industries, the total cost of unplanned absences is approximately 20 per cent of payroll expenses. The main reasons for unscheduled absences (personal illness and family problems) are unlikely to disappear anytime soon.[5] One primary reason for employee absenteeism is a genuine illness. Illness is very costly because it increases the frequency of absence along with the associated financial cost to the company, wherein employees are paid for time when they are not working.

Sick leave is a right afforded to employees that allows them to recover from illness. Sadly, the absenteeism rate may increase when employees abuse their right to sick leave. Employees might consider sick leave to be a right that they are entitled to use regardless of whether the illness is genuine or feigned. Taking sick leave has a negative influence on the organization, as the organization cannot function efficiently if employees do not report for duty.[3] Another reason for absenteeism is family issues. Balancing work and family life might be a problem and childcare is often a serious issue. With the rising cost of childcare, many people are unable to pay higher rates. Another common family problem is the responsibility adult children have to care for elderly parents. These needs may include doctor/medical appointments, hospitalization, etc., all of which take time to complete.[6] Bullying and harassment, stress, burnout and low morale, job hunting and disengagement are also common causes of absenteeism.[7]

Absenteeism disaggregation by sex, age and other factors

J. Paul Leigh (2008) showed that although women are absent more often than men, in general, this observation is not particularly informative due to significant differences in job and worker characteristics. Women take more responsibility for children and are more often absent as the number of young children in their family increases.[8] However, as Allen (1984) suggests, age may show a curvilinear effect on absence, with younger and more mobile workers showing high rates due to frequent (but short) absence events, while older workers show high rates due to long absences for illness.[9] There is evidence that blue collar workers are more often absent but this is not caused by unpleasant working conditions, but by increased dangers associated with these occupations. Also,

long hours of work are related to lower absenteeism. This might be because workers who choose these kinds of jobs are healthier and more committed to their job.[10]

A systematic review of smoking and absence from work shows that smoking increases both the risk and duration of absenteeism. Current smokers were, on average, 33 per cent more likely to be absent from work than non-smokers.[11]

Coping mechanisms of companies with absenteeism

As stated in Article 70 of the Law on Labour of Mongolia, the standard hours of work per week for a full-time employee are up to 40 hours and the length of a normal workday is eight hours.[12] Every organization has its own HR management and policies. For instance, the HR policy of Capital Project Design Institute allows up to five days of paid leave if an employee's spouse, parents, children, siblings, grandparents or parents-in-laws die; if the employee is getting married; or if the employee's wife has given birth. Also, employees are entitled to take up to four hours of paid leave once a quarter for medical examinations.[13]

The theme is consistent with suggestions offered by Mitchell, Ozminkowski and Serxner (2013) that implementing health promotion programmes provides services designed to educate employees to reduce health risks and actively prevent the occurrence of diseases.[14] Health promotion programmes include activities and programmes to:

- Reduce stress
- Increase physical activity and fitness
- Reduce high blood pressure and cholesterol
- Reduce excess body weight
- Improve nutrition
- Reduce tobacco, alcohol and substance abuse.

In some cases, programmes included cancer screening, health risk appraisals and various health education activities.[15]

Direct and indirect hidden cost to the company due to absenteeism associated with air pollution

The results of research conducted by Hansen and Selte (2000) show that an increase in the average level of PM10 of 1 microgram (μ)/m3 leads to an increase in the number of sick leaves by around 0.6 per cent. In addition to general welfare losses (decline in the individual utility of a being) and costs resulting from increased demand for public health services, results indicate that air pollution also entails costs to trade and industry through a higher number of sick leaves.[16]

According to an evaluation of sick leave among employees of a large Massachusetts manufacturer, Milton, Glencross and Walters (2000) found a consistent relationship between increased sick leave and lower levels of outdoor air supply.[17] In a study of economic costs and health effects related to air pollutants in Mumbai and Delhi, the total economic cost attributed to PM10 pollution in the most populated and most polluted city accounted for, on average, about 1.01 per cent of India's gross domestic product between 1991 and 2015, when the gross domestic product growth rate was about 5.87 per cent, at a constant 2005 United States dollar price.[18]

Another study notes that organizations incur direct and indirect costs from unscheduled absences, which are disruptive to business. Direct costs include costs related to lost days, sick pay, lost

productivity and reduced service provision. Indirect costs include costs related to disruptions, management's time to revise work schedules, administrative costs to monitor and administer the leave policy, loss of expertise and experience, training costs for replacement workers, resentment and lowered morale of other employees, reduced productivity, staff turnover and terminations of contracts.[19]

Rodrigues-Silva and colleagues (2012) suggested a causal, dose-dependent relationship between air pollution and absenteeism in a huge urban centre. The economic losses imposed on society can be valued (estimated at $6,472,686 annually for the urban centre population covered by this Brazilian study) to provide the size of the total burden of air pollution, and may serve as a parameter for determining investments in technologies, cleaner fuels and public policy for a region exposed to different gradients of pollution.[20]

Research analysing individual-level productivity inside a pear packing factory showed that a 10-unit change in PM2.5 decreases worker productivity by roughly 6 per cent. When the PM2.5 level is below current United States air quality standards, productivity is affected.[21] The study defined productivity costs as 'the costs associated with production loss and replacement due to illness, disability and death of productive persons, both paid and unpaid' in health economics, in general.[22] Another study noted that indirect costs accounted for 93 per cent of total costs, showing the importance of the consequences of disease for work performance.[23]

Typically, the concept of absenteeism is accompanied by presenteeism. This occurs when people come to work sick, possibly because they fear the consequences of taking time off. The cost of presenteeism refers to the loss of productivity at the office due to impairment and inactivity, leading to failure to complete designated tasks that are part of the employee's duties. Presenteeism costs represented 18–60 per cent of all costs for the 10 physical and mental health conditions looked at in the study.[24] In another study, presenteeism contributed 14–73 per cent to the total direct and indirect costs of doing business.[25]

According to a study conducted at China's Qinling-Huai River boundary, increasing air pollution reduces the accumulation of executive talent and skilled employees. Firms located in polluted areas have lower corporate innovation, productivity, firm value and sales growth. The impact of air pollution on firm performance is concentrated in industries highly dependent on human capital.[26] A study of the effect of pollution on worker productivity in China showed that higher levels of air pollution reduce worker productivity.[27]

Cost to individuals due to absenteeism associated with air pollution

Maji, Dikshit and Deshpande (2017) found that long-term exposure to PM2.5 is related to increased mortality in adults (>25 years) from stroke, ischaemic heart disease and chronic obstructive pulmonary disease (COPD). Also, COPD causes 22.9 per cent of PM2.5-attributable mortalities.[18] A study of indirect costs related to COPD showed that the disease is associated with significant indirect costs. Estimated mean annual indirect costs were $893–$2,234 per person with COPD ($1,521–$3,348 in 2010). The disease puts a burden on employers in terms of lost productivity and associated costs, and on individuals in terms of lost income related to absenteeism, activity limitation and disability.[28] In the study 'Real World Evaluation of Direct and Indirect Economic Burden among Endometriosis Patients in the United States' (Soliman et al., 2018), on average, incremental direct and indirect 12-month costs per endometriosis patient were $10,002 and $2,132.[29] According to the report Household Economic Research 2017, average Mongolian household expenses are 859,908 MNT/month, of which 45,600 MNT is spent on medical services.[30]

3. METHODOLOGY

3.1. DATA COLLECTION AND ANALYSIS

For Objective 1: Analyse absenteeism data in terms of reasons for absenteeism disaggregated by socioeconomic status and to assess the current coping mechanisms of companies and organizations with absenteeism.

Sociodemographic information about the study participants was collected by questionnaire. Absence information was assessed through five key questions in the questionnaire, which were:

1. Have you ever been absent due to illness experienced by you or your family members related to air pollution during wintertime?
2. How many days were you absent due to illness during air pollution?
3. How frequently were you absent due to illness during air pollution?
4. Who is the most vulnerable person in your family and may require your absence?
5. What type of absence do you incur due to illness during the winter air pollution period?

Additionally, absenteeism was analysed by a company's employee size, service sector and air pollution levels by company location. Company coping mechanisms linked with absenteeism were assessed through face-to-face interviews for qualitative analysis. Flexible arrangements related to absenteeism were assessed from employee and employer perspectives. From the employer side, the study team used semi-structured, face-to-face interviews with HR managers from among the selected companies to assess company compensation mechanisms associated with absenteeism. The employee side was assessed through a questionnaire and focus group interviews to understand flexible working conditions offered by employers and stress related to getting absence approval from employers due to illness during wintertime air pollution. For further qualitative analysis, category and subcategory heading titles were identified and short paragraphs were written summarizing the findings for each subcategory, noting similarities and differences observed across groups.

For Objective 2: Analyse the relationship between Ulaanbaatar air pollution levels and absenteeism among private companies selected for the study

A generalized linear model (GLM) was used to see how high-dimensional air pollutant longitudinal data related to employee daily absence data. Employee absence data were based on repeated measurements over the course of a year. The mixed-effect model used an individual employee-level approach by adopting random effects to capture the correlation between observations of the same subject.

Correlations between high air pollution and absenteeism were determined by analysing absenteeism and air quality levels as officially recorded by a sample of air quality monitoring stations across Ulaanbaatar.

GLM

$$Absent_{ijkt} = a + b_1 P_{kt} + b_2 X_{ijkt} + b_3 Z_{jkt} + b_4 V_{kt} + \varepsilon_{ijkt}$$

$Absent_{ijkt}$: Absence of employee i, in company j, local area k and year t;

P_{kt}: Pollution level in area k and year t

X_{ijkt}: Time-varying individual characteristics (age, gender, education level, etc.)

Z_{jkt}: Time-varying company characteristics (number of employees, sector, etc.)

V_{kt}: Time-varying local area characteristics (for example, weather variables)

ε_{ijkt}: Error term

Analysis of control variables

Access to individual-level attendance records over the last five years was obtained, jointly covering 2015 to 2019, allowing us to control for potential confounds and sources of variability, such as seasonality, wind, precipitation, humidity and unobserved heterogeneity.

Control variables

Controls were set for weather, humidity, employment factor and the time (day of the week, month and year) of absenteeism.

For Objective 3: Assessment of both direct and indirect costs to the company due to absenteeism among private companies selected for the study

Direct cost to the company calculation[3]: An economic estimation was conducted to monetize the absenteeism attributable to air pollution. Initially, cases of absenteeism attributable to air pollution were estimated. The year with the least air pollution, 2015, was considered the baseline year to determine the variation of PM10 concentration.

$$CA_{(air\ pollution)} = (exp^{(\beta PM10 \times \Delta PM10)} - 1)\ x\ BRS;$$

Where $CA_{(air\ pollution)}$ is the number of instances of absenteeism attributable to air pollution, β_{PM10} is the estimated coefficient for *PM10*, *ΔPM10* is the variation of the *PM10* concentration during the period and *BRS* is the baseline scenario.

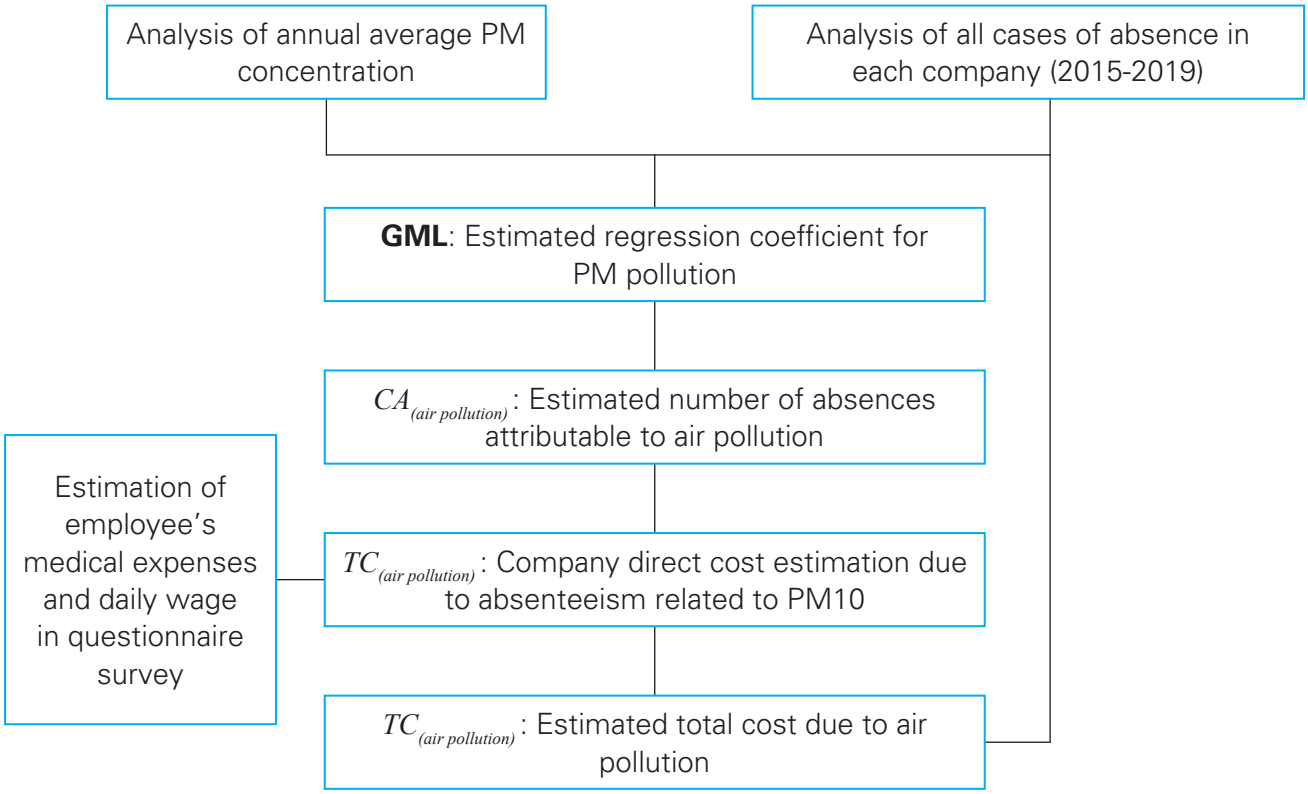
CA is limited to *BRS* (the number of absences) and to observed *PM10* variation. The minimum value of *CA* is zero, which can occur if *ΔPM10* is zero. *CA* is normalized in absolute terms of the number of absences, since there is variation in the number of observed participants. This formula is necessary in order to enable the economic valuation to be used in any scenario. The calculation of the total cost considered the salary equivalent of the employee's absence, which corresponded to a direct cost borne by the employer.

$$TC = (CA)\ x\ (EW + ME);$$

where EW is the equivalent wage/typical one day absence, and ME is average medical expense due to illness per absence.

3 Tayra, Flávio, Helena Ribeiro and Adelaide de Cássia Nardocci, 'Economic Cost of Air Pollution in Cubatão – SP based on health expenses related to diseases of the respiratory and circulatory systems', Saúde e Sociedade [online], vol. 21, no.3 2012, pp. 760–775.

Figure 1. Company direct cost due to absenteeism associated with air pollution



Indirect cost for the company: Semi-structured, face-to-face interviews were conducted with key HR personnel to determine indirect costs that are important to employers, developed through the literature review (see Appendix 6). The following data were requested to assess the following indirect costs incurred by the employer:

- The cost of outsourcing to cover the labour shortage
- Overtime for replacement of absent workers
- Training expenses for temporary/replacement employees
- Loss of production and quality of product/service because of absenteeism
- Reduced quality performance from undertrained replacement workers
- Management costs related to dealing with absenteeism
- Lowered employee morale as remaining staff feel overworked.

For Objective 4: Assessment of individual direct and indirect costs during air pollution.

Direct individual cost estimation[4]: A cost-of-illness approach was used to sum up the direct and indirect costs associated with disease to establish the value of the cost of morbidity, with the required data being relatively easy to obtain. Estimates did not attempt to quantify pain and suffering, preventive expenditures associated with an illness, or the values of any reduced mortality risks. There are two main categories of direct costs: medical costs and non-medical costs. Medical costs,

4 Jo, Changik, 'Cost-of-illness Studies: Concepts, scopes, and methods', Clinical and Molecular Hepatology, vol. 20, no. 4, December 2014, pp. 327–337. .

