



A woman wears a protective face mask while walking in Beijing.

# Face masks could raise pollution risks

People can get a false sense of security from flimsy gauze, and linger too long outdoors in toxic air, argue **Wei Huang** and **Lidia Morawska**.

**A**cross Asia, and increasingly elsewhere, people are wearing medical masks in the street. Young and old, people are tying gauze squares over their noses and mouths when they step outside.

In China, the habit began in 2003, when health authorities recommended wearing medical masks to slow the spread of severe acute respiratory syndrome (SARS). Today, many Chinese citizens wear masks regularly, in a range of fabrics and styles, to lower the risk of catching or transmitting colds or influenza — we, too, wear them for this purpose.

But masks are increasingly donned for another reason — air pollution. Although cloth can filter out large grains of dust, pollen and sand, it does not block the finer particles that reach the lungs, arteries and veins. These include particulate matter that is less than 2.5 micrometres in size (PM<sub>2.5</sub>) and ultrafine particles (less than 0.1 μm) as well as toxic vapours emitted by cars and industry. PM<sub>2.5</sub>

is associated with more than 4 million deaths every year worldwide.

People want ways to protect themselves. They are aware of the health risks of dirty air, and social media is full of images of people wearing masks on smoggy days. But public-health bodies such as the World Health Organization (WHO), the American Heart Association and the European Society of Cardiology have no recommendations on the use of masks or portable purifiers against air pollution.

Hardly any clinical studies have tested how effective medical masks are against air pollution, or how people use them. It is hard to predict individual risks because people's exposures and health statuses vary widely. We worry that wearing masks could even make the problem worse. They have the potential to lull people into a false sense of security, encouraging them to spend more time outside in dirty air.

By contrast, there are clear standards for the specialist respirators that professionals working in dirty environments must use, including builders, pavers and traffic police. These are certified for specific situations, and include gas masks and other devices that limit dust inhalation. None is suitable for everyday wear on the streets.

Governments and scientists need to educate the public and health workers about the correct ways to avoid risks from polluted air. Researchers need to establish what protections might be valuable in some circumstances. But the only long-term solution is to clean the air. Until then, the message is the same: stay indoors as much as possible when pollution levels are high.

## FALSE SENSE OF SECURITY

Medical staff and patients wear disposable cloth masks to cut the likelihood of contracting or passing on infections transmitted

through liquid droplets. For the same reason, some members of the public wear masks to prevent them from spreading viruses when they sneeze or cough.

Typically, medical masks are made from three layers of dense cotton or similar materials. These capture the large droplets that carry bacteria and viruses when people exhale. These droplets are typically the size of pollen grains or dust specks (from a few to about 100  $\mu\text{m}$ ). But for small particles in the air, and toxic gases (such as nitrogen dioxide, ozone and volatile organics), medical masks, and even the best fabric masks, offer no protection.

Good masks also have pleats or folds to cover the nose and chin fully. They fit some face shapes better than others; they cannot fit tightly over a beard for example. Physicians are trained to put them on correctly<sup>1</sup>. The public is not. Air and pollutants can flow through gaps between the mask and face to reach the nose and mouth.

Behaviours are also important when advising a population. Face masks of any kind are uncomfortable to wear for a long time<sup>2</sup>. It can be difficult to breathe in one, especially on a hot day. Carbon dioxide can build up and cause drowsiness<sup>3</sup>. The mask must be taken on and off to talk, eat and drink. The filter can become wet, altering its performance. People sometimes wear the same one many times to save money; once clogged, masks are worse than useless.

Many outdoor workers are advised and trained in how to use specialist equipment. These devices comply with standards developed by the US National Institute for Occupational Safety and Health. Simple cotton masks block dust and asbestos on construction sites and in workshops. Others contain active adsorbent materials that filter chemicals and gases more thoroughly. Some respirators have splash-proof face guards and their own air supplies. They're nothing like a small bit of cloth, in other words.

### SCANT EVIDENCE

Medical masks have been well researched in clinical settings, and shown to do a good job against the spread of infections. Hardly anything is known about how effective they are against polluted air<sup>4,5</sup>. The performance of any face mask is inherently hard to quantify. Many factors need to be considered, including the sizes and sources of particles, the type of mask and the face shape and behaviour of the wearer.

Some lab studies of the filtration properties of mask materials have been done. But only a handful of human studies has examined the efficacy of wearing a face mask under real-world conditions. Most of these studies were done in Beijing and Shanghai in China and in the United States. They typically followed people just for a few hours, and most focused on effects on the heart<sup>6-9</sup>. Few studies have



A child in India wears a face mask on a smoggy day.

examined the impacts on respiratory health.

A few trends have been reported; none were statistically significant. For example, one study found that people who regularly wear masks in polluted conditions have lower blood pressure and more regular heart rates than those that don't<sup>6</sup>. Healthy adults might benefit more than people who already have heart conditions<sup>6,7</sup>. But studies often disagree on everything from the direction and magnitude to the timing and types of response.

Rapid changes in pollution levels also make it difficult to assess health impacts. For example, concentrations of gases and ultrafine particles can be 100 times higher at a busy intersection or in a road tunnel than in a back street. And people's age, gender, health status, medication and activity patterns complicate matters. For example, fit and active people often spend more time outdoors exercising, increasing their exposure. Men are typically more exposed to outdoor pollution; women to pollutants indoors. There are no rigorous studies quantifying how people change their behaviour when wearing face masks.

### NEXT STEPS

People need to know when, why and how to wear a mask.

Experts and authorities need to gather evidence to advise on the situations in which short-term wearing of a mask could be beneficial, such as during a dust storm, or in certain cities in Africa where desert dust is a big component of air pollution. Researchers should collect evidence on the efficacy of mask use against air pollution. Clinical trials should use larger sample sizes and follow-up the long-term impacts in high-risk populations.

The WHO and other public-health bodies should educate the public on the best ways to protect themselves. Until better evidence is available, they should recommend

wearing a well-fitting mask only for preventing infection, not for protecting against air pollution.

Staying indoors when pollution levels are high is safest, as long as indoor pollutants such as tobacco smoke are avoided. Outdoors, people should stay away from heavy traffic when walking and exercising. Cyclists should find routes away from busy roads. Drivers should shut car windows. When pollution is high, it is probably better not to cycle, rather than cycle and wear a mask. People who must work outside for long hours, such as construction workers, should be given professional-quality respirators and training.

And the top priority remains preventing air pollution in the first place. ■

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