Adoption, use, and effects of air purifiers in households in Dhaka

Martin Mattsson, Teevrat Garg, Maulik Jagnani and Ashfaqul Chowdhury

- Households in Dhaka underestimate air pollution inside their homes, leading them to ignore a potentially life-threatening problem.
- The use of air purifiers to combat indoor pollution only increases when people have an air quality monitor that makes them aware of pollution levels and an air purifier to tackle the pollution.
- The use of air purifiers by early adopters may spark widespread use of the technology. This means reducing prices, even by a small amount, may result in large increases in purifier use.

POLICY BRIEF BGD-24040

MAY 2025

This project was funded by IGC Bangladesh

theigc.org

DIRECTED BY

FUNDED BY

Policy motivation

Dhaka is frequently cited as one of the most polluted cities in the world.[1] This is a major public health issue and may mean that, on average, a Dhaka city resident's life is cut short by 5.4 years due to excessive pollution. Pollution in this city has many sources, including vehicles, construction sites, power plants, brick kilns, etc.

It is understandable that citizens expect the government to take action against air pollution. However, development and pollution have an interesting inverted-U-shaped relationship. As a country begins to develop via industrialisation, initially, pollution tends to go up. However, after achieving a certain level of development, pollution begins to decline with advancement in technological capacity and pollution awareness. Unfortunately, Bangladesh is at the initial, polluting phase of development, evidenced by its reliance on gas and coal-based power plants and construction booms in the last two decades. Experiences from other developing countries suggest it will be very difficult to reduce pollution in the short term.

China is a vivid example of success, having significantly reduced air pollution since 2013. However, China set aside USD 390 billion for pollution reduction between 2013-2017.[2] Bangladesh's economy is nowhere near being able to invest even a fraction of that amount.

Given that any significant reduction in pollution in the near term is elusive, what options do citizens have? They may try to stay home as much as possible, as is practised in Delhi[3], a city with a similar pollution level to Dhaka.

Sadly, our research suggests staying home is inefficient in saving people from pollution. Contrary to popular belief, indoor air is unsafe when outdoor pollution is very high, as it is on most winter days in Dhaka. Indoor pollution is almost three-quarters that of outdoor pollution, making it extremely dangerous for people in general and even more so for people with breathing difficulties.

Typical middle-class people spend more than one-third of their day in their homes and possibly more than two-thirds of their day in an indoor setting. Given this, we decided to investigate whether using air purifiers inside homes can help combat air pollution harms and what kind of policies may support their use.

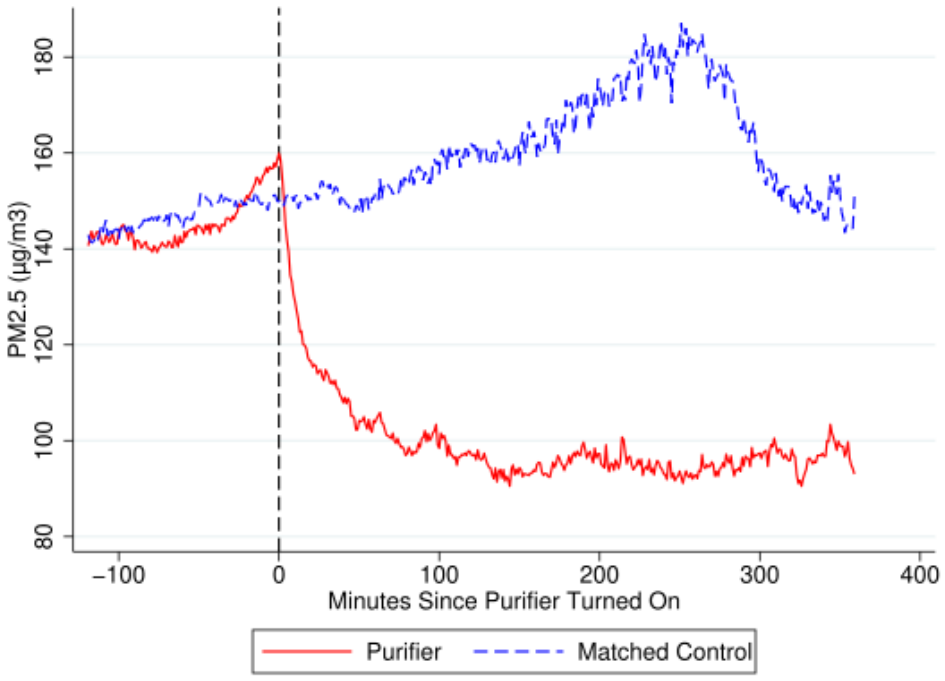
[1] New Age. (2024, May 20). *Dhaka becomes 2nd most polluted city with AQI score of 196.* https://www.newagebd.net/post/environment-climate-change/259609/dhaka-becomes-2nd-most-polluted-city-with-aqi-score-of-196
[2] AQLI. (2023, August 28). *China: National Air Quality Action Plan (2013)*. University of Chicago. https://aqli.epic.uchicago.edu/policy-impacts/china-national-air-quality-action-plan-2014/
[3] Times of India. (2024, November 19). *Delhi Air Pollution Live Updates: Call on work-from-home, odd-even measures to be taken soon, says Gopal Rai*. https://timesofindia.indiatimes.com/city/delhi/delhi-air-pollution-live-updates-toxic-air-aqi-level-grap-4-restrictions-schools-private-offices/liveblog/115433153.cms