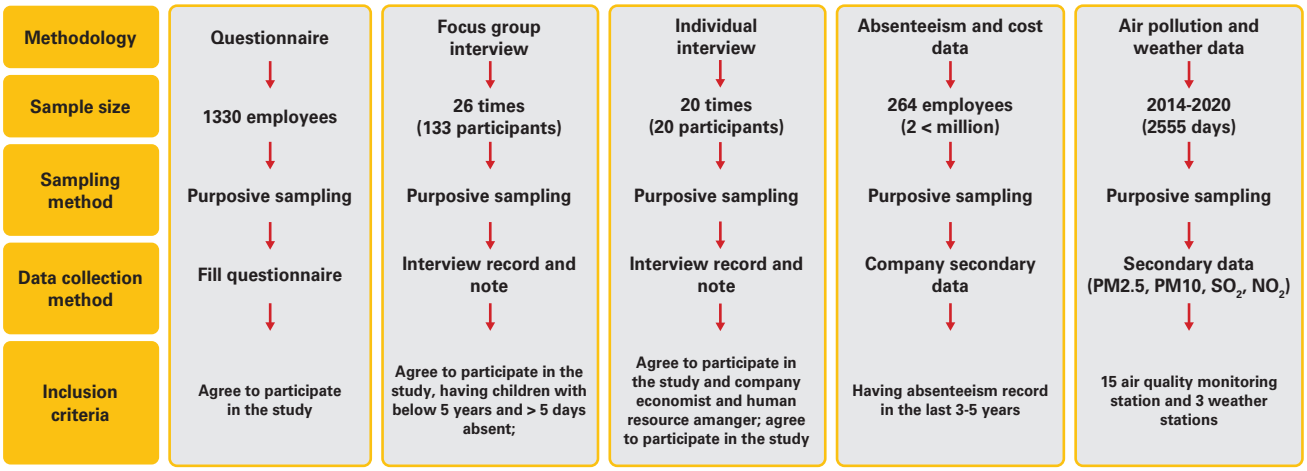
also referred to as health-care costs, include all types of health-care costs directly related to the studied disease, from diagnosis and treatment to continuing care. In our study, cost-of-illness direct medical cost includes hospitalizations, doctor visits, a health professional's care and prescriptions for any drugs.

Indirect individual cost estimation[5]: To assess indirect cost to the individual, a measure of productivity loss quantified the output lost due to cessation or reduction of the patient's or family member's productivity as a consequence of morbidity, mortality or disability caused by the disease under investigation. The study employed the human capital method, as it is one of the first formal methods developed for quantifying value of life. Using this method, the hours of work lost by the person due to disease were estimated and then multiplied by the hourly wage. Hourly wage data was collected and multiplied by the number of hours or days that the employee missed because of air pollution-related illness. For instance, if the company employee's hourly wage was 5,000 MNT and they missed work for three days (8 hours per day), the calculation was:

*5,000 MNT x (8 hrs*3 days) = 120,000 MNT (total lost wages).*

Each employee reported their contracted salary within a range specified in the questionnaire.

Figure 2: Study procedure framework



3.2. STUDY INCLUSION CRITERIA

In partnership with UNICEF, the study team defined target private sector employers. This included creating inclusion and exclusion criteria. These criteria encompass business type, employee numbers, availability of employee attendance records, format of records and quality and completeness of records. In addition, the study team used the stratification sampling method, allowing for areas of high, moderate and low air pollution. Companies were selected based on their number of employees, local area air pollutants and employer business type.

3.3. AIR POLLUTANT DATA

Air quality information was obtained from 15 air quality monitoring stations operated by the Mongolian National Agency for Meteorology and Environmental Monitoring. The air pollutants include PM2.5, PM10, SO2 and nitrogen dioxide, from 2014 to 2019.

5 Bai, Ruiqiao, Jacqueline C.K. Lam, and Victor O.K. Li, 'A Review on Health Cost Accounting of Air Pollution in China', Environment International, vol. 120, November 2018, pp. 279–294.

3.4. ABSENCE DATA

Quantitative employee absenteeism data were collected from fingerprint machine records the companies agreed to share. Using the data set, the study team was able to identify how long and how often people were absent. Effective absence registration includes accurate measurement and monitoring using absence management software. In analysing absence data, there were few issues in terms of the quality of the data. Absence due to employee illness is not the only reason why people need to take time off work. Bereavement, caregiving responsibilities, personal problems and the illness of others can all impact attendance at work.

The total cost of absence was the study's main outcome of interest. Additionally, there was a term defined as presenteeism that did not show up in our data set. This occurs when people come to work sick, possibly because they fear the consequences of taking time off. The occurrence of presenteeism was assessed in the questionnaire section of the study as well.

4. RESULTS

4.1. EMPLOYEE DEMOGRAPHIC INFORMATION

Employee demographic information was obtained through a questionnaire. Demographics such as age and gender, as well as employment sector, were collected. The data set also included the residential district, education status, average salary and number of children for all employees surveyed.

Table 1. Socio-demographic characteristics of study participants

VARIABLES	N	%
STUDY EMPLOYEE NUMBER BY SERVICE TYPE[b]		
Service sector employee	250	18.8
Manufacturing sector employee	257	19.3
Repair sector employee	182	13.7
Financial sector employee	521	39.2
Sales sector employee	61	4.6
Professional sector employee	59	4.4
GENDER		
Male	665	50.0
Female	665	50.0
AGE (mean ± standard deviation)	**31.0 ± 8.0**	
DISTRICT OF RESIDENCE		
Bayanzurkh	368	27.4
Bayangol	258	19.4
Songinokhairkhan	345	25.9
Khan Uul	175	13.4
Other	184	13.9
EDUCATION STATUS		
University graduate	1038	78.8
High school graduate	277	20.8
Did not graduate	5	0.4
AVERAGE SALARY PER MONTH[a]		
< 320,000	65	
320,001 - 500,000	490	36.8
500,001 - 900,000	323	24.3
900,001 – 1,300,000	215	16.2
1,300,001 – 1,500,000	118	8.9
< 1,500,001	119	8.9
CHILDREN		
Yes	1,075	80.8
No	255	19.2
NUMBER OF CHILDREN (mean ± sd)	**2 ± 1**	
TOTAL NUMBER AND PERCENTAGE	**1,330**	**100.0**

[a,b] - compare with the National Statistical Office, www.1212.mn

Table 1 shows employee demographic characteristics. Employees were distributed across six private business sectors. The median age was 31 years and half of the participants were male. Nearly 80 per cent of employees had received higher education and 77.3 per cent received a wage ranging from 320,000 MNT to 1,500,000 MNT. Some 80 per cent of employees had two children at home.

4.2. ABSENTEEISM DISAGGREGATION

Figure 3. Absenteeism by number of employees, industry type and air pollution level

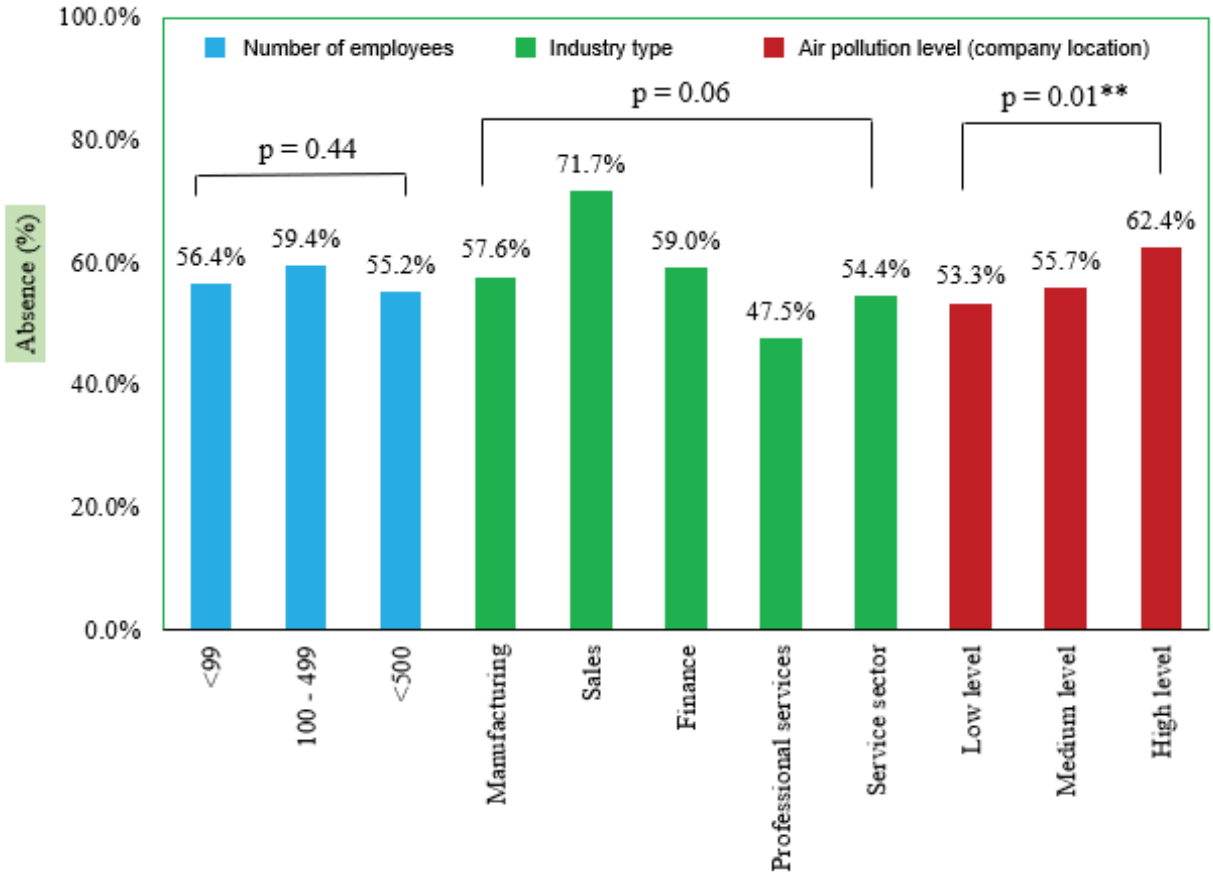


Figure 3 shows that absenteeism rates were independent of the number of employees of a company. However, absenteeism rates tended to be higher among companies specializing in sales versus professional services companies (72 per cent versus 48 per cent, p=0.06). Notably, absenteeism rates were significantly associated with increased levels of air pollution (p=0.01).

Qualitative results from HR managers also highlighted that as the size of the group increases, the rate of absenteeism goes up. This difference in the rate of absenteeism is believed to be due to the particular style and practices of management, the composition of the labour force and the culture of the organization. While survey results showed that the absentee rate is higher in winter months, qualitative results say that absences are highest during spring months, when land has to be prepared for the harvest season.

The absenteeism rate was calculated by using a questionnaire. The question was, 'Have you ever been absent during last winter?' Absenteeism causes were asked in the following categories: doctor's visit, taking care of sick children, a death in the family, and avoiding job duties.

Figure 4. Employee absenteeism rate in winter 2019

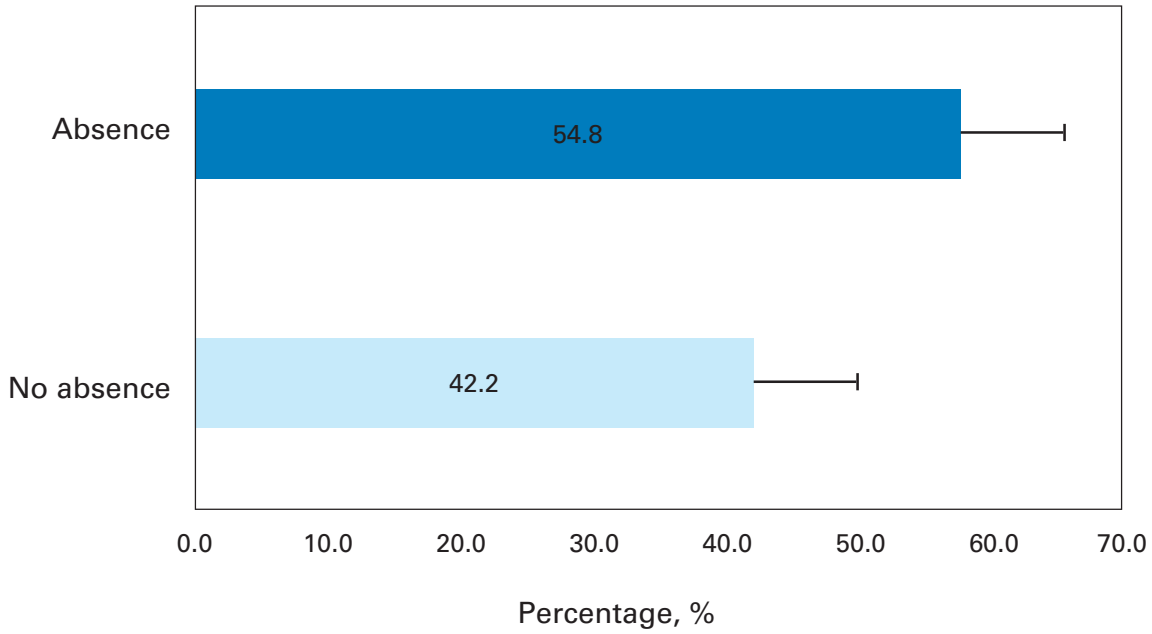


Figure 4 shows that one in 2 employees reported being absent at least one day during Winter 2019.

Qualitative results from employee focus groups showed that most employees ask for permission for a day of leave through an internal system within a company, typically by email. The reasons provided are usually related to personal issues, in which illness is sometimes included. However, asking for a day of leave may occur for several reasons. These include unexpected illness, business trips, the loss of a family member and a child's entrance into kindergarten or school. Among these reasons, the illness of a child is the most common reason for requesting a day of leave. Illness occurs at least once every winter and the severity of winter conditions – such as particularly cold weather – increases its frequency.

Employees do not always ask for a full day's leave for their own illness but instead they take several hours of leave for a medical consultation. Workers usually continue with their work, accounting for presenteeism, while receiving or administering treatment at home or at their workplace, even in the case of injections, in order to avoid accumulating absences. This was often due to no replacement workers being available for their position, or to continue receiving their salary to pay for debt, which was analysed through a review of employee focus group notes.

Figure 5. Employee-reported causes of absenteeism

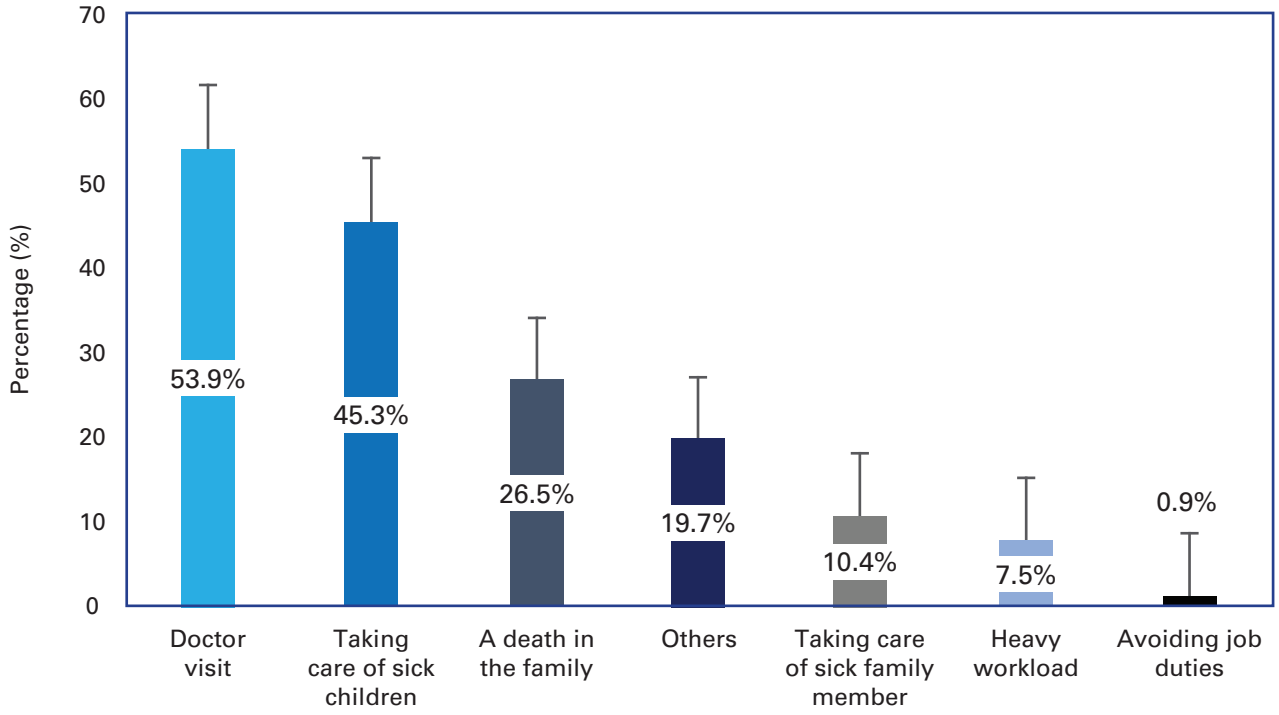


Figure 5 shows the main reasons given by employees to justify absences from work including a doctor visit (54%), as well as taking care of sick children (45%). Importantly death in the family was given as a justification by 27%.

