Integrating Quantitative and Qualitative Approaches to Explore Absenteeism Attributed to Air Pollution and its Attributed Direct and Indirect Costs Among Private Sector Companies in Ulaanbaatar, Mongolia

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Research

Keywords: Absenteeism, Air pollution, Direct costs, Indirect costs, Private sector

DOI: https://doi.org/10.21203/rs.3.rs-31720/v1

Abstract

Background Ulaanbaatar, Mongolia, the coldest national capital city, has the highest winter seasonal mean concentrations of $PM_{2.5}$ and PM_{10}. During January, the coldest month, peak pollution levels are > 8 times higher than the World Health Organization (WHO) guideline values are reached, on average, 15.7 times. Over 80% of this seasonal air pollution is due to domestic heating with coal stoves in large ger residential communities that surround much of the city. This report presents an analysis of the direct and indirect costs of wintertime seasonal air pollution due to the absenteeism of private-sector employees.

Methods Questionnaire data were obtained for 1330 employees working for private sector companies over six economic sectors. To assess employee's direct and indirect costs, healthcare-related costs such as cost per hospitalization, medication, and outpatient visits were calculated using the Cost-of-Illness approach. Non-healthcare costs, such as transportation and food, were also estimated in the study. Individual Indirect costs were calculated with the Human Capital Approach, which estimates the hours of work lost by the person due to disease and then multiplies total lost hours by the hourly wage.

Results Approximately 60% of employee absences occurred during the coldest and hence most air polluted time of 4 months of the year from November to February. Female employees were proportionately more likely to be absent than their male counterparts. Individual direct healthcare costs attributed to air pollution related-sickness absences totaled 1,005,000₮ ($361.50) per year due to being absent from work an average of 3 days three times during the winter in Ulaanbaatar. The median cost of lost wages for 3 days' absence is 120,000₮ ($43.20).

Conclusions We conclude that wintertime pollution has a major impact on absenteeism rates among private-sector employees, and therefore, we postulate that this must be a significant driver of opportunity costs, affecting not only corporate bottom lines but also employees.

Background

Of the national capital cities in the world, Mongolia's capital, Ulaanbaatar, is the coldest during the winter season. Burning coal in domestic heating stoves produces > 80% of the winter seasonal air pollution. The extreme levels of PM_{10}, $PM_{2.5}$, SO2, and CO measured in the air in Ulaanbaatar are strongly associated with adverse health effects, including respiratory, cardiac, and pregnancy-related morbidities. According to the World Health Organization (WHO) guidelines, the mean values of $PM_{2.5}$ (PM_{10}) should not exceed an annual mean of 20 μg/m3 or a 24-hour mean of 25 μg/m3. Ulaanbaatar is among the global capital cities with the highest seasonally-polluted mean concentration of $PM_{2.5}$ and PM_{10}, reaching 157 μg/m3. Burning coal in domestic heating stoves produces > 80% of the winter seasonal air pollution. The extreme levels of PM_{10}, $PM_{2.5}$, SO2, and CO measured in the air in Ulaanbaatar are strongly associated with adverse health effects including respiratory, cardiac and pregnancy-related morbidities. According to the World Health Organization (WHO) guidelines, mean values of $PM_{2.5}$ (PM_{10}) should not exceed an annual mean of 20 μg/m3 or a 24-hour mean of 25 μg/m3. Ulaanbaatar is among the global capital cities with

the highest seasonally-polluted mean concentration of $PM_{2.5}$ and PM_{10}, reaching 157 μg/m3 and 160 μg/m3, respectively, during the winter months.

At a recent UNICEF meeting on air pollution health effects in children, it was postulated that there might be an equally strong association between wintertime air pollution and absenteeism of a child's primary caretaker, which may result in significant opportunity cost to employees.

Absenteeism has been defined as a withdrawal behavior due to an unwanted working environment (Nielsen, 2008). The three main categories of absence are sick leave, authorized absence, and unauthorized absence. Involuntary absence may be distinguished from voluntary absence on the basis that involuntary absence is caused by certified sickness or funeral attendance and is beyond the employee's direct control. In contrast, voluntary absence is associated with uncertified sickness and shirking (Dew et al., 2005). In the US service sector, about 2.3% of all scheduled working hours are lost because of unplanned absences. However, in other industries, the total cost of unplanned absences may amount to 20% of payroll expenses.

Every organization has its own human resource management policies. For instance, one employer allows up to five days of paid leave if the employee's wife, husband, parents, children, siblings, grandparents, or parents-in-law have passed away, if the employee is getting married, or 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 examination (Work time management, 2015).

In Oslo, Norway, an increase in PM_{10} by 1 $\mu g/m^3$ was associated with a 0.6% increase in the number of sick-leaves. In addition to the loss of sense of overall well-being (decline in the individual utility of being) and increased financial costs through more utilization of public health services, the Norwegian results indicate that air pollution also entails costs to trade and industry through the higher number of sick-leaves (Hansen & Selte, 2000). An evaluation of sick leave among employees of a large Massachusetts manufacturer found a consistent relation between increased sick leave and lower levels of ventilation (Milton, n.d.). In a study of economic cost assessment of the health effects related to air pollutants in Mumbai and Delhi, the total financial cost attributed to PM_{10} pollution was, on average, about 1.01% of India's GDP, from 1991 to 2015, when the GDP growth rate was approximately 5.87% (Maji et al., 2016).

Employer direct costs include lost paid absence days, sick pay, lost productivity, and reduced service provision, while indirect costs include 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, terminations of contracts, and loss of income (Hoeijenbos et al., 2005). The purpose of our study was to determine the direct and indirect costs of wintertime seasonal air pollution due to the absenteeism of private-sector employees living in Ulaanbaatar, Mongolia.

