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Air pollution in Bangkok

Addressing unequal exposure and enhancing public understanding of the risks

SEI policy brief
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IMAGE (ABOVE): Hazy morning, Bangkok
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Key messages:

- **Though the very high air-pollution levels in Bangkok threaten the health of those throughout the area, exposure is higher for some groups as a result of conditions they face at work, and in their homes and neighbourhoods. This brief suggests that higher levels of exposure occur from working outdoors or in occupations involving (or near to) cooking; and from living near train tracks and highways; in poor, informal settlements; and in homes that lack air conditioning.**
- **A survey of 400 people in five districts of Bangkok suggests that informal workers were more likely than formal workers to experience one or more symptoms (e.g., headaches, sneezing, hoarse throat, nasal congestion, burning or irritated eyes) that likely stem from exposure to air pollution.**
- **A majority of those surveyed had low levels of awareness about air quality in the areas where they work and live. Their perceptions about the extent of their own exposure to air pollution largely depended on their beliefs about the air quality in their districts rather than on information from the government's air-quality monitoring.**
- **The brief puts forward six measures to address these issues in Bangkok. The authors advocate 1) improving communication about the level of air pollution and the harms from exposure; 2) expanding access to affordable health care and health insurance; 3) providing masks to those who are most exposed; 4) expanding labour-safety training; 5) improving vehicle emission inspections schemes and adopting other policies to reduce air pollution and generate revenue to fund protective measures; and 6) providing training and capacity building to improve pollution monitoring and air quality.**

Introduction

This brief reports the findings of a study that examined the relationship between air-pollution exposure, socio-economic status, and working and living conditions in Bangkok. The study explored air-pollution exposure levels and beliefs about exposure levels in different districts of the city, and the extent of exposure of different groups according to various characteristics, including occupation and income level. The aim of the study was to identify potential policy options to reduce exposure to air pollution, and to help address the health impacts of such exposure. This brief provides an overview of the study and offers six specific recommendations.

High levels of air pollution in Thailand threaten human health; annual exposure to the fine inhalable particles with diameters 2.5 microns or smaller ($PM_{2.5}$) in Thailand is more than four times the recommended global standard set by the World Health Organization (WHO) in 2021. In Bangkok, in certain months of the year, $PM_{2.5}$ concentrations are eight

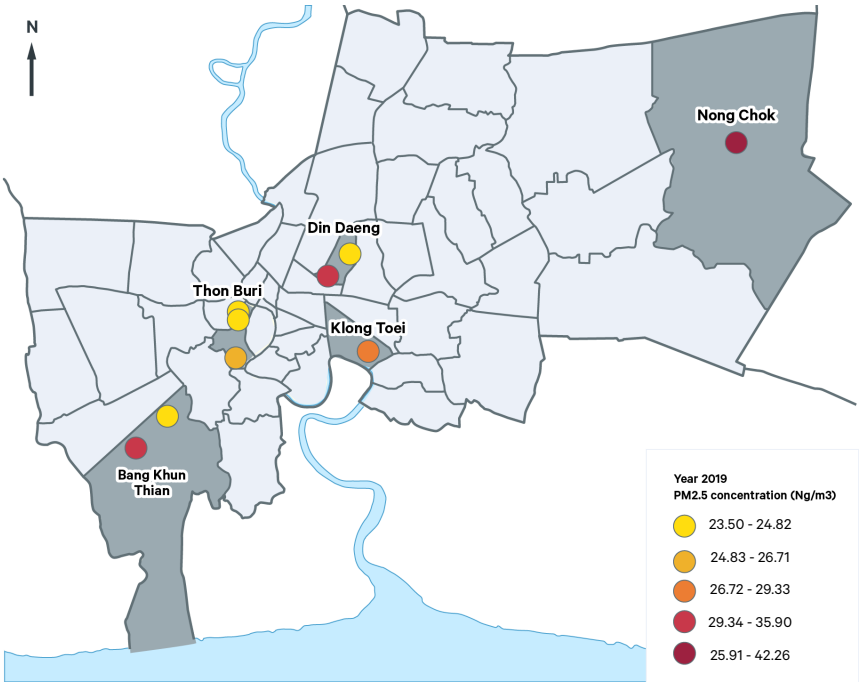
times the WHO annual air-quality guideline value. For example, in January 2019, the $PM_{2.5}$ concentration levels in Bangkok rose to 47.4 μg/m^3 (IQAir, 2021).