From the perspective of HR managers, the reasons for being absent from work can be divided into two categories: illness-related or unrelated to illness. Illness-related absence, especially the illness of a child, was reported more frequently among respondents. Other reasons for absence reported by part-time employees included personal issues, family visits, business trips, children entering kindergarten, and student exams. An HR specialist from one company mentioned that workers asking for a day of leave is rare because leave is unpaid and workers do not want their work to accumulate in their absence. Long-term absences because of illness were due to operations.

The maximum frequency of absence reported by participants was 10 times during winter. Some respondents could not remember how many times they had been absent during winter. A cough or illness could last for 5–20 days every 1–3 weeks, even after receiving a full course of antibiotic therapy. Experiencing a cough or illness was more frequent in winter for all participants, while allergies due to air pollution were frequent in all seasons, especially in spring. Frequency of illness is directly related to the number of children in the household, with frequency increasing with the number of children in the family.

Figure 6. Study participant absentee status by cause

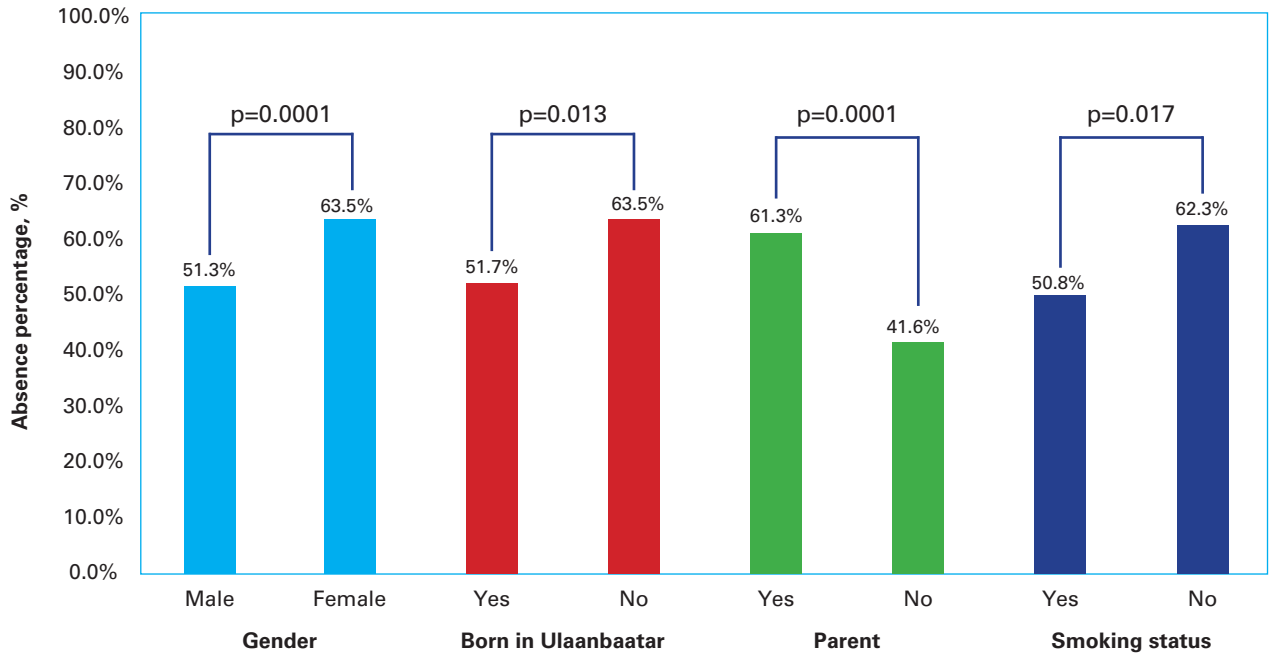


Figure 6 identifies key sociodemographic factors that are significantly associated with employee absences during the winter pollution season from a statistical standpoint. Results for employees who answered 'yes' to being female (p=.0001), born in Ulaanbaatar (p=0.013), having a child (p=0.0001) and being a smoker (p=0.0170) were significantly different from their counterparts among absence and non-absence groups.

Figure 7. Potential risk factors associated with workplace absenteeism

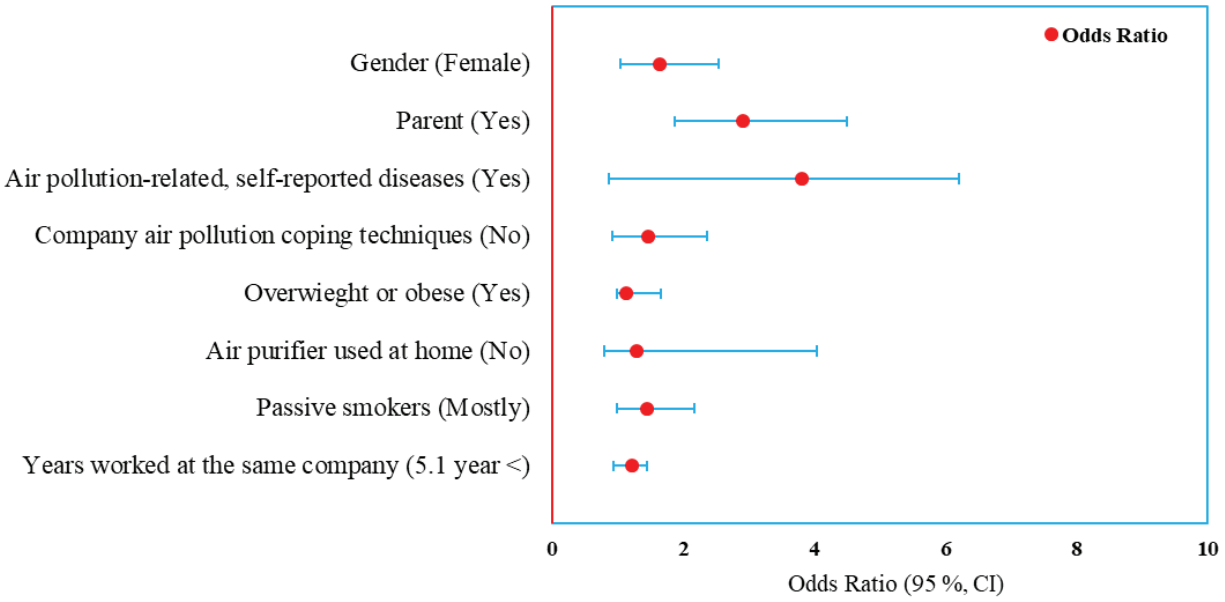


Figure 7 shows that being female and having children at home are significant risk factors for absences during the winter pollution season. Female employees were 1.65 times more likely to be absent than

their male counterparts, and while the calculation was adjusted by other variables, these factors remain significant (p=0.03; 95 CI 1.04–2.54). An employee with a child had odds 1.87 times higher of being absent than employees without children, adjusted by other factors (p<0.001; 95 CI 1.87–4.49). Both self-reported diseases and company air pollution coping techniques were 1.17 and 1.64 times more frequently associated with absence. Being overweight or obese was associated 1.12 times more often with absenteeism than employees in the normal body mass index group; however, it was not a significant risk factor. Lastly, being a passive smoker and working for a company for more than five years were significant factors associated with absence.

HR qualitative results highlighted that female workers, especially those who have children, were more likely to request a day of absence to take care of children when a child is sick, or to take children to the start of school or kindergarten. For male workers, it was more common to request a day of leave when they were sick themselves. Some companies in the study offer paid paternity leave for male workers. Female workers with a child under the age of five are the most likely to have an absence related to a child's illness. Some companies encourage their employees' roles as parents, with policies in place allowing women to have 3–5 absences per year if their child is sick.

Child illness was the most frequent reason for absence from work related to illness for employees who have a child. Most employees take leave for the first few days or hours to consult with a paediatrician. If the child's illness is not severe, employees leave their children at home with somebody else. Most commonly, they ask their parents or another family member to look after their children. Less commonly, they hire someone to take care of their sick children. However, these employees do not concentrate on their job or often worry about their children while working, and some of them they think that they should take a day of leave instead of working. In the case of hospitalization of a child, employees have to take leave from work for seven days to two months. Some employees treat their children intensively from Friday to Sunday so they can return to work on Monday. For employees with absences related to an elderly parent's illness, absences were sometimes related to time spent searching for a better diagnosis or treatment abroad.

Employees are more likely to be absent in the cold seasons, winter and early spring, when illness is more frequent and the air is most polluted. From November to February, child illness reaches its highest levels. In autumn, the start of the school year is another reason for absenteeism.

4.3. ABSENTEEISM COPING MECHANISMS OF COMPANIES

Company coping mechanisms linked to absenteeism were assessed through both quantitative and qualitative analysis. Flexible arrangements for absenteeism were assessed from employee and employer perspectives.

Figure 8. Type of leave provided to employees when they are sick

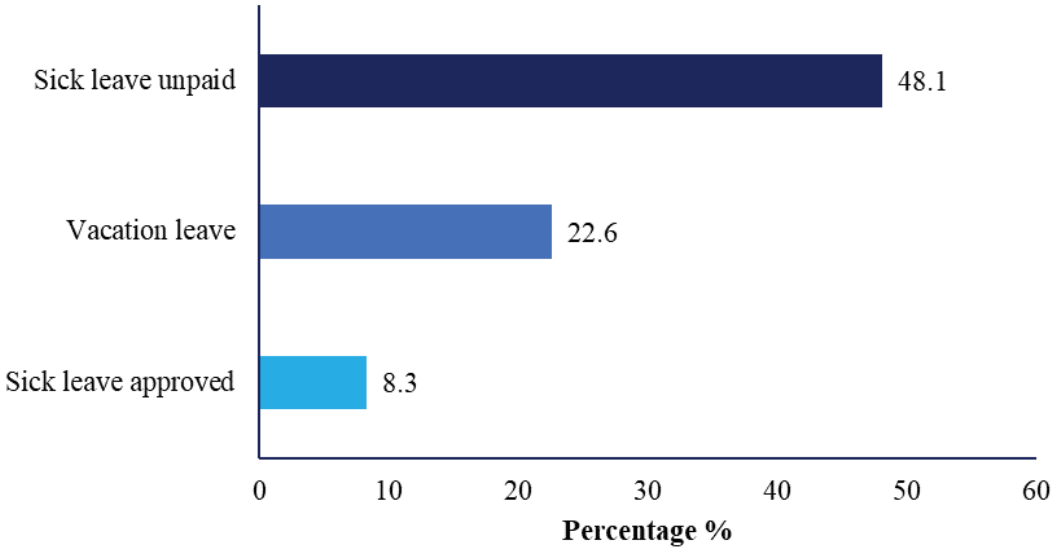


Figure 8 shows that sick leave is approved for about one-third of employees who ask for it. About half of employees do not receive sick pay, while a significant proportion may use up sick leave or vacation leave.

In interviews with employees, it was reported that the current arrangements for employees concerning absences related to illness are not flexible. Almost all of the workers said they subtract their leave days from their vacation, or they try to schedule their vacation leave in winter, when child illness is more frequent. If the illness-related absence is not taken from their vacation time, they might be faced with an unpaid absence unless they have a note from a doctor confirming illness.

Unpaid leave is mostly associated with a specific reason: health-care providers do not offer documentation to those who take care of children under the age of three. Another reason for taking unpaid leave is that once available vacation time has been used, an employee has taken leave to look after a sick child. If there is a lack of replacement workers at their company, they take care of their children during the day and work at night, or they work overtime to finish their assigned tasks.

Some employees have no knowledge of their company's paid leave possibilities or policies. Additionally, ***from the employee perspective***, a sick employee might not take leave unless they are severely ill. When their child is sick, however, companies usually offer unpaid leave to their workers, except in 2017, when Government Resolution No. 215 required the granting of paid leave. Hence, employees try to find someone (often their parents) or hire someone to care of their child. If they cannot find someone to provide care, the employee deducts a day of leave from their vacation time. For workers receiving health consultation for themselves or their children from a state-owned institution, costs are paid by their health insurance, but the majority had to consult with private clinicians and make out-of-pocket payments. Few companies offered private health insurance.

Figure 9. Company human resource policy of flexible working arrangements on absenteesim

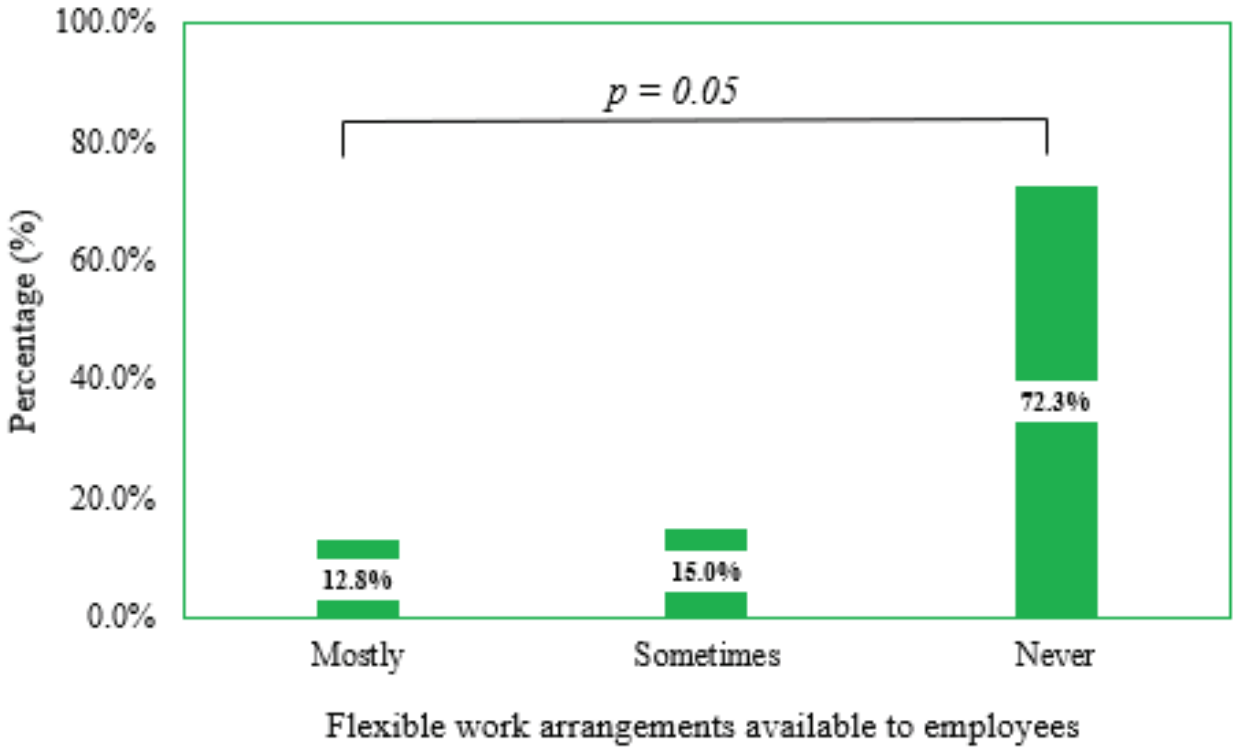


Figure 9 describes the impact of company flexible time management policy on rates of absenteeism. Those companies with flexible HR policies experienced significantly (fivefold) lower rates of absenteeism.