Methods

Study setting

Using a purposive sampling method, we defined target private-sector employers. Inclusion criteria encompassed business type, employee numbers, and willingness to participate in the study.

Data Collection Mixed Methods

Socio-demographic information of the study participants was collected by questionnaire. Absence information was assessed using five main questions through the questionnaire, such as, have you ever been absent due to sickness during air polluted wintertime? Additionally, absence disaggregation was accomplished using employee demographic information and risk factor assessment associated with absenteeism for the study participants. Absenteeism causes and disaggregation were analyzed through questionnaires and individual employee interviews. Company coping mechanisms linked with absenteeism were assessed through qualitative analysis.

Company absenteeism flexible arrangements were assessed both from the employee and employer perspectives. From the employer side, we used semi-structured face-to-face interviews with human resource managers among selected companies to assess company compensation mechanisms associated with absenteeism. The employee side was assessed through a questionnaire and focus group interviews on understanding company flexible working conditions and any stress related to getting approval from employers due related to sickness associated with wintertime air pollution.

Direct And Indirect Cost Estimation

To assess employee's direct and indirect costs, healthcare-related costs such as cost per hospitalization, medication, and outpatient visits were calculated using the Cost-of-Illness approach. Non-healthcare costs, such as transportation and food, were also estimated in the study. Individual Indirect costs were calculated with the Human Capital Approach, which estimates the hours of work lost by the person due to disease and then multiplies total lost hours by the hourly wage.

Statistical analysis

The categorical quantitative data were summarized by number and percentage. Chi-Square was calculated to compare the absent-from-work and present-at-work groups regarding demographic factors. Binary logistic regression with absence from or presence at work as the dependent variable was used to determine possible risk factors of absenteeism such as age, gender, number of children, and other employee risk factors. The individual direct costs data had a nonparametric distribution that we expressed as median and interquartile range as well as the 95% Confidence Interval. For qualitative analysis, we identified the categories and sub-categories of interest and wrote brief paragraphs

summarizing the findings for each sub-category, noting similarities and differences observed across groups.

Results

Table 1
Socio-demographic characteristics of study participants

Variables	N	%
Study employee number by service type [a]		
Service sector employee	248	18.7
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	653	50.0
Female	653	50.0
Age (years, mean ± sd)	31.0 ± 8.0	
District where they live		
Bayanzurkh	368	27.4
Bayangol	258	19.4
Songinokhairkhan	344	25.9
Khan uul	175	13.2
Others	184	13.9
Education status		
University graduate	1013	78.8
High school graduate	267	20.8
Did not graduate	5	0.4
Average per monthly salary[b] (₮)		
≤ 320,000	65	4.9
320,001–500,000	490	36.8
500,001–900,000	323	24.3

[a,b] obtained from National Statistical Office 1212.mn

Variables	N	%
900,001–1 300,000	215	16.2
1 300,001–1 500,000	118	8.9
≥ 1 500,001	119	8.8
Children		
Yes	1075	80.8
No	255	19.2
Number of children (mean ± sd)	2 ± 1	
[a,b] obtained from National Statistical Office 1212.mn		

Employee demographic characteristics are shown in Table 1. Employees were distributed across six private business sectors. Their Median age was 31 years, and half were female. Their domiciles were distributed across 4 Khoroos (administrative districts) in Ulaanbaatar. Nearly 80% of employees had received higher education. Their median salary was around 500,000₮ ($185) per month, while 80% of employees had two children at home(Table 1). Figure 1 shows the proportion of employees who took at least one absence during the last winter (58%) based on the survey results(Fig. 1). Figure 2 shows the main reasons given by employees to justify absences from work including a doctor visit because of being sick (54%), as well as taking care of sick children (45%). Importantly, death in the family was also given as a justification by 27%(Fig. 2). Employee qualitative results also showed that child sickness was the most common reason given to take a day leave. Illness occurred at least one to three times in a wintertime, and the frequency of feeling sick increased during winter. Regarding employee self-illness questions, rather than asking for sick absence, the employee continued their job at the workplace unless they found themselves very ill, that could not get out of the bed. However, the employees took several hours or the entire day to visit a doctor. “The frequency of sickness had a direct relation with the number of children in a family” as stated by interviewees. Child sickness was frequent and more frequent than employees themselves. Interviewees believed there were various reasons such as the air pollution is more toxic for a child, too many children in the classroom (kindergarten and school) decreases children’s immunity, and coughing at the school can easily transmit infections among children. Children up to 3 years of age were more frequently sick during the wintertime, which caused their parents to miss work. Female workers took more time off from work than male workers when their children became sick. Male workers usually took time off for the first 1 or 2 days of a child’s sickness, supporting mother and child with the transportation to the health facility and then the men would go back to work, whereas female workers would remain with their sick child if they could not find someone to look after their child.

From the Human Resource managers’ perspective, the reasons for being absent from work can be divided into 2 groups: 1) related to sickness, and 2) not related to sickness. Sickness-related absence, especially

child sickness, was reported more frequently than the illness of other family members to HR managers by employees.

