COMMENTARY

Addressing the syndemics of physical inactivity and air pollution

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Physical inactivity and air pollution are both major global health challenges, contributing to substantial disease burden and millions of deaths every year. Around the world, 1 in 4 adults[1] and 4 in 5 adolescents do not achieve recommended levels of physical activity.[2] However, 9 in 10 people live in places where air pollution levels exceed World Health Organization guidelines on the air quality required to ensure health.[3] Whether it is safe for people to exercise regularly in areas where air is polluted is a subject of scientific enquiry.

In a related research article, Guo and colleagues used a large prospective cohort from Taiwan to consider the relative impacts of physical activity and air pollution on death from natural causes.[4] They found that high levels of air pollution (measured by area-level fine particle matter [$PM_{2.5}$]) and low levels of exercise (measured using a questionnaire on habitual leisure-time physical activity) were independently associated with higher hazards of dying.[4] Among participants who were exposed to the highest levels of air pollution, habitual exercise remained protective, although air pollution was more strongly linked to death in groups with higher levels of exercise. The authors concluded that exercise was beneficial for health despite air pollution; however, exercise was most beneficial in areas with the lowest levels of air pollution.

That the benefits of physical activity outweigh the risks associated with air pollution is generally supported by existing literature.[5] However, it is important to emphasize the health harms of air pollution, even for those who are apparently healthy and physically active. Guo and colleagues focused on $PM_{2.5}$ as the exposure and death as the outcome, and were bound by the limitations of an observational study design. A systematic review and meta-analysis of experimental studies found that exercising in a polluted environment, defined by a range of pollutants or combinations of pollutants (e.g., ozone, diesel exhaust, traffic-related air pollution), was associated with poorer cardiopulmonary function, immune function and exercise performance.[6] Given that Guo and colleagues quantified air pollution exposure from a spatiotemporal model,[4] the exact quantity of pollutants inhaled by participants as they engaged in physical activity remained unknown. A 2017 systematic review evaluated levels of ambient air pollution by mode of transport and found that, among all commuting modes, active commuters (i.e., pedestrians and cyclists) had the lowest levels of air pollution exposure, but the highest inhalation and uptake dose of pollutants, given their proximity to traffic emissions, an absence of physical barriers and higher respiration rates.[7] Furthermore, higher levels of air pollution have been associated with lower levels of physical activity,[5,8] which suggests that air pollution is indirectly, as well as directly, detrimental to health, as it deters people from engaging in physical activity.

To date, most academic and public dialogues around exercising in polluted areas tend to centre around encouraging people to avoid exposure, such as by walking or cycling away from highly congested roads,[6] avoiding the time and location of heavy air pollution and exercising indoors. Although these downstream strategies may reduce risk for individuals, particularly those with pre-existing health problems such as asthma, they may contribute to a vicious cycle of inequalities at the population level. People of lower socioeconomic status tend to have fewer choices

Key points

- Both physical inactivity and air pollution are important global health problems.
- Although research suggests that physical activity may still reduce risk of death when conducted in areas of relatively high air pollution, exposure to air pollution remains detrimental to health.
- Physical inactivity and air pollution should be considered as "syndemics," given that they share drivers and disease outcomes.
- Addressing the root causes of air pollution and physical inactivity synergistically through systems approaches, such as urban planning, transportation, and energy policies, can reduce the disease burdens of both problems.
- Joining forces across noncommunicable disease prevention agendas would maximize human, environmental and planetary health.

regarding when, where and how they can exercise; are less able to afford indoor exercise facilities; tend to live in areas with worse air pollution; and have poorer access to urban greenspace and public exercise facilities away from roadways.[9] Therefore, risk reduction approaches that do not address the root causes of noncommunicable diseases could exacerbate health inequalities. People should not be forced to choose between physical activity and air pollution.

Instead, physical inactivity and air pollution should be addressed as syndemics. This means that the 2 problems share health outcomes (e.g., cardiovascular disease), interact with one another on the mechanistic pathways to ill health and co-occur within the same context, namely car dependency, unsustainable urban and transportation planning, and social and health inequalities.[10] Our recent systems mapping exercise showed that physical inactivity and air pollution jointly affect disease and economic burdens and share various drivers, including poor urban planning, transportation systems and reliance on fossil fuel.[10] Tackling the syndemics of air pollution and physical inactivity requires working across sectors and disciplines to understand the complex systems that have perpetuated both health issues and to address the root causes by developing sustainable whole-system solutions that include urban planning, transportation and energy policies.

By focusing on the systems, capitalizing on the synergies across various agendas for noncommunicable disease prevention and developing upstream solutions, priorities could be aligned across sectors and win–win solutions could be attained. Our recent scoping review and agent-based modelling showed that at-scale physical activity interventions could help societies meet the United Nations Sustainable Development Goals.[11] Through a combination of transportation and urban planning strategies, such as improving public and active transportation infrastructure, reducing inequalities in access to public recreational spaces and disincentivizing driving, societies around the world could reap multiple "co-benefits," such as better health through physical activity, fewer traffic deaths and injuries, improved air quality and reduced greenhouse gas emissions.[11]

Both physical inactivity and air pollution have detrimental effects on health. Staying active should not be at the cost of compromised health from air pollution. Addressing both major public health issues through synergistic, upstream, system-level approaches would lead to long-term health benefits for humans and the planet.

References

1. Guthold R, Stevens GA, Riley LM, et al. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants. *Lancet Glob Health* 2018;6:e1077-86.
2. van Sluijs EMF, Ekelund U, Crochemore-Silva I, et al. Physical activity behaviours in adolescence: current evidence and opportunities for intervention. *Lancet* 2021 July 21 [Epub ahead of print]. doi: 10.1016/S0140-6736(21)01259-9.
3. Air pollution. Geneva: World Health Organization. Available: https://www.who.int/health-topics/air-pollution#tab=tab_1 (accessed 2021 July 17).
4. Guo C, Yu T, Chang L-y, et al. Effects of air pollution and habitual exercise on the risk of death: a longitudinal cohort study. *CMAJ* 2021;193:E1240-9.
5. Tainio M, Jovanovic Andersen Z, Nieuwenhuijsen MJ, et al. Air pollution, physical activity and health: A mapping review of the evidence. *Environ Int* 2021;147:105954.
6. Qin F, Yang Y, Wang S-T, et al. Exercise and air pollutants exposure: a systematic review and meta-analysis. *Life Sci* 2019;218:153-64.
7. Cepeda M, Schoufour J, Freak-Poli R, et al. Levels of ambient air pollution according to mode of transport: a systematic review. *Lancet Public Health* 2017;2:e23-34.
8. An R, Zhang S, Ji M, et al. Impact of ambient air pollution on physical activity among adults: a systematic review and meta-analysis. *Perspect Public Health* 2018;138:111-21.
9. Cowie CT, Ding D, Rolfe MI, et al. Neighbourhood walkability, road density and socio-economic status in Sydney, Australia. *Environ Health* 2016;15:58.
10. Howse E, Crane M, Hanigan I, et al. Air pollution and the noncommunicable disease prevention agenda: opportunities for public health and environmental science. *Environ Res Lett* 2021;16:065002.
11. Salvo D, Garcia L, Reis R, et al. Physical activity promotion and the United Nations Sustainable Development Goals: building synergies to maximize impact. *J Phys Act Health* 2021 July 13 [Epub ahead of print]. doi: 10.1123/jpah.2021-0413.

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