An HR manager mentioned that some professionals are able to work from their home, such as architects, designers, engineers and technicians. Some employees worry about asking their boss about taking an illness-related day of leave but others do not. However, no company hesitated to let employees take leave when an employee was sick or when a family member was sick. When a worker is absent, somebody else has to continue their work. Some HR managers and economists have reported that the higher workload results in added stress for workers. HR managers mentioned that flexible arrangements depended on the job type and work experience of the employee. For example, a designer or architect has the opportunity to work from home when they need to be absent from work. For a new worker with limited experience, they may face stress when extra work is assigned due to the absence of a co-worker.

Table 2. Employee morale and flexible arrangements

QUESTIONS	N	%
HOW OFTEN DO YOU COORDINATE THE RESPONSIBILITIES OF CO-WORKERS WHEN THEY ARE SICK DURING HIGH AIR POLLUTION PERIODS?		
Mostly	144	13.4
Sometimes	276	25.7
Rarely	333	31.1
Never	319	29.8

IF YES, HAVE YOU EVER EXPERIENCED STRESS DUE TO UNPLANNED EXTRA RESPONIBILITY ON THE JOB?		
Mostly	156	13.9
Sometimes	261	23.2
Rarely	296	26.3
Never	412	36.6
WHAT WORD BEST DESCRIBES HOW YOU FEEL WHEN YOU REQUEST SUDDEN LEAVE DUE TO ILLNESS DURING HIGH LEVELS OF AIR POLLUTION IN WINTER?		
Worried	299	26.0
Scared	599	52.1
Relax	193	16.8
Other	58	5.0
DOES YOUR COMPANY HAVE FLEXIBLE WORK ARRANGEMENTS, SUCH AS WORKING FROM HOME OR DUTY SHARING?		
Mostly	113	11.0
Sometimes	143	13.9
Rarely	146	14.2
Never	625	60.9
Total	1,330	100.0

Table 2 quantifies company policies and employee perceptions of flexible company care policies for absences related to illness. Almost 40 per cent of the employees of companies selected for the study experienced coordinating and being responsible for the duties of co-workers who had an illness-related absence during winter air pollution periods. The same percentage of employees said they felt stressed due to extra work being assigned when others were absent. Eighty per cent of the study participants reported experiencing mixed feelings of frustration and fear. Seventy-five per cent of the participants revealed that no, or limited, flexible time arrangements were available from the employer side.

The HR managers and economists interviewed felt that workers should not feel stressed because they are receiving a higher salary for doing the additional work. However, few companies actually offer additional compensation to workers for doing the job of absent co-workers, and none had ever calculated the stress resulting from the absence of co-workers. One HR manager said that they had not received any reports about stress experienced by a substitute worker. At another company, work arising due to the absence of a worker is divided among other co-workers, thus preventing any extra payment being made to any single employee.

Some companies offer flexible work schedules, namely 9.00 a.m.–9.00 p.m., 6.00 a.m. to 3.00 p.m. or 48 hours off/24 hours on, so that workers can arrange time for their personal business. Workers who finish their work early are allowed to leave early. Employees working on the weekend are allowed to receive a weekday off as compensation. For the majority of the companies surveyed, they do not allow their employees to work from home, especially dairy product companies, with the exception of employees with an office job.

Regarding internal rules for absenteeism, after an absence of three work days or for 24 hours (in 24-hour duty), an employee faces the risk of being terminated. In one company, if the worker is absent twice, they cannot receive a bonus. At another company, if the teacher had to teach a class on another day after an absence, their salary was reduced by 40 per cent.

4.4. AIR POLLUTION EXPOSURE ASSESSMENT

The assessment of personal exposure to air pollution is a critical component of epidemiological studies associating air pollution with short- and long-term health effects. Short-term effects are more likely to be associated with symptoms. Longer-term effects may be more often related to morbidity.

Figure 10. Study participant experience with air pollution's short-term effect on self-reported symptoms

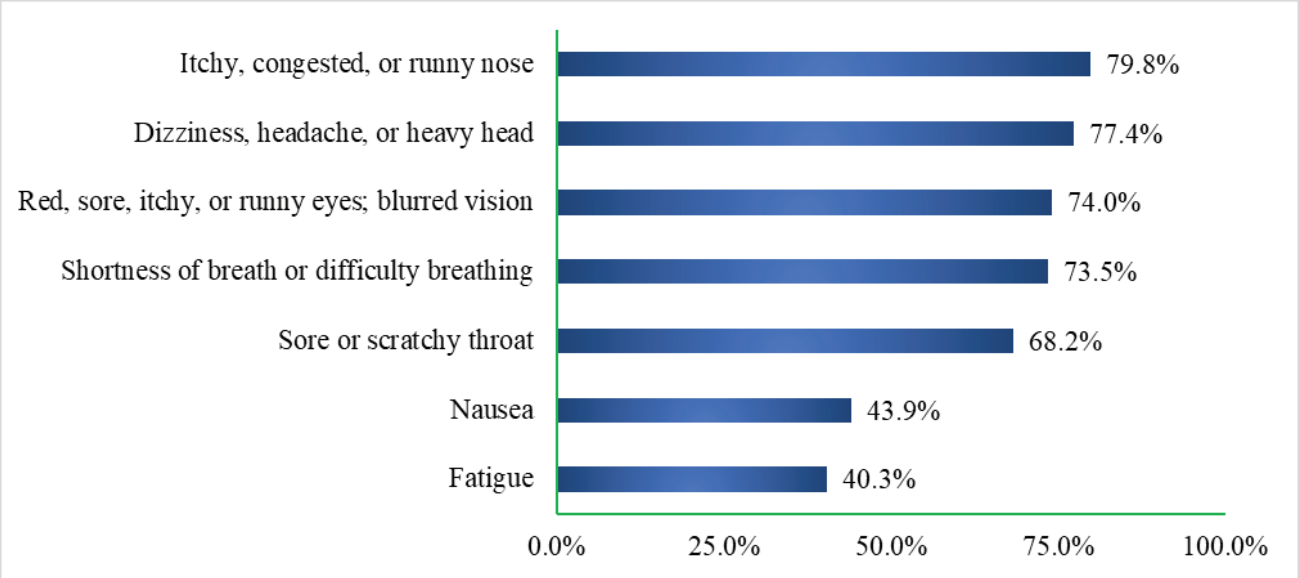


Figure 10 shows that 60–80 per cent of employees self-report symptoms such as nasal, throat or eye irritation, and a cough or head congestion, which they associated with wintertime air pollution.

Qualitative results among employees showed that with regard to air pollution related to sickness, all participants answered that air pollution affects their health somehow. The most common symptoms cited were effects on the respiratory system, lung disease including repetitive cough, bronchitis, respiratory allergic disease and pneumonia. Other symptoms frequently mentioned were blocked nose, runny eyes, sore throat, headache and shortness of breath. Long-term consequences included lung cancer, fetal malformation, cardiovascular disease and asthma. Air pollution can have a psychological impact, resulting in stress, and asthma attributed to air pollution can also psychologically impact employees, with symptoms manifesting due to high levels of stress.

Qualitative results also added that companies did not have any plans for reducing absenteeism, except for one company that planned to open a staff canteen and an on-site fitness centre to support its staff's health. Companies had a variety of support resources for their staff's illnesses. In some companies, the cost of the first five days of an employee's hospitalization is paid for by the employer. In the case of companies offering private insurance, an insured employee can spend up to 35 million MNT annually on health-care services, while some companies pay a certain percentage of an employee's hospitalization costs. Some companies made allowances for employees who had more than one medically certified illness-related absence in one month. Periodic health screenings for employees are offered by almost all of the companies that took part in the study. One HR manager reported that with the help of health screenings, one of their employees was diagnosed with cancer at an early stage and received treatment in time for recovery.

The availability of doctors and diagnostic equipment in the workplace facilitates employees receiving timely diagnosis, consultation and treatment for an illness. In winter, when there is a high incidence of cold and flu, one company offered sea buckthorn juice, fermented dry milk, lingonberry juice, oxygen cocktails (particularly for pregnant women) and other immune-supporting beverages and supplements to support the health of their employees.

In addition to offering annual health check-ups for employees, companies also distributed air pollution protection masks. Many employers have air purifiers in their workplace but not in all facilities or rooms. Furthermore, the company might send employees recommendations or information about air pollution and instructions on how to strengthen immune system defences, distributed through company email.

Figure 11. Study participant self-reported diseases attributed to air pollution

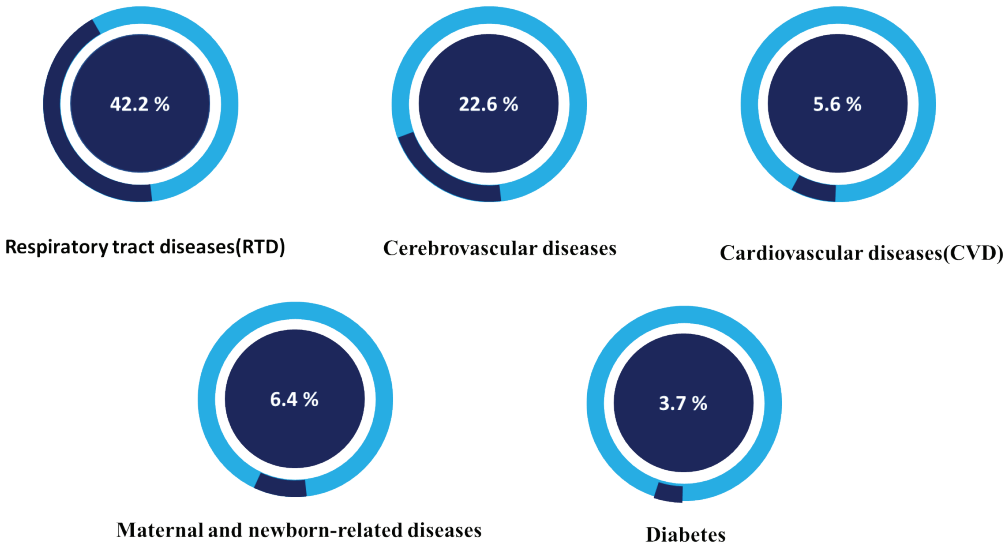


Figure 11 shows that respiratory disease accounts for 42 per cent of self-reported long-term complications of winter air pollution, while cerebrovascular complications account for 22 per cent of self-reporting in this category. With regard to air-pollution-related illness, all participants said that air pollution somehow affects their health, especially those suffering from respiratory system complications. These include lung disease, chronic cough, bronchitis, allergies with respiratory symptoms, and pneumonia. Other frequent symptoms mentioned included nasal congestion, runny eyes, sore throat, nasal irritation from the smell of smog, headaches and shortness of breath. Long-term consequences included lung cancer, fetal deformity, cardiovascular disease and asthma.

Based on qualitative results, companies had some support for their employees in terms of their reported illness. Some companies offer a 'Health Day', which is a day when the employee has the opportunity to choose between one paid day of absence or a grant of 100,000 MNT to cover the costs of their illness. In addition, some companies have working shifts that give the employee the opportunity to manage their illness-related issue. Another form of support from companies is offering private health insurance coverage, in which only 20 per cent of the total medical cost is paid by the employee out-of-pocket. Moreover, all of the companies had a doctor in the workplace and ultrasound equipment, allowing the employee to receive consultation or treatment in the workplace. Some companies had enough replacement workers, or a system whereby any employee can replace an absence within the team.

Figure 12. Study participant air pollution exposure assessment

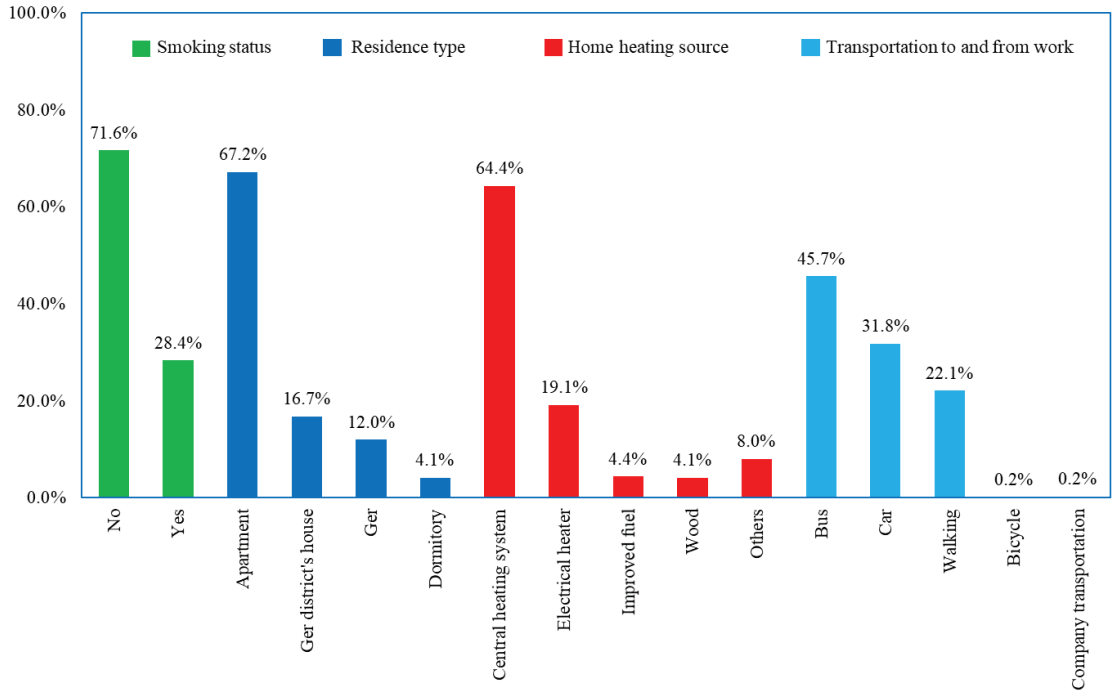


Figure 12 looks at individual exposure assessment, such as smoking status, residence type, home heating source and transportation to and from work. Most of the study participants live in apartments that are equipped with access to the city's central heating system. Twenty per cent of study participants had electric heaters. The majority of employees relied on a bus or car for their daily commute to and from work. Twenty-eight per cent of study participants admitted to smoking.

Figure 13. Study participant individual exposure assessment

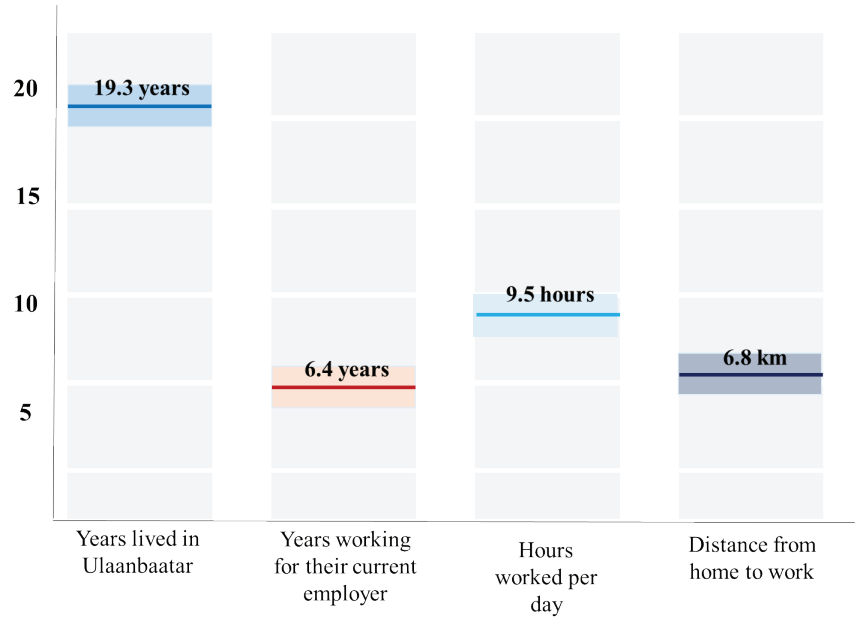


Figure 13 looks at individual air pollution exposure assessment. The mean number of years employees had lived in Ulaanbaatar was 19.3 years. The average number of years employees had been working for their current employer was estimated to be 6.4 years, and hours worked per day was 9.5 hours. The mean commuting distance was around seven kilometres.