Table 2
Study participant role and flexible management

Questions	N	%
How often do you coordinate the duty of co-workers when they are sick during the high air pollution period?		
Mostly	144	13.4
Sometimes	276	25.7
Rarely	333	31.1
Never	319	29.8
If yes, have you ever been stressed due to assuming an unplanned missing person's role at your job?		
Mostly	156	13.9
Sometimes	261	23.2
Rarely	296	26.3
Never	412	36.6
Feeling when you request sudden leave from your job due to sickness during high air pollution (single response)		
Worried	299	26.0
Scared	599	52.1
Relaxed	193	16.8
Other	58	5.0
Does your company have flexible working 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

Table 2 quantifies company policies and employee perceptions of company flexible care policies for sickness-related absences. Almost forty percent of the private company employees that participated in this study had experience coordinating duties of co-workers when they are out sick during the winter air pollution period. The same percentage of employees reported being stressed due to the extra work when others are unexpectedly absent. Eighty percent of study participants in the private sector reported mixed

feelings of frustration and fear when they ask sick leave during wintertime. Seventy-five percent of the participants revealed no or less flexible time arrangements from their employer(Table 2). Figure 3 showed that sick leave was approved in about a third of employees who asked for it. Nearly half of employees did not receive sick pay, while a small proportion had the option of using sick time or vacation leave(Fig. 3). Almost all workers subtracted their absent days from their vacation or they tried to schedule their vacation in the wintertime when child sickness is frequent. If the sickness-related absence was not taken from their vacation, they sometimes incurred an unpaid absence, unless they bring a sick note from their physician. Unfortunately, some employees did not know about their company's paid absence policy.

Unpaid day leave was most likely when the health provider did not provide a sick note to the employee for the care of children under three years of age, and when the employee used all their vacation time caring for their sick children. In some cases, if there was a lack of a workforce replacement, the employee was obligated to care for their children during the day and work at night or work overtime to accomplish their work. Additionally, from the employee perspective, a sick employee rarely took time off unless they were severely ill. But when their child became sick, the company usually offered no paid sick leave to workers. However, that changed in 2017, when Resolution No. 215 from the Mongolian Government granted paid sick leave for parents taking care of their sick children under age 5. Employees typically tried to find someone, often their parents, or hire somebody to care for their child. If they could not find childcare, the worker took leave from their work using vacation days. For workers who received a health consultation from a public healthcare facility, this was paid by their health insurance. But the majority had to consult with private clinicians incurring out-of-pocket payment, due to some difficulties getting access to timely care in public facilities, when they or their children became ill. Few companies offered private health insurance.

Table 3
Study participants air pollution exposure assessment

VARIABLES	N	%
Smoking status		
Yes	378	28.4
No	952	71.6
How many years smoke (mean ± SD)	7 ± 4	
Type of house		
Ger	160	12.0
Ger district house	222	16.7
Apartment	894	67.2
Others	54	4.4
Heating source		
Central heating system	856	64.4
Improved fuel	58	4.4
Electrical heater	254	19.1
Wood	61	4.6
Others	101	7.6
Transportation used to reach work place		
Walk	294	22.1
Bicycle	3	0.2
Car	422	31.8
Bus	608	45.7
Company provided transportation	3	0.2
Season when the air pollution symptoms were experienced the most		
Winter	948	71.3
Spring	307	23.1
Autumn	48	3.6
Summer	27	2.0

VARIABLES	N	%
In your opinion, does air pollution cause diseases?		
Yes	1291	97.1
No	39	2.9
Born in Ulaanbaatar		
Yes	537	40.4
No	793	59.6
Years lived in ulaanbaatar city	19.3 ± 11.0	
Years worked for current employer (mean ± SD)	6.4 ± 3.4	

Table 3 shows an assessment of risk factors for air pollution exposure among employees who participated in this questionnaire study. Twenty-eight percent reported smoking, 67% lived in apartments, while 29% lived in ger districts. The 64% who reported using central heating are presumably those who lived in apartments. Their mean commuting distance is 7 Km(Table 3). Figure 4 shows that the adoption of individual protection methods against air pollution such as mask wearing or air purifiers at home was self-reported by employees to be less than 10%(Fig. 4). Except for a few participants, the qualitative results revealed that some people report using protection when they go outside, either with an air pollution mask or just with a scarf (which offers no real protection). However, the use of the mask can pose various challenges, for example difficulty, difficulty breathing and eyeglasse fogging (the latter means the mask doesn't properly fit and thus provides little to no protection). Air pollution mask usage seemed to depend on location, for example, Residents from Bayankhoshuu districts (highly polluted region) were more likely to use air pollution mask in wintertime. Nearly all respondents providing a mask to their children in wintertime, some schools and parents require students to use a mask, even though its was uncomfortable to use, while other families were not sure whether their children used the mask regularly or not despite their parents' expense and effort. As a protective measure, the air pollution face mask typically costs between 1600 to 5000₮ ($0.60 - $1.80) per week and men usually buy the mask for their children and wife rather than for themselves. Moreover, employees typically purchase an air purifier and replacement filters for their home and/or workplace and pollution filter with their own money.

Table 4
Workplace absenteeism potential risk factors.

Variables	Crude OR				Adjusted OR			
OR	95%, CI		p	OR	95%, CI		P	
	Lower	Upper			Lower	Upper		
Gender								
Male	1				1			
Female	1.65	1.29	2.11	0.00	1.63	1.04	2.54	**0.03**
Age, (Sig).	0.002(0.319)							
Having a child at home								
Yes	2.23	1.62	3.07	0.00	2.90	1.87	4.49	**0.001**
No	1				1			
Air pollution-related self-reported diseases								
Yes	1.17	0.90	1.52	0.23	3.08	0.87	10.97	0.08
No	1				1			
Company air pollution coping techniques								
Yes	1				1			
No	1.64	1.10	2.44	0.01	1.46	0.91	2.36	0.19
Body mass index								
Normal weight	1							
Overweight and obese	1.10	0.94	1.45	0.09	1.12	0.98	1.65	0.12
Do you use air purifier at home?								
Yes	1				1			
No	1.11	0.82	3.4		1.28	0.79	4.03	0.16