Emissions from heavy traffic, factories and open burning generate these pollutants, which are associated with increased lung and heart diseases and reduced life expectancy, with children and the elderly particularly vulnerable (WHO, 2013). In 2019, in recognition of the need to improve air quality in Thailand, the country's Pollution Control Department (PCD) developed a national action plan to reduce $PM_{2.5}$ exposure from major emission sources (open burning, transportation, and industries), and, in 2022, the Department of Health suggested air quality levels for indoor environments.

At the same time, Thailand has one of the world's most extreme levels of socio-economic inequality (Thongsawang, Rehbein, & Chantavanich, 2020); this inequality also plays a role in levels of air-pollution exposure and access to needed treatment for related health impacts. Around 28% of workers in Bangkok work in the informal sector in jobs such as motorbike taxi drivers, market vendors, street vendors and home-based workers; indeed, the informal economy accounts for 42% of employment nationwide and 56% of jobs in metropolitan areas in Thailand (Poonsab, Vanek, & Carré, 2019). These jobs are often held by migrants, poor women, and youths. The positions, which pay poorly, expose people to hazards. People outside of the formal sector lack access to social assistance and insurance programmes to cover healthcare, unemployment, disability and retirement; or to address workplace safety.

Against this backdrop, we conducted a study that sought to examine the links between air-pollution exposure and various socio-economic characteristics, including informal-sector employment, income level, working and living conditions. We also evaluated how personal beliefs about the extent of air pollution in the districts where people work or reside affect their beliefs about their own exposure.

Figure 1. Study area and $PM_{2.5}$ concentrations in 2019



Data sources: Thailand Pollution Control Department (PCD) and Bangkok Metropolitan Administration (BMA).
Note: The annual mean global air quality guideline level set by the WHO for $PM_{2.5}$ is 5 μg/m^3.

The study

We focused on five Bangkok districts that include diverse social, cultural and economic groups; diverse socio-economic activities; and different levels of air pollution. (See Figure 1.) Two districts – Thon Buri and Din Daeng – are in central Bangkok. The other three – Bang Khun Thian, Klong Toei and Nong Chok – are peri-urban suburbs, where agricultural activities still take place.

The Air Quality Guidelines from the WHO indicate that the annual average concentrations of $PM_{2.5}$ should not exceed 5 micrograms per cubic metre of air (5 µg/m^3) (WHO, 2021). According to data from the Thai Pollution Control Department and Bangkok Metropolitan Administration, in 2019, average annual $PM_{2.5}$ concentrations in three of the studied districts (Din Daeng, Bang Khun Thian, and Nong Chok) ranged from 35.90 to 42.26 µg/m^3, and in the other two studied districts (Klong Toei and Thon Buri), they ranged from 23.60 to 24.92 µg/m^3, levels that were considerably lower but still well above WHO guidelines.

To assess and compare air-pollution exposure under different conditions, we installed six air-quality-monitoring sensors in three locations: inside and outside of both an agricultural farmhouse and a typical village house, both in the Nong Chok district; and inside and outside of a condominium in the Din Daeng district. Table 1 shows the results of the 24-hr average $PM_{2.5}$ concentration during 45-day monitoring period (August-September 2022).

Table 1: Concentrations of $PM_{2.5}$ in Bangkok

House types	24-hr Indoor conc. (µg/m^3)	24-hr Outdoor conc. (µg/m^3)	Discussion
Farmhouse (Nong Chok)	1.3 - 36.6	1.3 - 43.1	Indoor and outdoor concentrations were similar, likely because windows and doors were open most of the time.
Village house (Nong Chok)	0.7 - 33.9	1.5 - 42.8	Most peak indoor concentrations were lower than those recorded outdoors, likely because windows and doors were closed when the air conditioner was on.
Condominium (Din Daeng)	0.7 - 16.6	2.7 - 17.1	Peak indoor concentrations were lower than those outdoors, likely because the air conditioner was always used when the owner was home.

Source: authors' study.
Note: The WHO has established an annual mean global air quality guideline for 24-hr average $PM_{2.5}$ concentration of 5 µg/m^3 (WHO, 2021); the Thailand Department of Health has suggested that 24-hr $PM_{2.5}$ concentration levels in a public building in Thailand should not be higher than 25 µg/m^3.

The monitoring data in Table 1 show a wide range of $PM_{2.5}$ concentrations at the locations we studied; the levels mostly depended on the sources of nearby pollution (such as traffic, or open burning of solid wastes). The village house and condominium appear to offer better protection against $PM_{2.5}$ when the windows and doors are closed. Because the study did not take place at a time of a high $PM_{2.5}$ episode in Bangkok, residents did not use air purifiers in their households during our study. Note that the use of both air conditioners and air purifiers also raises questions about income-related inequality because of the costs of buying and operating such equipment to reduce exposure.