Figure 14. Employee individual air pollution protection methods

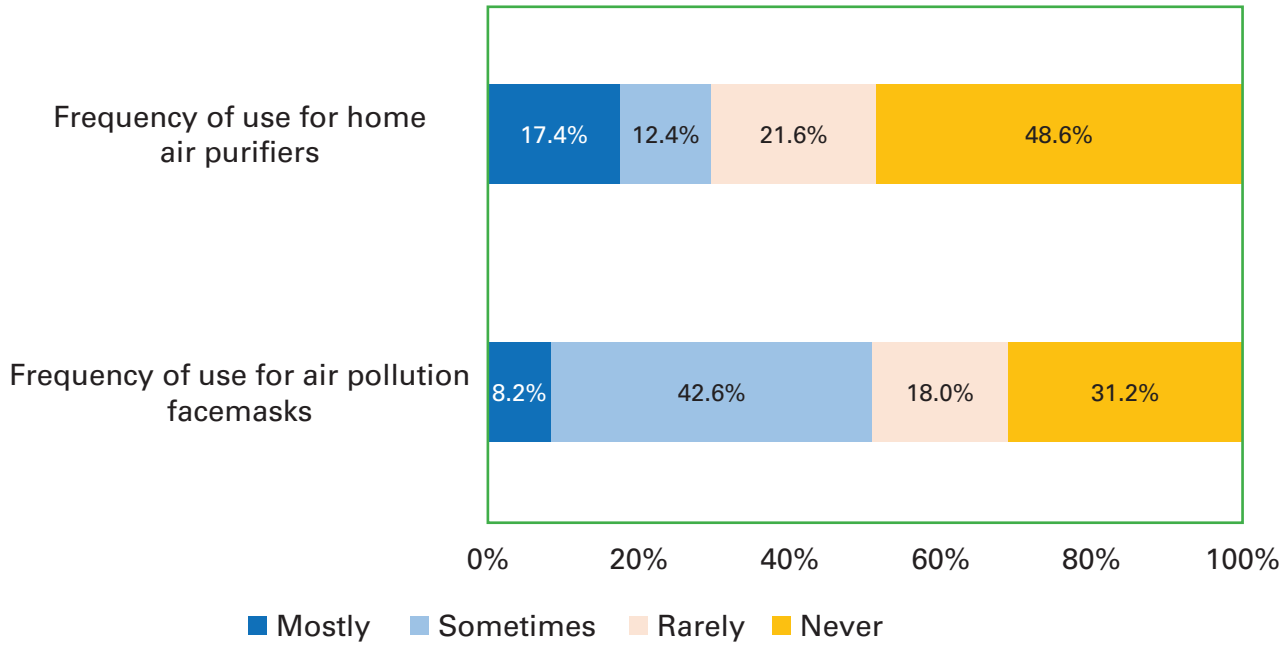


Figure 14 shows that the consistent uptake of individual protection methods to combat the effects of air pollution, such as mask wearing or using air purifiers at home, was very low.

Employee qualitative results revealed that air pollution mask use may depend on location. If the employee resides in a polluted ger district, such as Bayankhoshuu, they may be more likely to wear an air pollution mask. The use of a mask can yield various difficulties; for example, difficulty breathing and fogging up eyeglasses. All participants offer masks to their children; some of them are obligated to use them at school but some parents reported that their children found them uncomfortable for the same reasons that adults chose not to wear them. Other family members were not sure whether or not their children used masks often after receiving them from their parents. Masks are frequently used to protect the wearer from the effects of air pollution, and employees spend 1,600 to 5,000 MNT per week on them. The men surveyed said they usually buy masks only for their spouses and children.

Air purifier use: The use of an air purifier at home was common among employees. Some respondents used other alternatives to improve air quality at home, such as using wet cleaning methods at home, opening windows frequently, putting filters in windows at home, and using additional filters in their cars. Others said they bought apartments in parts of the city with lower levels of air pollution, such as the National Garden Park and Viva City, but that pollutants produced by construction in some of these areas were still an issue. Other employee costs mentioned were for the purchase of air purifiers used at home or in the workplace, pollution filters for windows and the cost of electricity to use air purifiers.

4.5. ANALYSIS OF DATA ON AIR POLLUTANTS AND ABSENTEEISM

The number of daily company absences was analysed against the daily levels of air pollution using a GLM. The analysis included exposure to air pollutants such as PM of 10 and 2.5 micrometres or less in aerodynamic diameter, SO_2 and nitrogen dioxide.

Figure 15. Ulaanbaatar air pollutant distribution data from 15 official monitoring stations (2014-2020)

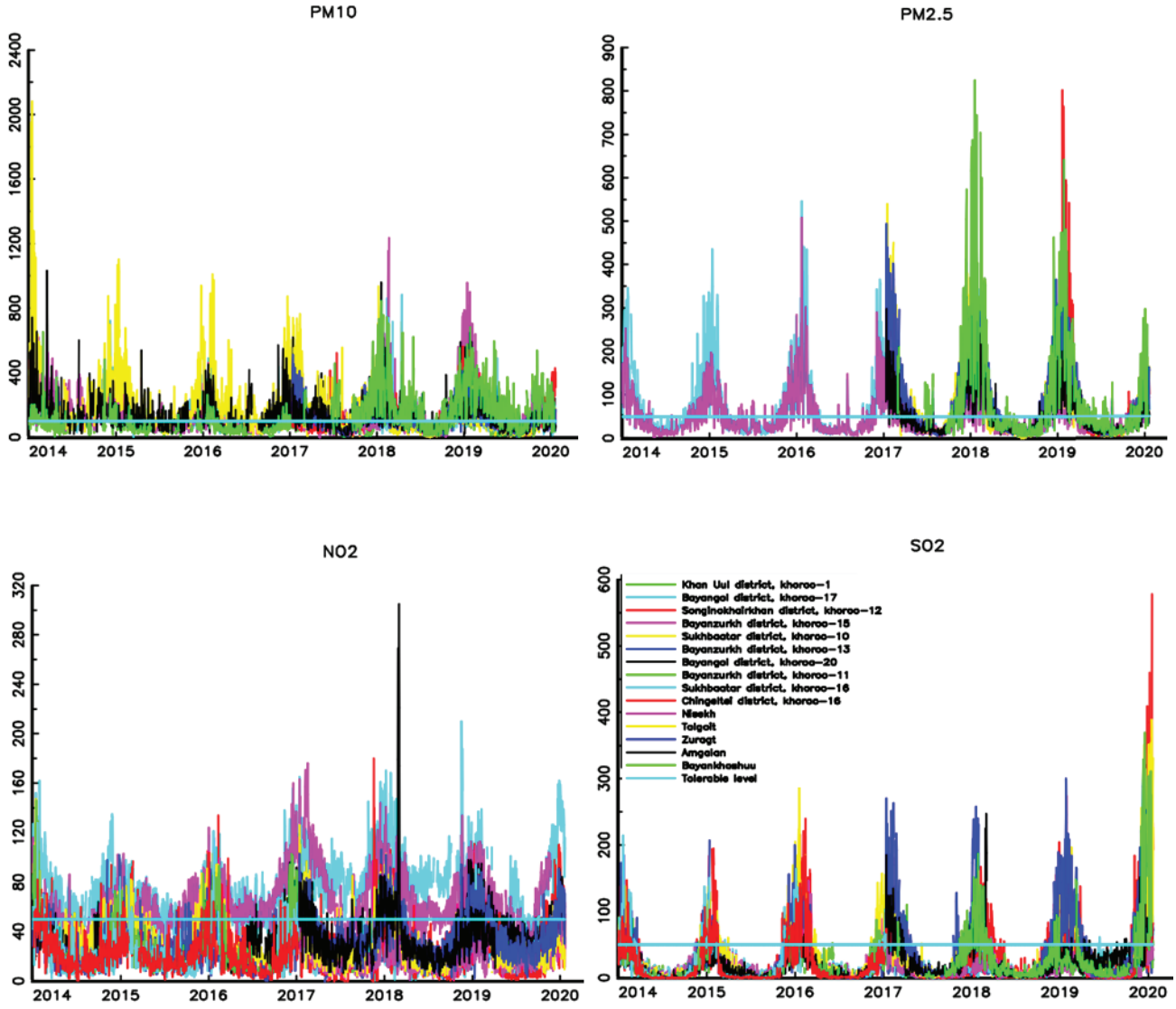


Figure 15 looks at air pollutant trends from 2014 to 2020. Data from 15 monitoring stations and data trends from each are illustrated with different colours. There is a reference line in blue for each air pollutant, which shows the maximum recommended levels according to World Health Organization guidelines. Bayankhoshuu and Songino Khairkhan had the highest average concentration of PM10. The PM2.5 level much exceeded the reference value in data from each air quality monitoring station. At most of the locations, the nitrogen dioxide level went beyond the reference value. Lastly, SO2 levels were consistently high but dramatically increased in the first quarter of 2020.

Figure 16. Average absence level versus stratified mean pm10 level

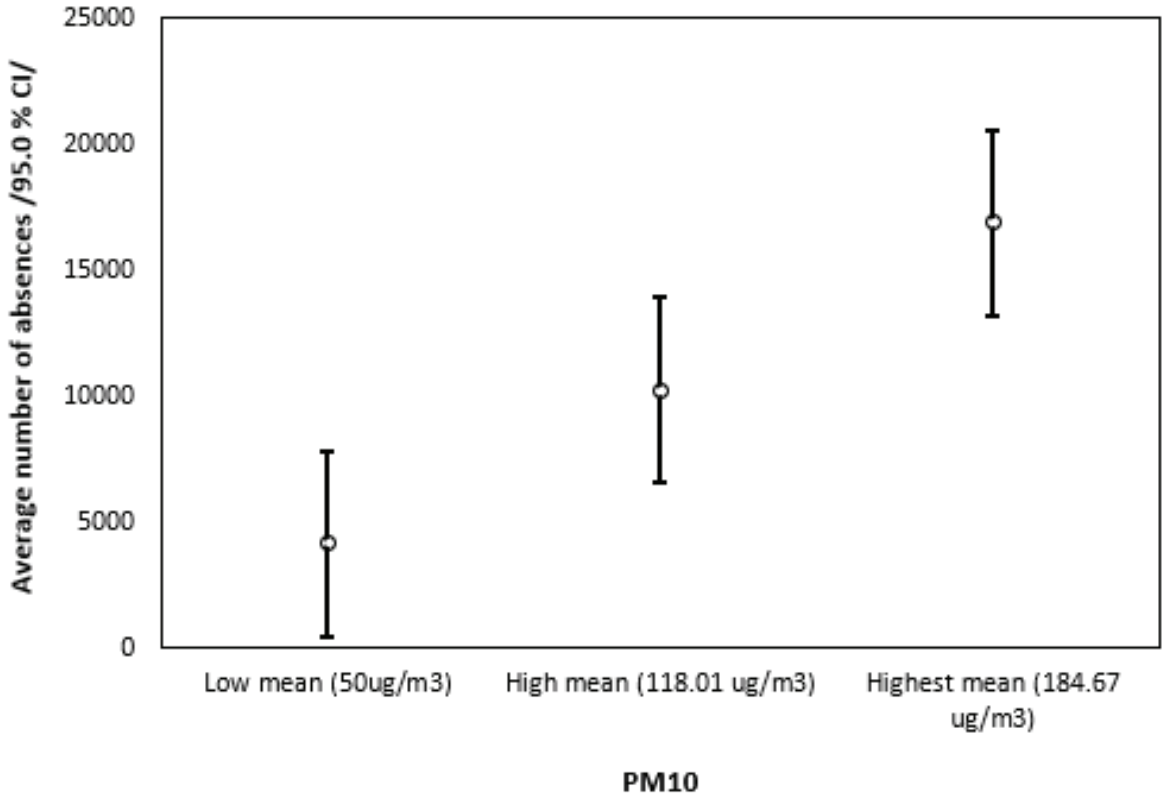


Figure 16 shows the average number of absences plotted against PM10 concentration. When the absences are stratified by low, high and highest PM concentrations, it becomes clear that the highest average PM10 concentration was in the upper absence range. The total days of absence was 52,914 over a period of five years, from 2015 through 2019. In this analysis, we excluded 2020 air pollutants data due to the study data-collection period and raw coal ban.

Qualitative results from HR managers showed that almost all companies surveyed have a fingerprint scanner that is used to link the individual's employee payroll number to their clock-on and clock-off time to record attendance. This allows HR managers to monitor monthly lateness and absences. Each year, this data is used to create the company's work schedule, including the hiring of replacement workers. In general, absenteeism is infrequent because it is directly related to a worker's salary. For this reason, employees generally do not take leave unless they are very ill. Absence due to illness was registered but the specific cause of illness was not registered in detail by any company.

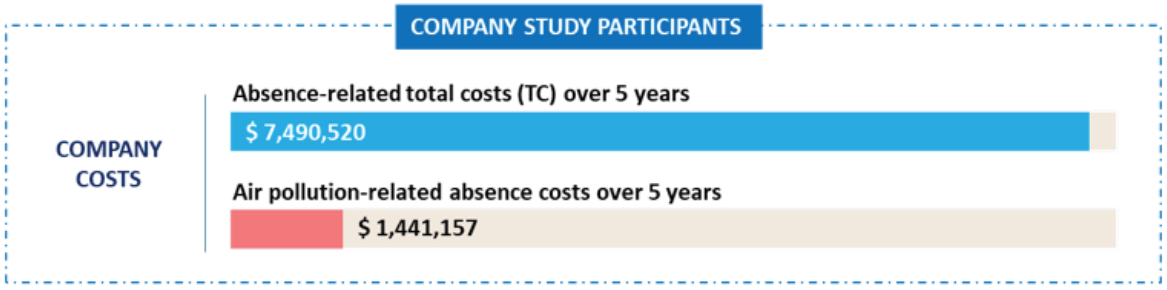
Table 3. Relationship between absence and air pollution

Criteria	PM10	SO2	Temperature	Humidity
β_{GML}	0.152**	0.299*	- 0.215**	-0.122
(p)	(0.001)	(0.012)	(0.009)	(0.059)

Significances: 0.001**, 0.01*, β_{GLM}: Beta coefficient of GLMs.

Table 3 shows that there was a significant relationship between air pollutants such as PM10 and SO_2 and absenteeism status compared to temperature and humidity. Each unit increase of PM10 (1μ/m^3) was associated with an absentee rate that was 0.152 times higher ($p<0.001$), while a one unit increase of SO2 (μ/m^3) in the air was associated with 0.299 times more absence ($p=0.012$). These associations were thus significant. Colder temperatures and lower humidity were also significantly linked to increased absences.

Figure 17. Company costs due to absenteeism associated with air pollution



Note: The MNT – United States dollar exchange rate on 13 February 2020 was MNT 2,755/$1).

In the figure 17, the cost of absences to employers shows there was nearly $7.5 million lost due to total absenteeism over the last five years among the private companies participating in this study. This loss represents a $1.4 million annual hidden cost to the Mongolian economy due to air pollution over the last five years.

4.6. DIRECT AND INDIRECT COST TO THE COMPANY DUE TO ABSENTEEISM

Company direct cost estimation: An economic estimation was conducted to monetize the absenteeism hidden costs attributable to air pollution. Initially, the cases of absenteeism attributable to air pollution were estimated. Air pollutants of PM10 were used for this analysis. Data from a total of eight companies was looked at, including a total of 2,764 employees, between 2015-2019. Almost all of the companies used fingerprint scanners, which link each employee to a payroll number.

Table 5. Direct cost estimation due to absenteeism related to pm10

Attributable cases	Equivalent daily wage	Medical expenses	Air pollution-related absence costs over 5 years	Absence-related total costs over 5 years
10,731	12.70 USD	121.60 USD	1,441,157 USD	7,490,520 USD

Mongolian Tugrik exchange rate against the U.S. Dollar on February 13, 2020, was 2,755 MNT/1USD; this was used to calculate the equivalent daily wage lost from the employer's side, plus medical expenses for the employer and employer insurance premiums for the employee.

Table 5 shows that nearly $7.5 million was lost due to air pollution-related absenteeism over the last five years among the private companies participating in this study. This loss represents a $1.4 million annual indirect loss to the Mongolian economy due to air pollution.

4.7. QUALITATIVE RESULTS FROM INDIVIDUAL INTERVIEWS TO ASSESS COMPANY DIRECT AND INDIRECT COST

Company costs related to worker absenteeism depend on the duration of and reasons for absence. Some companies set a limit on absences related to illness, such as a maximum of six paid absences per year being allowed by one company; another allowed less, only three to five paid absences. In the case of a child's illness, the medical documentation for a child requiring care is not effective for an employee to seek a paid absence. Companies also offer a paid absence to employees in the case of the death of a family member. In another special case, at a hospital, when a doctor is absent, the company still needs to pay for nurses and other staff, and postpone patient appointments. Overtime payment was calculated for employees, and this cost increases in winter.