Overview of the research

Our research primarily used indoor air purifiers from SQAir, priced at BDT 16,500–17,500 (approximately GBP 100–110). These purifiers proved capable of reducing indoor air pollution by almost three-quarters within 30-45 minutes of switching them on (and also keeping the doors and windows shut).

Our research finds that households hold incorrect beliefs about the severity of indoor air pollution and the effectiveness of air purifiers. Correcting both misconceptions is necessary to increase the adoption and use of air purifiers.

FIGURE 1: Reduction in indoor particulate matter pollution while using air purifiers



In the first phase of research in November 2023, we recruited 1,008 households from three large housing associations in Mirpur, Dhaka. Eligibility required a functioning WiFi connection and no existing air purifier – criteria met by 99% of interested households. These are middle-income households with an average annual household income above USD 6,000 (Munir, Muehlstein & Nauhbar, 2015); 34% own an air conditioner, which costs at least twice as much as an air purifier and consumes substantially more electricity.

Following recruitment, we immediately conducted a short Phase 1 survey on perceptions of indoor and outdoor air quality. Subsequently, 512 randomly selected households received an air quality monitor displaying real-time PM2.5 levels and a chart that categorised these levels from “good” to “hazardous.” These monitors recorded and transmitted minute-by-minute data on indoor PM2.5 levels.

Two months later (January 2024), we conducted a Phase 2 survey, gathering information on household beliefs about outdoor and indoor air pollution and the benefits of air purifiers. We used a modified Becker-DeGroot-Marschak (BDM) mechanism to elicit households' willingness to pay for air purifiers. Before the elicitation, we informed households that air purifiers remove indoor air pollution.