Sig – Significance,

Variables	Crude OR			Adjusted OR			
Are you passive smokers at workplace or home?							
Never	1			1			
Sometimes	1.18	0.64	2.12	1.45	0.74	2.84	279
Mostly	1.15	0.74	1.78	1.21	0.74	1.93	0.41
Years worked at the same company							
≤ 5.0 years	1			1			**0.01**
> 5.1 years	1.36	1.05	1.75	1.39	1.11	1.62	
Sig – Significance,							

Table 4 shows that female gender and having children are significant risk factors for workplace absences during the winter pollution season, whereas self-reported air pollution-related diseases and company air pollution-coping techniques are not. A female was 1.65 times more likely to be absent than her male counterparts. Even after adjustment for other variables, female gender remains a significant factor for air pollution-related workplace ($p = 0.03$; 95 CI 1.04–2.54). Reporting having a child imparts 1.87 times higher odds of being absent than persons 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 associated with absence. However, these risk factors became non-significant after adjusting for confounders ($p = 0.08$; 95 CI 0.87–10.97 and $p = 0.19$; 95 CI 0.91–2.36). Being overweight and obese were not associated with being absent compared to the normal BMI group. Lastly, being a passive smoker ($p = 0.41$; 95 CI 0.74–1.93) and working for a company greater than five years were significant factors associated with absenteeism $p = 0.01$; 95 CI 1.11–1.62) (Table 4).

Table 5
Individual health care and non-health care-related direct costs attributed to wintertime air pollution

Cost	Frequency	Median cost per occurrence	Total cost
Individual health care-related direct costs			
Diagnostic services and doctor visit-related costs	3	65000₮	195000₮
Medication purchasing-related costs	4	70000₮	280000₮
Hospitalization-related costs	1	200000₮	200000₮
Total individual healthcare-related direct costs	3	335000₮	1005000₮
Individual non-health care-related direct costs			
Transportation	4	50000₮	200000₮
₮ - Symbol for Mongolian tugrik currency			

Table 5 shows the contributing components to direct costs to employees for medical-related absences during the wintertime air pollution season. Principal cost drivers include doctor visits for diagnosis and related costs, buying medicine at the pharmacy, hospitalization, if necessary, and transportation to obtain care. The average cost associated with diagnosis and doctor visit was 195,000₮ ($70.10). Four medications were typically purchased with an average cost of 280,000₮ ($100.70). During last winter, the median number of visits to the doctor was 3(Table 5). From qualitative analysis among employee participants, most of them reported having a bad experience during their family doctor consultation at a public facility and commented that the physician was usually a recently graduated young woman, who had poor skills and was not perceived as trustworthy; thus the employee was not satisfied with the service. Furthermore, the treatment received was not effective, so they had to consult with a private doctor later. Some mentioned that everything depended on how the family doctor managed the illness from the start. Participants also commented that doctors were usually uncertain about the cause of the sickness and often transferred patients from doctor one to another, which was costly and time-consuming for participants. Another reason for seeking care at private healthcare facilities was the long delay for patients at the public healthcare facilities, often months, and that the family often felt they could not wait for their child sick to be seen. Some private healthcare facilities offered free second opinions within 14 days of being evaluated at a public facility, while others charged for 20000₮ ($7.20). Importantly, private healthcare facilities offered consultation on the weekends, which allowed the employee to see the doctor without missing work. One employee reported having a private medical concierge consultant, which cost 80000₮ ($28.80) per month.

From the focus group notes analysis, the cost for laboratory tests started from 50000₫ ($17.90) and reached a maximum of 200000₫ ($71.90). For radiology tests, the cost varied between 15000₫ ($5.40) to 300000₫ ($107.90) and some health providers, who work at public healthcare facilities, requested that the X-ray be done at private facilities.

When the employee or their child becomes ill, they try to resolve it as soon as possible, so they purchase oral or IV antibiotics over-the-counter at a pharmacy, without medical consultation, while having vitamins, seabuckthorn or lingonberry juices, and fermented hot, dry milk at home. Believing it led to a fast recovery, high dose antibiotics were often misused to treat viral illnesses compounding the problem of antibiotic resistance. Participants also mentioned changing their medicine on the third or seventh day after initial treatment, if they do not see any health improvement, leading them to buy other medication and waste the previous ones.

Participants spend money not only for medication but also to support their children's and their own immune system with vitamin C, D, and influenza vaccination. For vitamin C, they may spend 30,000₫ ($10.80) to 300,000₫ ($107.90) per month depending on the number of users, while for vitamin D 60,000₫ ($21.60) monthly for two children. The main medications used for sickness were self-prescribed antibiotics and others, namely painkillers, probiotics, anti-allergy medications, medicine for fever, and nebulization or inhalation. Some participants also responded that they were willing to buy the most expensive and what they perceived to be the most effective drugs for fast recovery. Furthermore, many reported that recovery from illness might take more than a month, and some have an incomplete recovery and become ill again. Overall, they believed that recovery depends on the density of children in the state-owned kindergarten, the family doctor skills, and access to medical service. Participants also responded to use multiple antibiotics in higher doses just for perceived faster recovery. The cost was between 30,000–500,000₫ ($10.80 - $179.80) per illness, 20,000–25,000₫ per single medication, 20,000–400,000₫ ($7.20 - $143.90) per child, 30,000–200,000₫ ($10.80 - $71.90) per adult, 9000₫ ($3.20) per day, 2800₫ – 7,000₫ ($1.00 - $2.50) per capsule or tablet of medicine, 5000₫ ($1.80) for nebulization and all those multiply with sickness repetition, number of medications used, number of children in a family, duration of treatment (typically 3–7 days) and frequency of medicine taken in one day (usually 3 times per day). Different aged children used different forms of the same medicine, such as capsule, syrup, or nebulization, with different prices. Medicine for children under the age of three was the most expensive according to their experience. If they requested that an injection be administered at home, a payment of 5000₫ ($1.80) added for each daytime call for the on-call nurse. When modern medicine was not effective in two months, phytotherapy, traditional therapy, or immune-based treatment was tried. Most of the participants did not have insurance coverage to buy medicine, lacked knowledge regarding which medicine to buy, and often found a lack of medicine available in the pharmacy. Self-medication was frequent. Participants knew that pharmacists were not trained to be clinicians, yet they still tended to go to the pharmacy and consult with them and bought the medicine they recommended. For air pollution, some people received hyperbaric oxygen and treatments using oxygen concentrators, which costed 50,000₫ ($17.90) per person. Rezine (cetirizine), an anti-allergy medication, was the most commonly used drug in the summer.