Costs related to compensation for a deficit in the workforce: Companies have their own policies for maintaining their workforce. Some have contracts with other companies that can provide a substitute, while others find substitutes internally. Other companies face greater difficulties, expending time searching for substitutes and thus increasing the indirect cost of absenteeism. For the few companies that have contracts with other companies to supplement their workforce of on-call contract drivers, payment is directly transferred to the company that provides drivers. Also, companies can hire casual or short-term contract employees, such as students and nurses during busy times, and replacement workers to fill in for an assistant or salesperson. Casual workers have a salary of around 30,000 MNT per day. Additionally, companies can prepare at least two workers to do a rotation within a company; this way, if somebody is absent, there is another worker who can do the job. Some companies did not attach a significant cost to a worker's illness-related absence.

Costs related to finding a substitute: For an absence of less than one month, a company may arrange for the work to be done internally by reassigning work to their other employees. For an absence of more than one month, however, the company usually starts to look for a substitute from outside the company. Finding substitution from outside the company can be difficult, particularly if a specially licensed worker is required. Additional payroll is calculated and paid to the person who compensates for the absence with a 1.5 per cent salary increase. In one company, full compensation for the job comes with an additional payment of 40 per cent of the salary, and if the compensation is half the original salary, an additional 30 per cent is paid. One company, a hotel, does not pay extra to substitute workers. In the case of janitorial staff, the replacement worker is paid by transferring the salary of the absent worker to their substitute. Short-term substitute training costs were not relevant for some companies but they can be significant for long-term substitutes or new employee training. Some companies have a three-month training or trial period that pays 80 per cent of the full salary. Also, for special training, companies offer paid leave to the substitute.

Production loss: Company production loss as a consequence of an absent worker is measured through different methods. However, not all companies measure production loss due to worker absenteeism. For instance, five financial personnel out of 11 said that they measure it depending on operational functions, client complaints, penalties for the delayed delivery of products, postponing a scheduled appointment or a project delay. It is sometimes calculated by an internal company scoring system and sometimes by salary.

Company leaders noted that a worker's productivity declines after eight hours of work and overloading a worker also affects productivity. Some companies do not calculate absence-related impacts on productivity. In contrast, for other companies, the absence of one worker does not affect company costs when the company has enough substitutes, which allows production to continue without interruption. Some companies' HR departments do not measure a substitute's performance because the substitute is monitored by their direct supervisor.

During an individual interview, one HR representative said, 'The substitute does not have a real will to work.' No company surveyed had put in place a plan to reduce costs related to absenteeism. Only one company was considering the results of this study to develop a policy and future plan.

4.8. COST TO INDIVIDUALS ASSOCIATED WITH AIR POLLUTION

Direct and indirect costs associated with individual absenteeism have been calculated separately. Direct health-care cost estimates costs relate to diagnosis, medicine and hospitalization. Transportation was assessed as a cost unrelated to health care.

Figure 18. Indivdual direct and indirect costs associated with air pollution

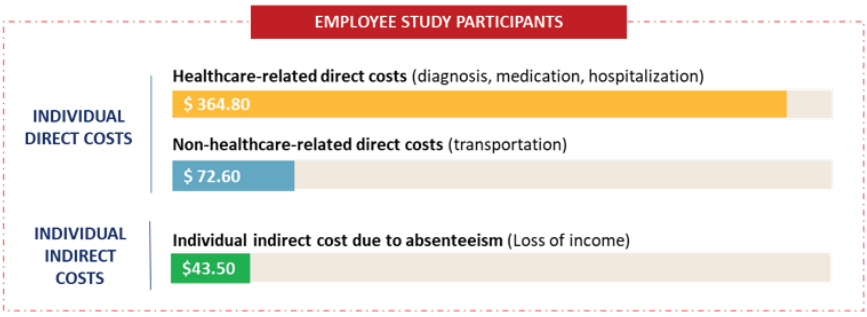


Figure 18 shows that the major drivers of direct cost to employees were health-care expenses – including doctor visits, medication and hospitalization – and transportation, in addition to loss of earnings. Average health-care-related direct costs are estimated at $245.00, direct costs unrelated to health care account for $72.60, and loss of earnings per three-day absence was $43.50 during winter 2019.

Diagnosis related costs:

Table 5. Cost of diagnosis and doctor visits

	Frequency	Median cost per time	Total cost
Cost of diagnosis and doctor visits	3 times	65000 ₮	195 000 ₮

Table 5 shows that in winter 2019, the median number of doctor visits was three. The average cost related to diagnosis and doctor visits was 195,000 MNT.

Qualitative results also added, however, that medical attention must start from the first level of health-care provision, a doctor at a family clinic. Most participants with children said that they have their private paediatrician consult, for a first-time consulting fee ranging from 20,000 to 55,000 MNT, depending on the cost of visits at numerous private hospitals and clinics in Ulaanbaatar. Many reported having had bad experiences with diagnosis and said that family clinic doctors are usually recently graduated young women who have poor skills and are untrustworthy, so the quality of service is bad. Some also said the treatments they had been prescribed were not effective, so they had to consult with a doctor at a private hospital or clinic.

Some respondents said that everything depends on how the family clinic doctor first manages the situation. Participants also said that doctors are often unsure about the cause of the illness and transfer them from one doctor to another, which is costly and time-consuming. Another reason for seeking consultation from a private hospital is the long waiting list for service at state hospitals. Some private hospitals offer a free second consultation within 14 days of an initial visit, while others charge 20,000 MNT. Moreover, private hospitals offer consultations on weekends. One employee said their family's monthly private medical consultancy costs were 80,000 MNT.

Costs for standard laboratory tests start at 50,000 MNT with a maximum of 200,000 MNT reported. For radiology tests, the cost runs from 15,000 to 300,000 MNT. Health-care providers who work for state-run organizations request X-rays be taken at private hospitals and clinics

Medicine related costs:

Table 6. Costs of buying medicine

	Frequency	Median cost per time	Total cost
Costs of buying medicine	4 times	70000 ₮	280000 ₮

Table 6 demonstrates that the frequency of medication purchases was four times, with an average cost of 280,000 MNT.

Qualitative results also added that when the employee or their child gets sick, they try to address treatment as soon as possible. Some take antibiotics in an oral or injection form, without medical consultation, supplemented by taking vitamins, drinking sea buckthorn or lingonberry juice, and drinking hot fermented milk at home. High-dose antibiotics are often misused in an attempt to recover quickly. On the third day of treatment, if the person being treated does not get better, they will visit a doctor or change the medication being used.

The survey participants spend money not only on medicine but also on supplements to support the immune system, such as vitamins C and D, probiotics and flu vaccination. For vitamin C, employees spend 30,000 to 300,000 MNT per month, depending on the number of people in the household, while vitamin D can cost 60,000 MNT monthly for two children. The main medicines purchased for respiratory illness are antibiotics, painkillers, anti-allergy medication, fever reducers, and nebulizers or inhalers. Often, three-day and seven-day treatments are ineffective and the employee looks for another treatment, so new medicine is purchased and previously purchased medication is wasted.

Some participants said that they tend to buy the most expensive medication, believing that it will be the most effective drug for a quick recovery because cheaper medicine is ineffective. Furthermore, recovery from illness sometimes takes more than one month and, for some, if there is not a full recovery, they will fall ill again. For parents with children in state-owned kindergartens, they said recovery also depends on the density of the student population the kindergarten, the skills of a family clinic doctor, and access to medical care. Study participants said that they use multiple antibiotics in higher doses for a faster recovery but this may impair a child's immunity and could also be toxic.

Children of different ages are prescribed different doses and forms of the same medicine, such as capsules, nebulizers and syrups, each with different prices. Medicine for children under the age of three is the most expensive. If the treatment of children requires an injection administered at home, a payment of 5,000 MNT for each daytime nurse visit is added to the cost of treatment. When treatment based on Western medicine is not effective within two months, employees may look to phytotherapy, traditional medicine or immune support-based treatment.

Most participants had not used discounted medicine available through state health insurance because of a lack of information about it or a lack of the medicine's availability at pharmacies. Self-medication was frequent and many employees said that although they know that pharmacists are not fully qualified to prescribe a medication, when they are ill, they tend to go directly to a pharmacy and consult with a pharmacist for the purchase of recommended medication.

Some people receive oxygen therapy that costs 50,000 MNT per treatment.

Long lines at state hospitals drive patients to visit private hospitals and clinics. Moreover, study participants say that family clinic doctors always prescribe only vitamin C and amoxicillin to treat respiratory illness.

Hospital related costs:

Table 7. Costs of hospitalization

	Frequency	Median cost per time	Total cost
Costs of hospitalization	1 times	200000 ₮	200000 ₮

Table 7 shows that the average hospitalization-related cost per illness-related absence is 200,000 MNT.

Qualitative results revealed that state hospital access is difficult and comes with the risk of misdiagnosis and complications. For complicated cases, hospitalization is suggested. Due to the low availability of beds at state-owned hospitals, most study participants go to private hospitals, but some people still hospitalize their children at state hospitals. Paid rooms are available at state hospitals, with the cost varying from 25,000 to 35,000 MNT per day.

The daily cost for a bed at a private hospital ranges from 100,000 MNT to 150,000 MNT. Treatment for pneumonia at a private hospital costs an average of 900,000 MNT, while the cost at a state hospital is 100,000 MNT. When someone is hospitalized, the cost of travelling to and from the hospital arises, whether it is for taxi fares or fuel. Study participants also noted that consulting a physician does not always lead to treatment covered by insurance and that sometimes the medicine that physicians prescribe is not on the list of reduced price medicine published by the Ministry of Health.

For people aged 18–35, there are no government insurance benefits. Most of the participants interviewed had not benefited from insurance because there is no insurance coverage for treating a cold. Only a few people purchased medicine at a reduced cost, typically for parents that require medication for hypertension, diabetes or oncological treatment. Respondents said that insurance coverage for medication is good but the quantity available is insufficient, so once reduced price medicine is available at pharmacies there are long lines to purchase what little is available.

Hospitalization in a state-owned hospital is covered by state health insurance. However, access to state hospital services is complicated by long lines, the quality of service and a lack of resources..

Total individual healthcare-related direct cost:

Table 8. Total individual healthcare-related direct costs

	Frequency	Median cost per time	Total cost
Total individual healthcare-related direct costs	3 times	291600 ₮	875000 ₮

Table 8 illustrates that individual employee direct costs related to absence totalled 875,000 MNT ($317.60) for an average of three instances of three-day illness-related absences during the winter in Ulaanbaatar.

Total individual non healthcare-related direct cost:

Table 9. Transportation costs

	Frequency	Median cost per time	Total cost
Transportation costs	4 times	50000 ₮	200000 ₮

Table 10. Individual healthcare and non-healthcare related direct costs by absentee status

INDIVIDUAL HEALTHCARE DIRECT COST	Have you and your family ever been absent during high air pollution periods?						P[b]
	No absence			Absence			
	Median	Interquartile		Median	Interquartile		
		25th	75th		25th	75th	
Diagnosis and doctor visit costs (frequency)	2	2	3	3	2	4	0.002**
Diagnosis and doctor visit costs (average costs, MNT)	70,000	40,000	150,000	60,000	35,000	125,000	0.229
Costs related to purchasing medicine (frequency)	3	2	5	4	3	7	0.001**
Costs related to purchasing medicine (average costs, MNT)	60,000	40,000	150,000	85,000	40,000	200,000	0.008*
Hospitalization-related costs (frequency)	1	1	2	1	1	2	0.821
Hospitalization-related costs (average costs, MNT)	165,000	100,000	360,000	200,000	100,000	400,000	0.416
INDIVIDUAL NON HEALTHCARE DIRECT COST							
Transportation -related cost (frequency)	3	2	7	4	2	10	0.038*
Transportation -related cost (average costs, MNT)	40000	20000	100000	50000	20000	100000	0.078

Notes: [b] *– Mann-Whitney U test, * - p value is less than 0.05, ** - p value is less than < 0.005*

Table 10 shows that health-care costs are driven by the number of visits to the doctor or pharmacy, and transportation costs by the number of trips taken. There was a significant difference in individual health-care visits between the absence and non-absence groups (p<0.002). However, costs related to diagnosis and doctor visits were not different (p<0.229). The frequency of medication purchases and costs were significantly different among the absence and non-absence groups (p<0.001; p<0.008). Hospitalization-related visits and costs were not significantly different. Individual non-health-care direct costs were significantly different among the groups with and without absence (p<0.038).

Table 11. Individual indirect cost using human capital approach by absentee status

		95.0%, CI		Interquartile	
Variables	**Median**	**Lower**	**Upper**	**25th**	**75th**
Absent days	3	3	5	2	7
Lost salary due to one day missed (MNT)	40,000	30,000	40,000	25,000	50,000
Individual indirect cost due to absenteeism*	120,000	80,000	210,000	60,000	245,000

*Note: A company employee's hourly wage was 5,000 MNT and they missed work for three days (8 hours per day), so the calculation was: 5,000 MNT x (8 hrs*3 days) = 120,000 MNT (total lost wages).*

Table 11 shows the effect of absenteeism on human capital cost. This calculation reveals the substantial increases in human capital costs that are driven by increases in days of absence. The median indirect cost due to three missed days of work was 120,000 MNT in this study (95 per cent CI 80,000–210,000). The cost of one missed day was 40,000 MNT.

5. CONCLUSIONS

This study was designed to test the hypothesis that winter air pollution is associated with significant hidden costs due to absenteeism from work among private sector companies in Ulaanbaatar, Mongolia, and that this may have a significant negative impact or opportunity cost for the national economy. The study revealed a $1.4 million annual hidden indirect opportunity cost to the Mongolian economy due to air pollution. Data from a total of eight companies between 2015 and 2019 were analysed, including a total of 2,764 employees. Almost all of the companies used fingerprint scanners that link each employee to a payroll number.

Questionnaire data was obtained for 1,330 employees working for private sector companies spanning six economic sectors who had, in total, 10,731 absences over five years. A total of 133 people were involved in focus groups (26 times) and 20 individual interviews were held. Absences occurred at a rate approximately three times higher during the coldest and, hence, most air polluted months. Over half of these absences were attributed to doctor visits for employees themselves and their children, and 45 per cent were attributed to caring for sick children. Individual direct health-care costs related to absence totalled 875,000 MNT for an average of three instances of three-day illness-related absences during winter in Ulaanbaatar. This sum included costs related to diagnostics and doctor visits per instance of 65,000 MNT (three visits), medication costs per instance of 70,000 MNT (four instances), and hospitalization costs per instance of 200,000 MNT (one instance). Direct cost unrelated to health care was 50,000 MNT (four instances) during the winter air pollution period in 2019. The average cost of three absences thus totalled 200,000 MNT. Additionally, the median value of lost wages for three days of absence was 120,000 MNT.

The study team concluded that the identified combined direct and indirect costs of absenteeism related to winter air pollution for employees and employers in the private sector in Ulaanbaatar, Mongolia, are significant. An indirect cost estimation approach is not adequately set up for the companies selected for the study and so an accurate indirect cost linked to the production of a specific good or service due to air pollution cannot be calculated. It was suggested to the companies that indirect expenses can be calculated as fixed costs or variable costs. In this study, identifying indirect cost was complicated due to unit product calculations provided by the companies selected for the study. The major cost drivers for employers are the number and human capital costs of employee absences.

Conclusion 1. Female employees were 1.65 times more likely to be absent than their male counterparts, and an employee with a child had odds 1.87 times higher of being absent than employees without children. It was also reported that current arrangements for employees concerning absences related to illness are not flexible enough. Almost all of the workers said they subtract their leave days from their vacation or they try to schedule their vacation leave in winter, when child illness is more frequent. Unpaid leave is mostly associated with a specific reason. If there is a lack of replacement workers at their company, they take care of their children during the day and work at night, or they work overtime to finish their assigned tasks. Some employees do not have any knowledge of their company's paid leave possibilities. Additionally, from the employee perspective, a sick employee might not take leave unless they are severely ill. From employers' perspectives, companies did not have any plans for reducing absenteeism.