We also analysed information from the 400 people who voluntarily participated in our surveys when we approached them at their workplaces in these five districts. The sample included an even distribution of males and females, and people of different ages and income levels, working in a variety of jobs, sectors, and conditions.

The most common health symptoms likely related to air pollution that surfaced among these respondents were headaches, burning or irritated eyes, sneezing attacks, and nasal congestion. Those working in three districts (Bang Khun Thian, Nong Chok, and Ding Daeng) reported having the highest number and prevalence of symptoms. Though fewer respondents in two districts (Thon Buri and Klong Toei) reported having multiple such symptoms, a high percentage of people there reported having headaches.

Those working in the informal sector and those with lower incomes reported more health symptoms (sneezing, headaches, burning or irritated eyes, hoarse throat, and nasal congestion) than those working in the formal sector and those with higher income. A slightly higher proportion of older workers (ages 45 to 65) reported a having headaches and burning or irritated eyes. We found no differences in health symptoms likely related to poor air quality between males and females, or between those who work indoors and outdoors.

We also compared the degree to which seven study participants were exposed to $PM_{2.5}$ concentrations during their eight-hour workdays, during which they carried personal sensors. The participants were four workers who did not have social security – a male and female farmer, and a male and female vendor in an open-air market – and three workers with social security – a female cook in an indoor kitchen, a male office worker, and a male engineer who worked both in an office and outdoors at the airport. The cook was found to suffer the highest exposure to $PM_{2.5}$ as the result of emissions from grilling food in a poorly ventilated kitchen. However, because the outdoor $PM_{2.5}$ concentrations during the study period were not exceptionally high, outdoor workers did not experience the degree of exposure to $PM_{2.5}$ concentrations that would likely be the case during such episodes of more severe $PM_{2.5}$ levels.

Perceptions about air pollution and exposure

A substantial portion of the workers surveyed in three areas (Thon Buri, Khlong Toei, and Din Daeng) expressed concern about the air quality. In Thon Buri, 51.43% viewed the air as toxic, while the rest saw it as either unhealthy or unhealthy for sensitive groups. In Khlong Toei, 40% deemed the air to be toxic, 45.5% considered it unhealthy or unhealthy for sensitive groups, and a small proportion (14.5%) considered it to be moderate or good. In Din Daeng, a minor percentage (2.5%) considered the air to be toxic, while the majority (85%) saw it as unhealthy; only 12% considered it to be good. By contrast, no respondents in the Bang Khun Thian district and only a small number in the Nong Chok district (2.5%) saw the air as toxic. Around 60% of those surveyed in these districts considered the air to be unhealthy, while the rest rated it as good.

The vast majority of those surveyed in the central Bangkok districts reported that they felt they had been subjected to poor air quality in recent years (97% in Thon Buri, 98% in Din Daeng, and 88% in Klong Toei). By contrast, a significant number of respondents in Nong Chok (69%) and a moderate number in Bang Khun Thian (38%) did not feel they had experienced extensive exposure to poor air quality – despite the fact that these peri-urban districts have higher pollution levels than in Thon Buri and Klong Toei where residents believed that they had been highly exposed. Only in Din Daeng did perceptions seem to match the picture portrayed by the government data.

Thus, our findings suggest that beliefs about the extent of one's exposure to air pollution are tied to one's *beliefs* about air quality levels where one lives or works, rather than to data on air pollution from government monitoring.

Hotspots

We constructed a machine-learning predictive model to examine associations and recognize patterns concerning air pollution exposure of those interviewed, and to predict the probability of a person being impacted by long-term exposure to poor air quality, both at work and at home. The model used information from the questionnaires, including the respondents' self-reported perceptions of the impact. We found:

- A significantly larger percentage of respondents working in the Nong Chok district (which has among the highest levels of pollution recorded in our study) are likely to be affected by multiple symptoms; by contrast, respondents working in the Thon Buri district (which has one of the lowest levels recorded in our study) are likely to have fewer symptoms.

- Respondents are likely to suffer greater air pollution-related symptoms if they live and/or work in certain locations: in poor, informal neighbourhoods; in settings in proximity to an indoor cooking with poor ventilation; and in settings near railroads, highways, and major streets.