Many respondents commented that pharmaceutical companies often promoted their expensive medicines to the physicians and pharmacists, who then sold them at high prices to the employee. On the other hand, some employees complained that family doctors always prescribed only vitamin C and Amoxicillin.

Hospitalization-related cost per occurrence was 200,000₮ ($71.90). Total healthcare-related average direct cost was estimated to be 1,005,000₮ ($361.50) per year. The individual non-healthcare-related cost was estimated to be 200,000₮ ($71.90) per year. Per person direct cost, including medical and non-medical costs, totaled to an average 1,205,000₮ ($433.40) per employee who took a sickness-related absence last winter. The qualitative analysis demonstrated that access to care at the public healthcare facilities was difficult, and was perceived to be risky because of misdiagnosis and complications and that complicated cases often required hospitalization. Due to the scarce availability of public hospital beds, most participants went to private hospitals; however, there were still some people whose children were hospitalized in public facilities. Private rooms in the state hospitals were also available at an additional cost, which varies between 25,000–35,000₮ ($8.90 - $12.60) per hospitalization. Simultaneous hospitalization of more than one child in the public hospitals was logistically more difficult for the employees, which is another reason why most of them preferred private hospitals. The private hospital bed fee per day ranged between 100,000₮ ($35.60) and 150,000₮ ($53.90). Treating pneumonia in the private hospital cost 900,000₮ ($323.70), compared to 100,000₮ ($35.9) in the state hospital. When a family member was hospitalized, a transportation cost was incurred, whether by bus, taxi, or fuel.

Mongolia's Social Health Insurance Agency selects "essential drugs" annually and sets the maximum price for these drugs as well as the extent to which the government will reimburse their cost. Employees noted that most physicians neither guided their patients to use insurance nor prescribed medication from the list of essential drugs subsidized by the government. Respondents said that having insurance coverage for essential medicines was good. Still, the quantity ordered by the pharmacies was not enough so that once the medication was on the essential drug list, it ran out immediately after which there was a long queue for it. For young people aged between 25–34 there were no insurance benefits. Most of the participants interviewed had not benefited from insurance because there was no insurance coverage for coughing due to air pollution.

Table 6
Individual indirect cost using human capital approach

		95.0%, CI		Interquartile	
Variables	**Median**	**Lower**	**Upper**	**25th**	**75th**
Number of days absent	3	3	5	2	7
Lost salary due to one day missed (₮)	35 000	30 000	40 000	25 000	50 000
Individual indirect cost due to absenteeism (₮)	120 000	80 000	210 000	60 000	245 000

CI - Confidence interval; ₮ - symbol for Mongolian tugrik currency

Table 6 described the effect of absenteeism on human capital costs. This calculation revealed the substantial increases in human capital costs that were driven by increases in days of absence. The median indirect cost due to three missed days of work was 120,000₮ ($43.20) in this study (95% CI 80,000–210,000₮). One missed day cost 35,000₮ ($12.60).

Discussion

The main findings of our study relate to employee absenteeism due to reported genuine illness and its costs. Illness-related work absence is very costly to employers who offer sick leave because employees are paid for time when they are not working. It is likewise very costly to employees without sick leave due to lost wages. Regardless of sick leave coverage, it always is associated with work being not accomplished, delayed, or shifted to others and is associated with increased healthcare expenses care.

Sick leave is a right afforded to employees, which allows them to recover from illness (Mostert, 2010). Yet sick leave often spills over to absenteeism related to providing care to other ill family members. Childcare is often a serious cost issue, as revealed by our study. Another common family problem is the responsibility of adult children to care for their elderly parents. These needs may include doctor/medical appointments and hospitalizations, all of which take time and money to complete (Kocakulah & Kelley, 2016).

Our study showed higher rates of absences reported by female employees with young children. The number of children in the household also had a significant impact on work-place absenteeism in this study. Women take more responsibility for children and are therefore, more often absent, particularly as the number of young children in the family increases (Leigh, 1983).

The weaknesses in our study include the possibility of recall bias in focus group interviews, socioeconomic selection bias because the subjects were all employed persons, and thus possible overestimation of the potential out of pocket GDP impact on employees in the general population. Representativeness of the study was limited by the purposive sampling method. We studied the direct and indirect costs associated with absenteeism, which our study participants attributed to air pollution. We did not identify the extent to which confounding variables, such as wintertime respiratory infections, affected these costs. Separating the effects of air pollution from infection would require determining absenteeism associated with personal air pollution exposure or differences in air pollution exposure among smaller groups of people at ground level in the same wintertime conditions. Interpreting the results would then require determining how much air pollution impacts the direct and indirect costs of seasonal respiratory infections.