Conclusion 2. Absenteeism due to respiratory disease accounts for 42 per cent of self-reported long-term complications of winter air pollution, while cerebrovascular complications account for 22 per cent of self-reporting in this category. With regard to air pollution-related illness, all participants said that air pollution somehow affects their health, especially those suffering from respiratory system

complications. In the study, the average number of absences was plotted against PM10 concentration: when the absences are stratified by low, high and highest PM concentrations, it becomes clear that the highest average PM10 concentration was in the upper absence range, while the lowest PM10 concentration was associated with the lowest range of absence. There was a significant relationship between air pollutants such as PM10 and SO_2 and absenteeism status compared to temperature and humidity. Each unit increase of PM10 (1μ/m^3) was associated with an absentee rate that was 0.152 times higher ($p<0.001$), while a one unit increase of SO_2 (μ/m^3) in the air was associated with 0.299 times more absence ($p=0.012$). Thus, these associations were significant. Colder temperatures and lower humidity were also significantly linked to increased absences.

Conclusion 3. There was nearly $7.5 million lost due to absenteeism over the last five years among the private companies participating in this study. This loss represents a $1.4 million annual indirect loss to the Mongolian economy due to air pollution. Companies have their own policies for maintaining their workforce. Some have contracts with other companies that can provide a substitute, while others find substitutes internally. Other companies face greater difficulties, expending time in their search for substitutes and increasing the indirect cost of absenteeism. Some companies did not attach a significant cost to a worker's illness-related absence.

For an absence of less than one month, a company may arrange for the work to be done internally by reassigning work to their other employees. However, for an absence of more than one month, the company usually starts to look for a substitute from outside the company. Finding substitution from outside the company can be difficult, particularly if specially licensed staff are required. Additional payroll is calculated and paid to the person who compensates for the absence with a 1.5 per cent salary increase. Short-term substitute training costs were not relevant for some companies but they can be significant for long-term substitutes or new employee training. Some companies have a three-month training or trial period that pays 80 per cent of the full salary. Also, for special training, companies offer paid leave to the substitute. No companies surveyed had put in place a plan to reduce costs related to absenteeism and they were considering the results of this study to develop a policy and future plan.

Conclusion 4. Individual employee direct costs related to absence totalled 875,000 MNT for an average of three instances of three-day illness-related absences during winter in Ulaanbaatar. This sum included diagnostic and doctor visit-related costs per absence of 65,000 MNT (three times), medication costs per absence of 70,000 MNT (four times), and hospitalization costs per absence of 200,000 MNT. Direct costs unrelated to health care (transportation) totalled 200,000 MNT for the whole winter. Individual indirect cost equated to the median value of lost wages for a three-day absence being 120,000 MNT. The study concludes that winter air pollution has a major impact on absenteeism rates among private sector employees and, therefore, this must be a significant driver of opportunity costs, negatively affecting not only corporate bottom lines but also employees.

6. RECOMMENDATIONS

To Government

- The elimination of coal burning of any kind in domestic stoves for residential heating is the only definitive solution to minimize winter air pollution, improve public health and address the hidden direct and indirect cost challenges identified. It is estimated that the combined direct and indirect opportunity cost of continuing to burn even coal briquettes in winter would clearly inhibit the annual growth of the broader economy by a similarly significant amount. The rationale for national investment in sustainable energy production and distribution systems – including scalable solar electricity generation and storage, wind power, the insulation of dwellings and rehousing families in more modern structures – on a scale that would result in net savings appears to be a highly compelling economic argument. Clearly, this scale of opportunity cost is unsustainable and is preventing Mongolia from growing its economy.
- Policymakers who examine the policy options affecting air quality management at the individual and company level, as well as societal levels, need to take into account the impacts of pollution on public health, as well as the benefits versus the costs of measures to reduce pollution.

To Employer

- The major identified drivers of the direct costs of pollution to employees are health-care costs, including doctor visits, medication, hospitalization, transportation and loss of earnings. Although employees were equally divided by gender, the cost of illness-related absence falls disproportionately on female workers with young children. Therefore, gender-responsive action is justified and would be expected to pay significant dividends for employers.
- Mobilization at all levels for social transformation on gender equality issues, and for the implementation of gender and female empowerment policies specific to both the state and private sectors, appears to be warranted.
- The commonest stated reason for absences was symptoms of respiratory illness in the employee or a sick child. Thus, employers can support families with children by incorporating the following types of policies into their workplace, which would contribute to lower absenteeism and higher productivity.
- Parental leave is an important benefit that provides time off for mothers or fathers to care for very young children. These policies may include paid and unpaid time. Additionally, companies should explore more flexible work arrangements, such as flexible time, job sharing, a compressed workweek, part-time employment and voluntary reduced work time. Lastly, the most practical management tool might be flex-place-telecommuting, which allows employees to work from home or at a satellite worksite, where they are connected to their offices by computer and/or telephone.
- Illness-related absences were significantly associated with increases in air pollution, cold temperatures and reduced humidity. Companies should be committed to supporting the well-being of their employees and providing appropriate support in relation to their health and attendance at work during winter's periods of air pollution. Employees who are unable to attend work due to poor health should be required to notify their manager of their absence. Managers should be supportive of employees when managing illness-related absence. They

should also ensure that such absences are addressed in a caring and sensitive manner, and with a fair and consistent approach.

With many employers trimming their health insurance benefits in the face of higher prices, employees are going to be left filling the gap. Employers also consider that time is money and an employee spending the entire morning at the doctor's office means less time at work and therefore the employer is paying for time when no work is being performed.

To Employee

- Masks outside and air purifiers at home should be used during periods of high air pollution in Ulaanbaatar.
- Medicine can get expensive, especially with frequent buying during illnesses. Out-of-pocket medications purchased should be legitimate and effective, and recommendations for medications that will not positively influence the course of treatment should be avoided. Therefore, individuals should avoid unnecessary and non-prescribed medication purchases.

APPENDICES

ANNEX 1: ESTIMATED NUMBER OF CASES ATTRIBUTED TO PM10 POLLUTION IN ULAANBAATAR

Health endpoints	ESTIMATED NUMBER OF CASES ATTRIBUTED TO PM10 POLLUTION IN ULAANBAATAR																	
	B	CI		B	CI		B	CI		B	CI		B	CI		B	CI	
		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper		Lower	Upper
	2014			2015			2016			2017			2018			2019		
Total mortality (>30 ages)	3097.9	2126.4	3869.3	2109.4	1382.4	2755.1	2190.9	1433.1	2866.9	2421.2	1591.9	3152.2	2590.1	1709.8	3358.8	2443.8	1603.8	3187.4
Chronic bronchititis (all ages)	9915.5	3397.0	13614.1	7063.4	2205.9	10459.7	7140.9	2221.7	10608.8	7649.6	2404.4	11265.8	8106.6	2568.4	11858.8	7698.0	2410.8	11372.6
Asthma attacks in children (<15 ages)	12597.4	8771.9	15635.1	9894.7	6580.0	12838.6	9870.2	6551.2	12830.8	10866.5	7249.6	14054.6	12068.9	8083.9	15548.6	11562.7	7699.9	14982.3
Asthma attacks in adults (≥15 ages)	26858.6	15227.2	35226.2	18141.5	9725.4	25024.5	18425.5	9855.1	25470.3	19559.6	10526.5	26883.7	20351.5	11005.5	27848.4	19209.2	10315.0	26456.3
Acute bronchititis (all ages)	30205.5	13006.0	39372.5	22063.7	8598.9	31137.5	22329.5	8666.7	31622.2	23852.0	9361.1	33464.3	25221.5	9984.4	35132.3	24027.7	9392.5	33823.6
Respiratory HA	1576.9	859.3	2309.8	986.6	537.6	1445.3	992.2	540.6	1453.5	1078.1	587.4	1579.3	1155.2	629.5	1692.3	1079.4	588.1	1581.2
Cerebrovascular HA	1211.5	87.1	2173.1	757.9	54.5	1359.7	762.2	54.8	1367.4	828.2	59.5	1485.8	887.5	63.8	1592.1	829.2	59.6	1487.6
Cardiovascular HA	973.7	487.0	1460.3	594.6	304.6	913.6	612.6	306.3	918.8	665.7	332.9	998.4	713.3	356.7	1069.8	666.4	333.3	999.6
Coughing in children	352659.0	344670.0	352659.0	399379.4	359837.5	399380.0	406571.1	363904.5	406572.0	424257.6	386222.8	424258.0	453164.8	417255.6	453165.0	459999.4	416353.6	460000.0
Coughing in adults	1010315.0	1001933.0	1010315.0	996908.0	943455.3	996908.0	1033874.9	974203.2	1033875.0	1038715.0	989595.8	1038715.0	1038210.0	996212.8	1038210.0	1040000.0	987160.7	1040000.0
Rsymptom days in children	352659.0	352658.9	352659.0	399380.0	399341.6	399380.0	406572.0	406522.7	406572.0	424258.0	424230.6	424258.0	453165.0	453147.1	453165.0	460000.0	459962.7	460000.0
Rsymptom days in adults	1010315.0	924863.5	1010315.0	996905.9	776279.0	996908.0	1033872.0	796211.0	1033875.0	1038713.8	823248.2	1038715.0	1038209.4	839504.2	1038210.0	1039998.3	816136.3	1040000.0
Lower RS in child	352659.0	352658.9	352659.0	399380.0	399341.6	399380.0	406572.0	406522.7	406572.0	424258.0	424230.6	424258.0	453165.0	453147.1	453165.0	460000.0	459962.7	460000.0
Lower RS in adult	1010315.0	1010315.0	1010315.0	996905.9	996907.7	996908.0	1033872.0	1033874.6	1033875.0	1038713.8	1038714.8	1038715.0	1038209.4	1038209.9	1038210.0	1039998.3	1039999.8	1040000.0

ANNEX 2: QUESTIONNAIRE

№	Opening Questions	Answer Section	Code
01	Were you born in Ulaanbaatar?	Yes No	K1
02	How many years have you been living in Ulaanbaatar? (Please do not count years living in other places.)		K2
03	Do you think that air pollution causes diseases?	Yes No	K3
04	In which season of the year do you get the sickest?	1. Winter 2. Spring 3. Autumn 4. Summer	K4
Common symptoms related to air pollution			
1	Which symptoms have you experienced during high air pollution periods? (Multiple answers)	1. Cough 2. Chest pain 3. Sore throat 4. Scratchy throat 5. Itchy nose 6. Blocked nose 7. Runny nose 8. Shortness of breath 9. Difficulty breathing 10. Blurry vision 11. Sore eyes 12. Red eyes 13. Itchy eyes 14. Runny eyes 15. Dizziness 16. Headache 17. Heavy head 18. Fatigue 19. Nausea	Q1
2	Which diseases have you and your family experienced during high air pollution periods? (Multiple answers)	1. Cough 2. Allergy 3. Bronchitis 4. Pneumonia 5. Allergy 6. Heart attack 7. Hypertension 8. Diabetes 9. Chest pain 10. Congenital abnormality 11. Miscarriage 12. Premature infant death 13. Low birth weight 14. Spontaneous abortion 15. Stroke 16. Cerebrovascular disease 17. Migraine	Q2

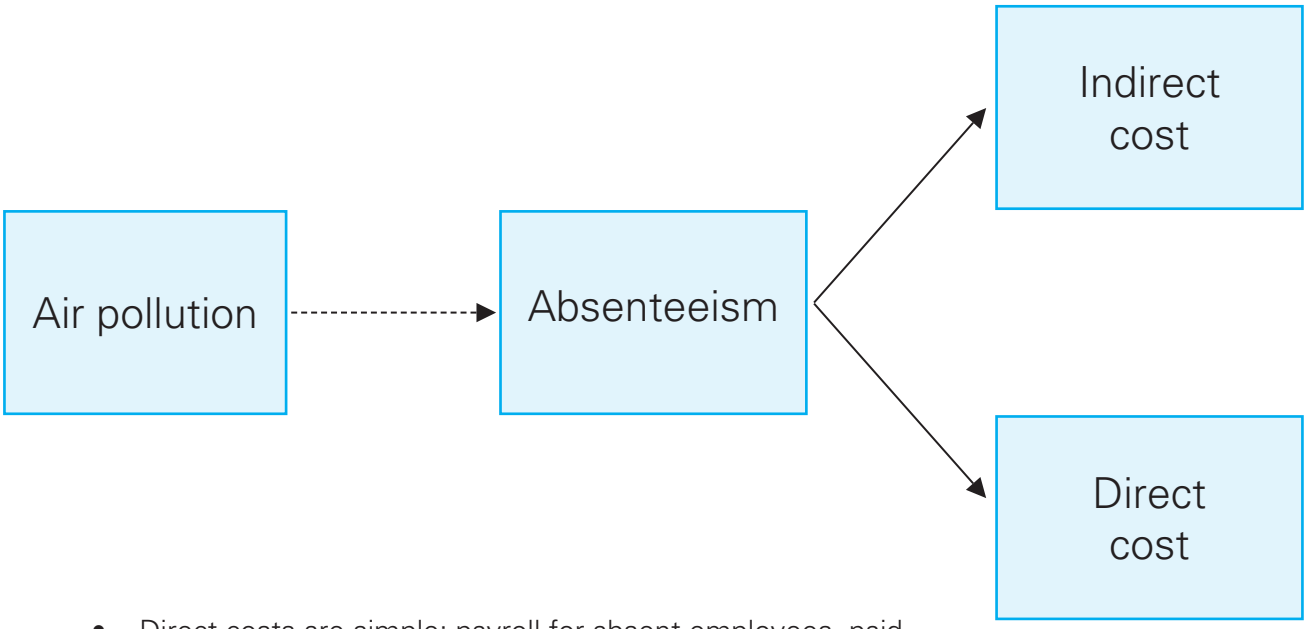
3	Have you and your family ever been absent during high air pollution periods?	1. Sick child 2. Sick parent 3. I was sick 4. Not absent even when sick 5. None	Q3
4	If yes, what was the disease?	_____	Q4
5	How long have you been sick due to air pollution-related diseases on high pollution days?	1. In hours _____ 2. In days _____ 3. Still come to work even when sick 4. I have never been sick	Q5
6	How often are you are absent from work on high pollution winter days?	1. None 2. 1 time 3. 2 times 4. 3 times 5. 4 times or more	Q6
7	How do you request your temporary leave when you are sick during high air pollution levels? (Multiple answers)	1. Sick leave (paid) 2. Sick leave (unpaid) 3. Borrowed sick time 4. Vacation leave	Q7
8	How often are you responsible for the duties of co-workers when they are sick during high air pollution periods?	1. Mostly 2. Sometimes 3. Rarely	Q8
9	If yes, have you ever felt stressed due to unplanned roles at your job?	1. Mostly 2. Sometimes 3. Rarely 4. Never	Q9
10	How do you feel when you request sudden leave from your job due to illness during high air pollution in winter?	1. Worried 2. Scared 3. Relaxed 4. Other	Q10
11	Does your company have flexible working arrangements, such as working from home or duty sharing?	1. Most of the time 2. Sometimes 3. Rarely 4. Never	Q11
12	Who is the sickest in your household during winter's high pollution periods?	1. Myself 2. Pregnant wife 3. Spouse 4. Kids 5. Parents 6. Grandparents	Q12

For that person, what is the frequency and average expense for each item below?		Answer		
		Frequency (times)	Average costs (MNT)	
13	Diagnosis and doctor visits-	_____	_____	Q13 A
	Purchasing medicine	_____	_____	Q13 B
	Hospitalization	_____	_____	Q13 C
	Transportation and food	_____	_____	Q13 D
Demographic information				
14	Age	_____		Q14
15	Gender	Male Female		Q15
16	Education	University High school Elementary school		Q16
16_1	The years of education	_____ (how many years)		Q16_1
17	Current position	_____		Q17
17_1	What is your monthly salary range?	1. <399,000 2. 400,000- 699,000 MNT 3. 700,000- 899,000 MNT 4. 1,000,000 – 1,299,000 MNT 5. 1,300,000 – 1,599,000 MNT 6. 1,600,000- 1,899,000 MNT 7. 1,900,000 - 2,199,000 MNT 8. >2,200,000 MNT		Q17A
18	Years and months working for your current employer	_____years / _____ months		Q18
19	Home address (Home address will be used to assess individual exposure level)	_____ District _____ khoroolol _____ khoroo _____ Apartment/ House _____ Street _____ Door Number		Q18
20	Do you have any children?	1. Yes 2. No		Q20
21	If yes, how many children do you have?	_____		Q21
22	How many hours do you work per day?	_____		Q22
23	Distance from home to office	_____ kilometers Number of bus stops: _____		Q23
24	How often do you wear an air pollution mask?	1. Mostly 2. Sometimes 3. I wear when I remember 4. Neve		Q24