Discussion

The health problems experienced by survey respondents are more pronounced in areas that show higher levels of air pollution. Among the five districts we studied, a higher percentage of respondents reported one or more health problems when they lived or worked in any of the three districts that have higher pollution levels (Ding Daeng, Nong Chok, and Bang Khun Thian). Fewer respondents reported health problems linked to poor air quality in the two districts that are less polluted (Klong Toei and Thon Buri).

The respondents' perception of the air quality contrasts with the level of air pollution shown by government monitoring data. Data from the Pollution Control Department and the Bangkok Metropolitan Administration indicate that the peri-urban areas have the area's highest levels of air pollution. However, relatively few respondents in the peri-urban districts we surveyed (Bang Khun Thian and Nong Chok) deemed the air there harmful. By contrast, many respondents in Klong Toei and Thon Buri respondents considered their local air quality to be harmful, even though the government data show that these regions have lower levels of air pollution. These observations suggest that the public has little information or awareness about the air quality in the areas where they live and work.

The respondents' perception of air quality in the district where they live and/or work appears to determine their perception of the degree to which they are exposed to air pollution. That is, respondents who believe that the air pollution in their district is not very high believe that they are not exposed to very much air pollution. The flip side is also true; respondents who believe that the air quality in their districts is poor believe that they are exposed to air pollution to a greater degree.

More respondents from the informal sector than the formal sector reported experiencing one or more health symptoms that likely stem from exposure to air pollution. Respondents with lower incomes also had health problems to a greater degree than those with higher incomes. Poverty and low socio-economic status has a stronger impact on the population's susceptibility to diseases and causes of death linked to exposure to air pollution (Hölzl, Veskov, Scheibner, Le, & Kleinschmit, 2021). In addition, low awareness of the risks other activities that also harm lung and cardiovascular health – such the effects of smoking cigarettes, and burning biomass and plastic – contributes to the greater prevalence of similar diseases and outcomes among the poor and those in low socio-economic status groups (Dawood, Rashan, Hassali, & Saleem, 2016).

Policy recommendations

Based on our study, we developed six key policy recommendations. They are:

- **Better public communication and education.** Policies should aim to increase public awareness of air pollution and to enhance understanding about its serious effects on health. Government, non-governmental organizations, community-based organizations, civil society, and mass media and social media should be part of such a communications campaign. Communication about the health risks of exposure to air pollution can encourage people to alter their behaviors and can support the development of skills they need to take actions themselves to reduce their own exposure and improve their own health.
- **Increased access to affordable health care.** Everyone should have access to primary care. Social policies should provide insurance for those who currently are not eligible (e.g., subcontracted workers, informal workers). A national medical programme offering free access to public healthcare for migrant workers and others with irregular employment. At a minimum, workers should have access to a free medical check-up every six months. Health and social programmes, primary-care organizations, and community health-care centres should expand to allow them to better address and prioritize work-related health needs.
- **Provision of masks to reduce work-related air pollution exposure.** Policies should be implemented to ensure healthy and safe working conditions for all (including those working the informal sector), and to provide all workers "labour safety toolkits" that contain items they need to do their work safely. The government should support labour-protection departments and community self-help organizations to supply masks to those who are highly exposed to air pollution.
- **Expanded health and labor-safety training.** Community centres for informal workers should offer training programmes on health protection and labour safety. Training can be provided by voluntary organizations, community-based organizations, and informal-sector workers' associations with the support of governmental agencies. Training of trainers should be promoted for workers in the informal sector.
- **Improved vehicle smoke inspection scheme.** The PCD should establish a better inspection system for all diesel vehicles (e.g., public buses and modified cars). These vehicles represent the single greatest source of $PM_{2.5}$ emissions in Bangkok (Cheewaphongphan, Junpen, Garivait, & Chatani, 2017). The government should adopt measures that have been used to elsewhere to help reduce pollution – such as imposing congestion charges, and establishing higher licensing prices for vehicles with lower fuel efficiency. The funds generated from such measures can be used to address other related needs (e.g., expanded provision of health care, health insurance and training on labour safety).
- **Improved air pollution control through training and capacity building.** The government should provide municipal authorities with the needed training and capacity to enhance their technical knowledge about measures to reduce air pollution from vehicles and industry, and to improve their ability to implement such measures.

Although many air-pollution prevention, reduction and control policies have been developed in the last decades in Thailand in many sectors (Narita et al., 2019), including in the labour and health sectors, air-pollution communication has yet to reach some of the population. Air-pollution exposure in Bangkok continues to be a concern, with certain workers very vulnerable. Thus, policies placing a strong emphasis on the issues we raise in our brief have the potential to enhance inclusion and equity in air-pollution prevention and protection and to improve the health of people who suffer the greatest exposure.

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