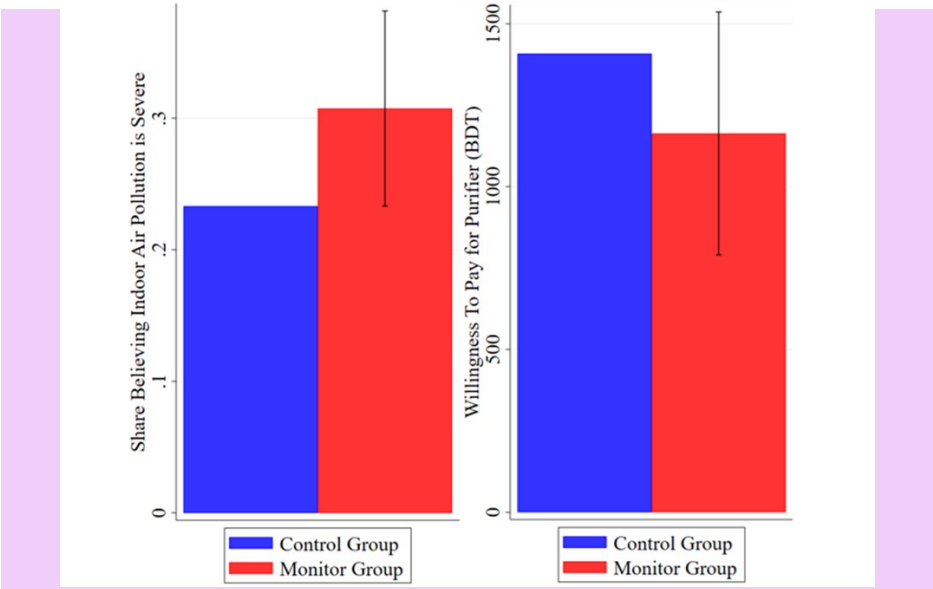
Subsequently, we randomly provided 345 households with a free air purifier. Each purifier was connected to a WiFi-enabled smart plug, allowing us to collect minute-by-minute usage data. We further randomly assigned these purifier-owning households to receive either no electricity compensation, compensation paid daily, or compensation paid monthly.

Finally, in March 2024, our Phase 3 survey collected endline data on perceptions of air purifier benefits, households' willingness to pay (WTP) for an additional purifier, and their willingness to accept cash to sell back their existing purifiers.

Results

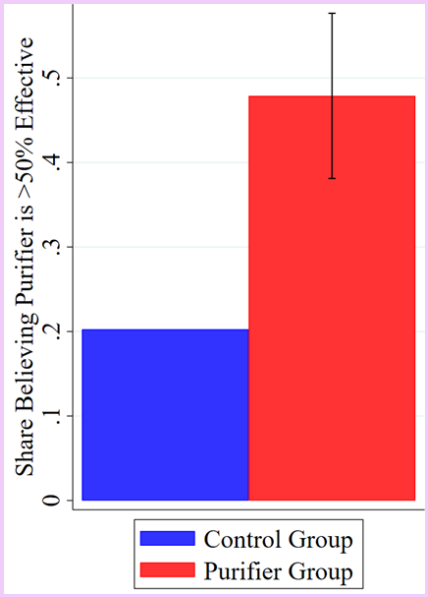
1. **Providing households with air pollution monitors has a large and statistically significant effect on correcting their perceptions of indoor air pollution and its health risks to adults and children** (Figure 2). Households that received monitors were 7.4 percentage points more likely to believe that the air in their homes was severely polluted – a 32% increase compared to households without monitors. However, access to air quality monitors did not increase households' willingness to pay for an air purifier, even though they were informed about its purpose in removing indoor air pollution before elicitation.

FIGURE 2: The effect of monitors on air pollution beliefs and purifier WTP (willingness to pay)



2. **Although providing air purifiers corrected misperceptions about their effectiveness (Figure 3), households did not seem to value the devices, as they rarely used them, even when we compensated them for the electricity costs of operating them.** Specifically, even with compensation, nearly two out of three households used the air purifier for less than 30 minutes per day (Figure 3).