The evaluation of measures affecting air quality management both at the individual, company, and societal levels needs to account for the impacts of pollution on public health, as well as the effectiveness, benefits, and costs of the measures to reduce pollution. Accordingly, air pollution exposure assessment is a necessary element of the health risk assessment. For many air pollutants, no risk-free exposure threshold values have been defined. This means that it is likely that at all levels of exposures, there are individuals for whom exposure reductions would bring health benefits. Therefore, the entire exposure distribution is relevant for the population-level risk assessment, not only when air pollution exceeds a particulate exposure level. This information is needed for the general population as well as for population subgroups of particular interest.

Conclusion

We conclude that the identified combined direct and indirect costs of absenteeism attributed to wintertime air pollution in Ulaanbaatar, Mongolia are compelling. The major identified drivers of direct cost to employees are healthcare expenses, including doctor visits, medication, hospitalization, transportation, plus the cost of loss of earnings. Although employees were equally divided by gender, the cost of sick absences falls disproportionately on female workers with young children. The major cost drivers to employers are the number and human capital cost of employee absences. Clearly, the level of economic opportunity cost analyzed herein is not sustainable and negatively affects the growth of the GDP of Mongolia. Further econometric research is needed to contrast the ongoing opportunity cost of air pollution due to domestic coal-burning versus the cost of investment in remediation and sustainable energy such as solar and wind power.

Abbreviations

WHO
World Health Organization, UNICEF:United Nations Children’s Fund, US:United States, IV:Intravenous, GDP:Gross Domestic Product.

Declarations

Ethics approval and consent to participate

Ethical approval was given by the Mongolian National University of Medical Sciences (#2019/03-13) and written and verbal informed consent was obtained from each participant.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed for the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that there is no conflict of interest.

Funding

We thank for the The Swiss Agency for Development and Cooperation and the United Nations Children's Fund are co-financing organizations for this study.

Authors' contributions

MG concepted and wrote the manuscript. DW, RA and CW added essential materials for interpretation and revised the manuscript. NE analysed and wrote interpretation quantitative data of this study. NA revised and added essential interpretations for quantitative analysis section. SN and CB did qualitative analysis and wrote this section. AH and MS participated in data collection, validation and manuscript preparation. The authors read and approved the final manuscript.

Acknowledgments

We thank the Swiss Agency for Development and Cooperation to co-financing this study. Our sincere gratitude to UNICEF's chief of Social Policy, Enkhnasan Nasan-Ulzii, for practical support throughout the implementation. We thank all the employers and employees for sharing their data and insights that made this study possible.