25	Do you use an air purifier at home?	1. Mostly 2. Sometimes 3. Rarely 4. Never	Q25
26	Please choose that what actions your company takes to protect employees from air pollution's harmful effects?	1. Has never taken action 2. Distributed air pollution masks 3. Distributed air purifiers for each room 4. Distributed hot aarts, chatsargana 5. Don't know 6. Other _____	Q26
27	Which type of residence do you live in?	1. Ger 2. Ger district house 3. Apartment 4. Other _____	Q27
27_1	What kind of heating and fuel sources do you burn? (Only applicable for those living in a ger or ger district house)	1. Improved fuel 2. Raw coal 3. Tree 4. Argal 5. Other	
28	What kind of transportation do you use when to go to work?	1. By walk 2. By bicycle 3. By car 4. By bus 5. Others	Q28
29	Do you smoke?	1. Yes 2. No	Q29
29_1	If yes, how many years and how many cigarettes per day?	By year _____ Number of cigarettes _____	Q29_1
29_2	If no, are you a passive smoker at your workplace or at home?	1. Usually 2. Sometimes 3. Never	Q29_2
30	Your body weight and height? (weight and height will be used to calculate BMI)	1. Height _____ cm 2. Weight _____ kg	Q30

ANNEX 3: ECONOMIC MODEL

Theoretical Framework A



- Direct costs are simple: payroll for absent employees, paid overtime, insurance premiums and other administrative costs related to absences.
- Indirect costs are more difficult to quantify, but they are no less important. Morneau Shepell estimates thar they can represent 50 to 500% of direct costs

ANNEX 4: DATA COLLECTION SUMMARY

	Company name	Questionnaire	Focus groups	Individual interview	Secondary data
1	Company 1	104	3 times (15 people)	2	64 employees (2017.8-2019.8)
2	Company 2	257	3 times (20 people)	2	551 employees (2015.5-2018.5)
3	Company 3	333	3 times (17people)	0	1645 employees (2017.4-2019.8)
4	Company 4	145	3 times (11 people)	2	181 employees (2019.1-2019.9)
5	Company 5	N/A	1 time (5 people)	2	101 employees (2019.1-2019.9)
6	Company 6	61	3 times (11 people)	2	158 employees (2019.1-2019.9)
7	Company 7	N/A	1 time (3 people)	1	47 employees (2019.6-2019.9)
8	Company 8	9	1 time (6 people)	2	17 employees (2018.2-2019.8)
9	Company 9	N/A	2 times (11 people)	1	N/A
10	Company 10	182	3 times (17 people)	2	N/A
11	Company 11	189	N/A	N/A	N/A
12	Company 12	50	N/A	2	N/A
13	Company 13	NA	3 times (17 people)	2	N/A
TOTAL		1,330	26 times (133 people)	20 times (20 people)	

ANNEX 5: SUMMARY OF THE FINDINGS AND METHODOLOGY

Cost	Cost calculation method	Findings Total cost	Method explanation
Company direct cost Source: Tayra, Flávio; Ribeiro, Helena Nardocci, Adelaide de Cássia. Economic cost of air pollution in Cubatão - SP based on health expenses related to diseases of the respiratory and circulatory systems. Saude soc. [online]. 2012, vol.21, n.3 [cited 2020-03-03], pp.760-775.	1.Generalized linear regression model $Absent_{ijkt} = a + b_1P_{kt} + b_2X_{ijkt} + b_3Z_{jkt} + b_4V_{kt} + \varepsilon_{ijkt}$ 2.$CA_{(air\ pollution)} = (\exp^{(\beta PM10 \times \Delta PM10)} - 1) \times BRS$, where $CA_{(air\ pollution)}$ 3. TC=(CA)x(EW+ME) TC refers to total cost A N>1 million observations	Air pollution attributable cases: 10,731 Equivalent daily wage (EW): $12.7 (35,000 MNT) Medical expenses (ME): $ 121.6 (335,000 MNT) Air pollution-related absence costs over 1 year: $ 1,441,157 Absence related total costs (TC) over 5 years: $7,490,520	$Absent_{ijkt}$: absence of employee *i*, in company *j*, local area *k* and year *t*; P_{kt}: pollution level in area *k* and year *t* X_{ijkt}: time-varying individual characteristics (age, gender, education level, etc.) Z_{jkt}: time-varying company characteristics (number of employees, sector, etc.) V_{kt}: time-varying local area characteristics (for example, weather variables) ε_{ijkt}: error term
Company indirect cost Source: Singh, T., Chetty, N., & Karodia, A. M. (2016). An Investigation into the Impact of Absenteeism on the Organisational Performance of a Private Security Company in Durban, Kwazulu-Natal. Singaporean Journal of Business, Economics and Management Studies, 51(3415), 1-55. And more references as attached	Variables to measure indirect cost: Semi-structured, face-to-face interviews were conducted with key human resources personnel to determine indirect costs that are important to employers. Total number of individual interviews to assess indirect cost estimation=11	Company indirect cost estimation: 1. The cost of outsourcing to cover the labor shortage 2. Overtime for replacement of absent worker 3. Training expenses for temporary/ replacement workers 4. Loss of production and quality of product/service due to absenteeism 5. Reduced quality performance by under-trained replacement workers 6. Management cost related to dealing with absenteeism	Data requested: 1. Replacement worker salary data 2. Overtime salary data for replaced hours/days 3. Training expenses data for temporary / replacement workers 4. Sales data, such as revenue, profit and turnover, production loss data 5. Key performance (KPI) data for workers 6. HR data related to dealing with absenteeism
Individual direct cost Source: Bai, R., Lam, JCK, Li VOK. A review on health cost accounting of air pollution in China. Environment International 2018; 120: 279-294	Cost of illness approach was obtained through self-reported questionnaire for employees N=1330	Total healthcare and non-health related costs: 1,205,000 MNT ($434) Per Diagnosis (65,000 MNT) Per Medicine (70,000 MNT) Per Hospitalization (200,000 MNT) Per Non-healthcare related costs (50,000 MNT): Average number of times=3	Cost of illness approach is used to sum up the direct cost associated with disease to establish the value of the cost of morbidity
Individual indirect cost Source: Linertova, R., Garcia-Perez, L., Gorostiza, I. Cost-of-Illness in Rare Diseases.	Human capital approach	Average absent days: 3 Salary loss due to one day missed: 35,000 MNT Individual indirect cost due to absenteeism: 120,000 MNT ($43.3) Sum of direct and indirect costs of absences to employee and employer per capita per annum = >$443	HC approach estimates the hours of work lost by the person due to disease and then multiplied by the hourly wage

ANNEX 6: VARIABLES TO MEASURE DIRECT AND INDIRECT COSTS

	Main variables	Proxy variables from company dataset	Main variable in Mongolian	Proxy variables from company dataset in Mongolian
VARIABLES TO MEASURE DIRECT COST ШУУД ЗАРДЛЫГ ХЭМЖИХ ХУВЬСАГЧ				
1	Short-term disability coverage	Short-term disability allowance data	Хөдөлмөрийн чадвараа түр алдсаны тэтгэмж	Хөдөлмөрийн чадвараа түр алдсаны мөнгөн халамжийн мэдээлэл
2	Bonus payments	Bonus payment data for employees	Нэмэлт цалин	Ажиллагсдад олгосон нэмэгдэл цалингийн мэдээлэл
3	Contracted overtime	Contracted payment data for overtime	Илүү цагийн хөлс	Илүү цагийн хөлсний мэдээлэл
4	Travel allowance	Travel allowance data	Унааны мөнгө	Ажиллагсдын унааны мөнгөний олголтын мэдээлэл
5	Meal allowance	Meal allowance data	Хоолны мөнгө	Ажиллагсдын хоолны мөнгөний олголтын мэдээлэл
6	Private healthcare insurance	Individual (private) healthcare insurance data	Хувийн даатгал	Ажиллагсдын эрүүл мэндээ хувиараа даатгуулсан мэдээлэл
VARIABLES TO MEASURE INDIRECT COST ШУУД БУС ЗАРДЛЫГ ХЭМЖИХ ХУВЬСАГЧ				
1	The cost of outsourcing to cover the labor shortage	Replacement worker salary data	Ажиллах хүчний дутагдалтай байдлыг нөхөхтэй холбоотой зардал	Түр орлогч ажилтны цалингийн мэдээлэл
	Overtime for replacement of absent worker	Overtime salary data for replaced hours/ days	Байхгүй ажилтныг орлож илүү цагаар ажилласнаас үүдсэн зардал	Орлож илүү цагаар ажилласан цалингийн мэдээлэл
3	Training expenses for temporary/replacement workers	Training expense data for temporary/ replacement workers	Байхгүй ажилтныг орлогч ажилтныг сургах/ дадлагажуулахтай холбоотой зардал	Орлогч ажилтныг сургах/ дадлагажуулахтай холбоотой зардалын мэдээлэл
4	Loss of production and quality of product/ service because of worker absenteeism	Sales data, such as revenue, profit, and turnover Production loss data	Ажил таслалтаас үүдэн гарах бүтээгдэхүүн, үйлдвэрлэл, болон үйлчилгээнд учирсан хохирол	Борлуулалтын мэдээлэл: орлого, ашиг, болон эргэлт Үйлдвэрлэлд учирсан хохирол
5	Reduced quality performance by under-trained replacement workers	Key performance index (KPI) data on workers	Орлогч ажилтнаас үүдэн гүйцэтгэлийн чанар буурсан байдал	Ажилтнуудын ажил гүйцэтгэлийн мэдээлэл
6	Management cost related to dealing with absenteeism	HR data related to dealing with absenteeism	Чөлөөтэй ажилтны орлох ажилтныг олох, сургах гэх мэт үйл ажиллагаатай холбоотой удирдлагын зардал	Үүнтэй холбогдолтойгоор үүссэн хүний нөөцийн зардлын мэдээлэл
7	Lowered employee morale as remaining staff feel overworked	Survey data	Чөлөөтэй ажилтныг орлох байдлаас бусад ажилтнуудад үүссэн стресс	Зан байдлын асуумжийн мэдээлэл

ANNEX 7: ECONOMIC COST VARIABLE DEVELOPMENTAL RESEARCH PAPERS

	Title	Variables (response)	Equations
1	Singh, Tamara, Niskika Chetty, and Anis Mahomed Karodia, 'An Investigation into the Impact of Absenteeism on the Organisational Performance of a Private Security Company in Durban, Kwazulu-Natal', Singaporean Journal of Business Economics and Management Studies, vol. 4, no. 11, 2016, pp. 105–159.	**Core variables to measure cost** 1. Lost wages paid to employees who are not performing any work for you 2. Corporate performance (return on assets, return on equity) **Alternative and additional variables to measure cost** 1. The cost of temporary hires and/or outsourcing to cover the labour shortage 2. Temporary staff 3. Training time for temporary staff 4. Loss of production 5. Quality loss 6. Reduced quality performance by undertrained replacement workers 7. Overtime for replacement of absenteeism 8. Costs of external agencies that provide support for absenteeism 9. Costs of HR dealing with absenteeism 10. Increased employee turnover 11. Management time spent on managing related issues 12. Supervisor time spent dealing with absences	1. The costs of job absenteeism = work days missed * daily earnings (Cawley, Rizzo and Haas (2008))
2	Onikoyi, Idris Adegboyega, Olawumi, Dele Awolusi, and Boyede Michael Ayodeji, 'Effect of Absenteeism on Corporate Performance: A case study of Cadbury Nigeria PLC, Ikeja, Lagos State, Nigeria', British Journal of Marketing Studies, vol. 3, no. 2, 2015, pp. 58–71.		2. y = a0 - b1x1 - b2x2 - b3x3 - b4x4 y = Corporate performance (return on assets or return on equity). (Onikoyi, Awolusi and Ayodeji (2015))
3	Kocakülâh, Mehmet C., Timothy G. Bryan, and Stevie Lynch, 'Effects of Absenteeism on Company Productivity, Efficiency, and Profitability', Business and Economic Research, vol. 8, no. 1, 2018, pp. 115–135.		3. Estimation of the mean productivity cost: $\mathrm{MPC} = \frac{1}{n}\sum \Delta\mathrm{days}_i \times \frac{\mathrm{hr}_i \times \mathrm{wage}_i}{5}$ $(i = 1, 2, \ldots, n)$ Where D days is the estimated number of days lost due to illness, wage indicates the hourly wage ($/hr), hri indicates usual working hours per week, and n indicates the number in the sample. (Akazawa, Sindelar and Paltiel (2003))
4	Lu, Jackson G., 'Air Pollution: A systematic review of its psychological, economic, and social effects', Current Opinion in Psychology, 2020.		
5	Gilliland, F. D., et al., 'The Effects of Ambient Air Pollution on School Absenteeism Due to Respiratory Illnesses', Epidemiology, vol. 12, no. 1, 2001, pp. 43–54.		
6	Cucchiella, Federica, Massimo Gastaldi, and Luigi Ranieri, 'Managing Absenteeism in the Workplace: The case of an Italian multiutility company', Procedia – Social and Behavioral Sciences, vol. 150, 15 September 2014, pp. 1157–1166.		
7	Alyıldız, Alishan, and İbrahim Hayri Kuğuoğlu, 'Evaluating of the Reasons for Absenteeism in Terms of Different Variables According to Their Own Perceptions of Pre-Service Teachers', Procedia – Social and Behavioral Sciences, vol. 2, no. 2, 2010, pp. 2577–2582.		4. Calculation of absenteeism rate: Absenteeism rate = (average number of employees x missed workdays) / (average number of employees x total workdays in the quarter) Absenteeism rate = (20 x 5.5) / (20 x 61) Absenteeism rate = 110 / 1,220 Absenteeism rate = 0.09
8	Saidane, Olfa, et al., 'Factors Leading to Work Absenteeism in Tunisian Ankylosing Spondylitis Patients', The Egyptian Rheumatologist, vol. 40, no. 3, 2018, pp. 183–185.		
9	Murti, Michelle, et al., 'Measuring the Impact of Influenza Vaccination on Health-Care Worker Absenteeism in the Context of a Province-wide Mandatory Vaccinate-or-Mask Policy', Vaccine, vol. 37, no. 30, 2019, pp. 4001–4007.		

10	Uribe, José Miguel, et al., 'Presenteeism, Absenteeism, and Lost Work Productivity Among Depressive Patients from Five Cities of Colombia', Value in Regional Health Issues, vol. 14, December 2017, pp. 15–19.	13. Lowered employee morale as remaining staff feel overworked 14. Increased safety risk on the part of temporary workers 15. Health and safety issues such as people rushing through a heavier workload or poorly trained staff made to fill in for absent colleagues 16. Poor morale as people have to work harder to fill in for absent staff	
11	Zehir, Cemal, et al., (2016). 'Strategic Human Resource Management and Firm Performance: The mediating role of entrepreneurial orientation', Procedia – Social and Behavioral Sciences, vol. 235, 24 November 2016, pp. 372–381.		
12	Kottwitz, Maria U., et al., 'Time Pressure, Time Autonomy, and Sickness Absenteeism in Hospital Employees: A longitudinal study on organizational absenteeism records', Safety and Health at Work, vol. 9, no. 1, March 2018, pp. 109–114.		
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14	Kessler, Ronald C., et al., 'Using the World Health Organization Health and Work Performance Questionnaire (HPQ) to Evaluate the Indirect Workplace Costs of Illness', Journal of Occupational and Environmental Medicine, vol. 46, no. 6 (6 Suppl), 2004, pp. S23–S37.		
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16	Navarro, Chris, and Cara Bass, 'The Cost of Employee Absenteeism', Compensation and Benefits Review, vol. 38, no. 6, 2006, pp. 26–30.		
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18	Nagata, Tomohiso, et al., 'Total Health-Related Costs due to Absenteeism, Presenteeism, and Medical and Pharmaceutical Expenses in Japanese employers', Journal of Occupational and Environmental Medicine, vol. 60, no. 5, May 2018, pp. e273–e280.		
19	Thompson, Jayne, 'How to Calculate Employee Absenteeism Rate Quarterly', Small Business Chronicle, 10 June 2019, <https://smallbusiness.chron.com/calculate-employee-absenteeism-rate-quarterly-10504.html>.		

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