FIGURE 3: Effect of purifiers on purifier effectiveness beliefs

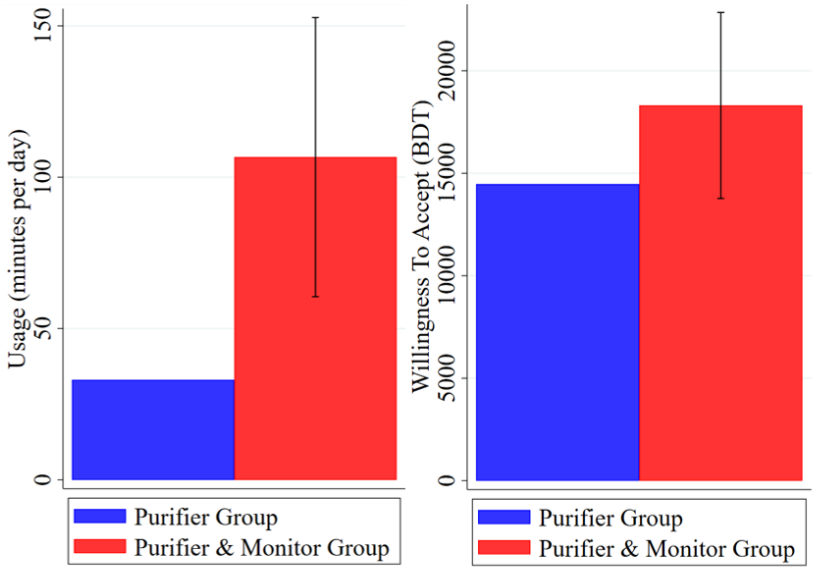


3. **Providing households with both monitors and purifiers increases both air purifier use and the valuation of the purifier relative to households that only receive a purifier** (Figure 4). Data from smart plugs indicate that monitors increased purifier use by 270%, equivalent to an additional 74 minutes per day.

4. **Households that received both monitors and purifiers increased the price they were willing to accept to sell back the air purifiers** by BDT 3,800 (USD 32), a 26% increase, compared to households that received only the purifier.

5. **Households provided with both a monitor and a purifier increased their willingness to pay (WTP) between Phase 2 and Phase 3 for a second purifier by 52.7%**, although this estimate is underpowered. In contrast, households that received only a purifier saw a much smaller and statistically insignificant 11.7% increase in WTP for a second purifier. Similarly, households that received only a monitor exhibited a small and statistically insignificant 8.1% increase in WTP for the first air purifier.

FIGURE 4: Effect of monitors and purifiers on purifier usage and valuation



Policy implications

The results convinced us that purifiers are effective in reducing indoor pollution. However, we also found that people's willingness to pay for purifiers is very low. Even if raising awareness increases this willingness slightly, purifiers will still remain too expensive for most middle-income households.

One reason purifiers were so expensive was the high taxes levied on them. According to the tax authority, the total tax incidence on purifiers was 58.6%, making them more expensive in Bangladesh than in countries like India and the Philippines.

After a joint effort between the researchers and the Ministry of Environment, Forest and Climate Change, the National Board of Revenue decided to reduce taxes on air purifiers to 31%. However, given their effectiveness, we feel that purifiers should be declared a medical good, and thus, taxes should be lowered much further.

Importantly, although air pollution monitors inform people about pollution, alone, they do not significantly influence people's willingness to own an air purifier. However, people do update their willingness once they know about the severity of pollution and the effectiveness of purifiers. Future research could explore the "neighbour effect" (Mu, Luo, Li, Tan, & Gao, 2024), wherein the adoption of a technology by a small minority spurs further uptake among neighbours due to reduced information search costs and demonstration effect.

References

AQLI. (2023, August 28). *China: National Air Quality Action Plan (2013)*. University of Chicago. https://aqli.epic.uchicago.edu/policy-impacts/china-national-air-quality-action-plan-2014/

Mu, L., Luo, C., Li, Y., Tan, Z., & Gao, S. (2024). *'They adopt, I also adopt': The neighborhood effects and irrigator farmers' conversion to adopt water-saving irrigation technology*. Agricultural Water Management, 305, 109141. https://doi.org/10.1016/j.agwat.2024.109141

Munir, Z., Muehlstein, O., & Nauhbar, V. (2015, October 22). *Bangladesh: The surging consumer market nobody saw coming*. Boston Consulting Group. https://www.bcg.com/publications/2015/bangladesh-the-surging-consumer-market-nobody-saw-coming

New Age. (2024, May 20). *Dhaka becomes 2nd most polluted city with AQI score of 196.* https://www.newagebd.net/post/environment-climate-change/259609/dhaka-becomes-2nd-most-polluted-city-with-aqi-score-of-196

Times of India. (2024, November 19). *Delhi Air Pollution Live Updates: Call on work-from-home, odd-even measures to be taken soon, says Gopal Rai*. https://timesofindia.indiatimes.com/city/delhi/delhi-air-pollution-live-updates-toxic-air-aqi-level-grap-4-restrictions-schools-private-offices/liveblog/115433153.cms