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Figures

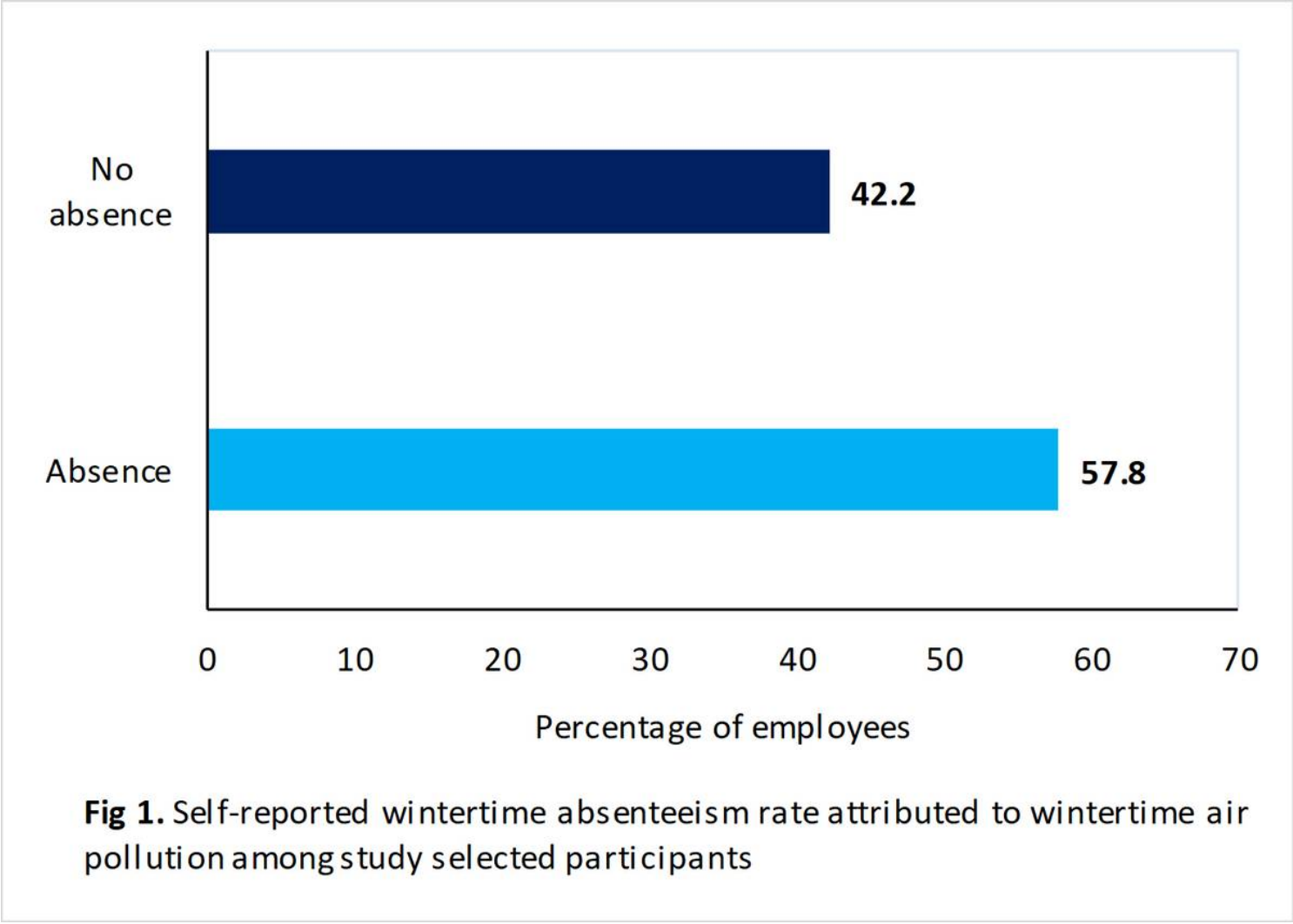

Fig 1. Self-reported wintertime absenteeism rate attributed to wintertime air pollution among study selected participants

Figure 1

Figure 1

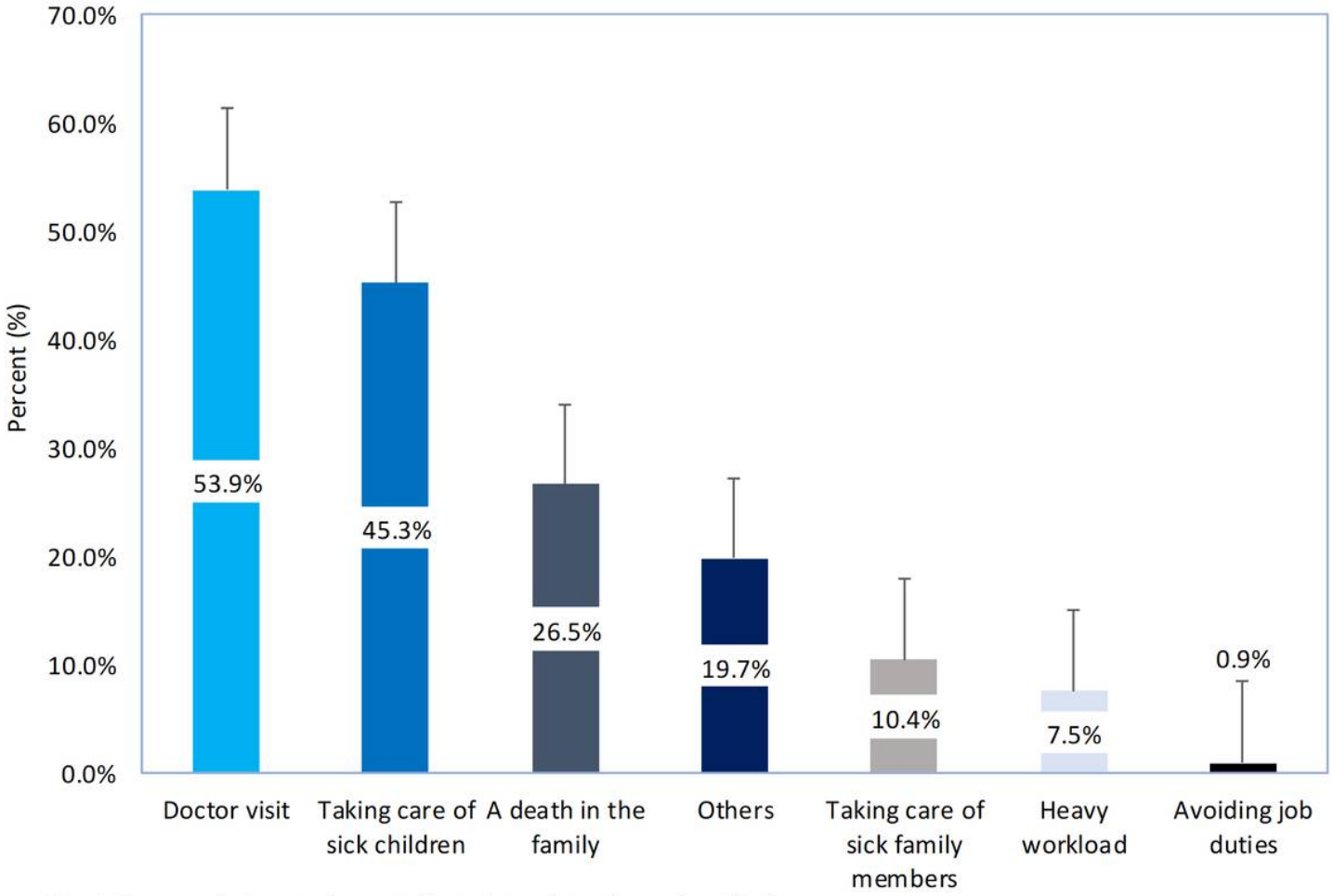

Fig. 2 Causes of absenteeism attributed to wintertime air pollution.

Figure 2

Figure 2

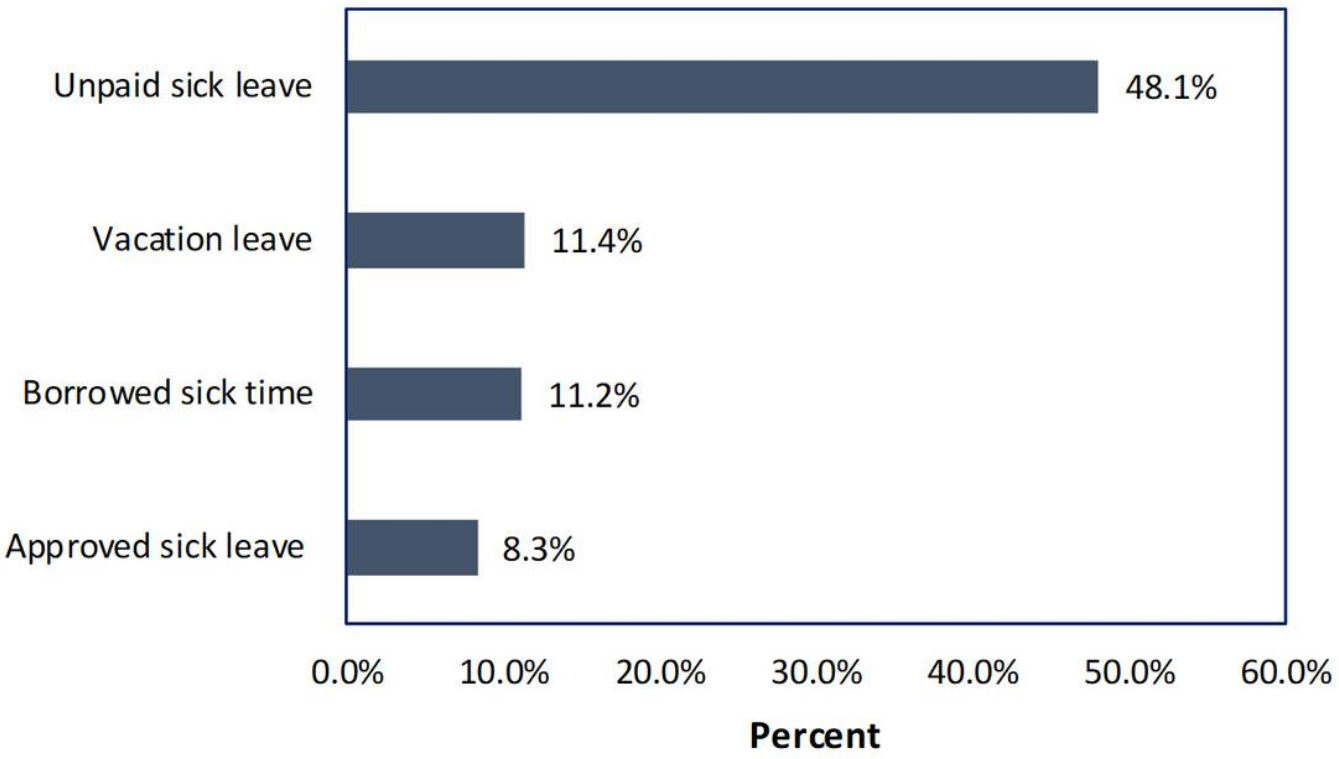

Fig. 3 Types of temporary leave among study participants.

Figure 3

Figure 3

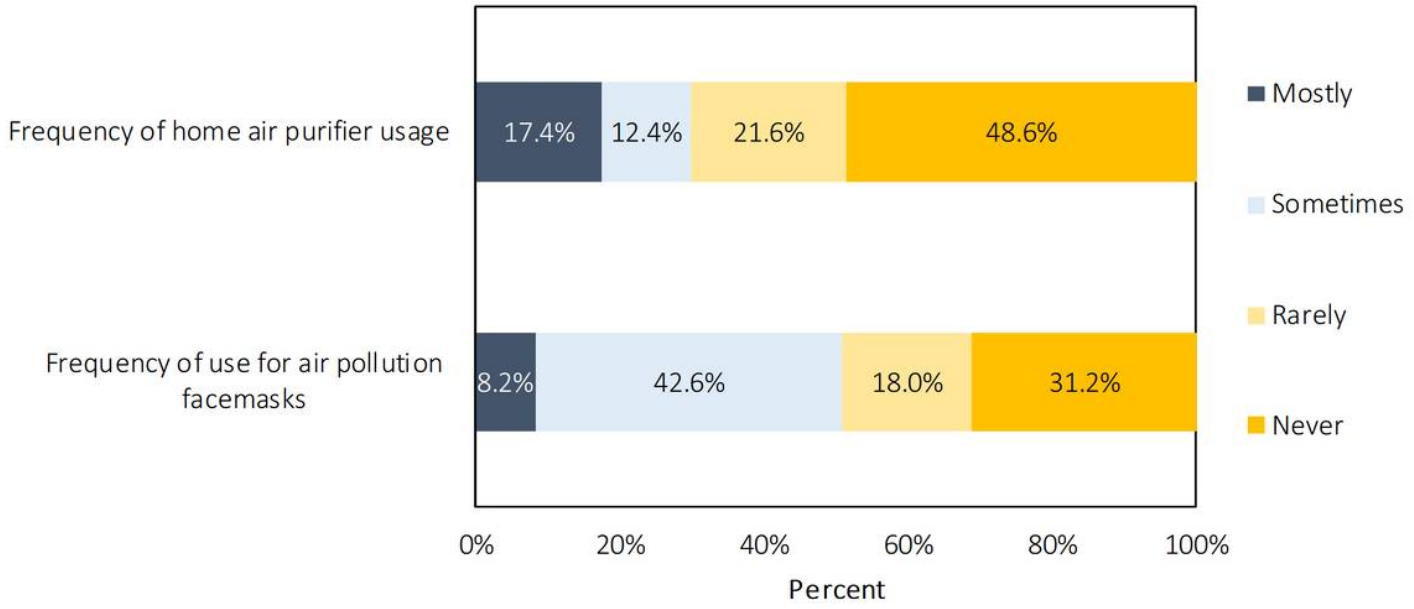

Fig 4. Individual employee air pollution self-protection methods

Figure 4

Figure 4