Physical activity and air quality, incorporating climate change; a look at the research

Poor air quality is the largest environmental risk to public health in the UK, as long-term exposure to air pollution can cause chronic conditions such as cardiovascular and respiratory diseases as well as lung cancer, leading to reduced life expectancy. Air pollution has a significant effect on public health, and poor air quality is the largest environmental risk to public health in the UK. In 2010, the Environment Audit Committee considered that the cost of health impacts of air pollution was likely to exceed estimates of £8 to 20 billion.

Low levels of physical activity are a major public health challenge, contributing to the national burden of non-communicable disease and demand on health and social care services. Regular physical activity is proven to help prevent and manage noncommunicable diseases (NCDs) such as heart disease, stroke, diabetes and several cancers. It also helps prevent hypertension, maintain healthy body weight and can improve mental health, quality of life and well-being.

This report highlights some of the available literature on the relationship between physical activity and air quality. It will explore some of the potential considerations that could be put into practice at 'place'.

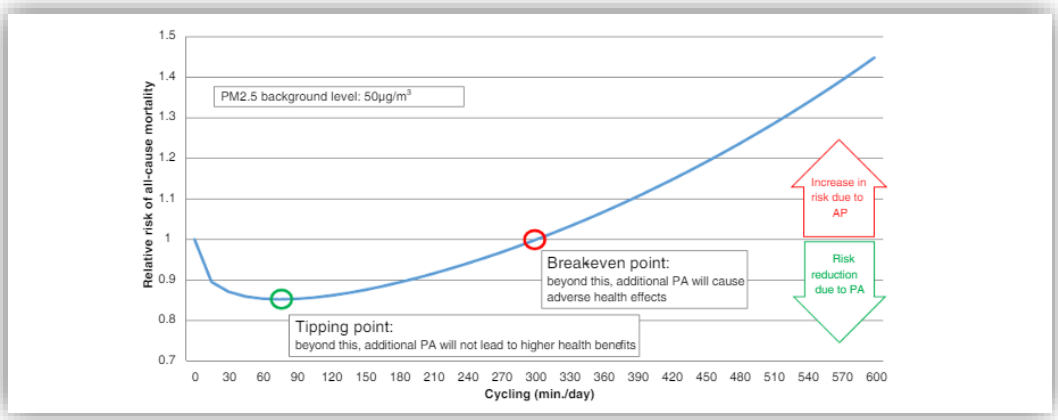
1.0 Physical activity and air quality

High quality, longitudinal evidence that directly looks at the links between physical activity and air quality and specifically at any potential mitigating effects of physical activity on people in areas of poor air quality, are lacking. However, evidence that is worth noting included;

1.1 Active travel

A study performed in 2016 by Tainio M et al. [1] which looked at whether air pollution negate the health benefits of cycling and walking for travel and found that the 'benefits of active travel outweighed the harm caused by air pollution in all but the most extreme air pollution concentrations' (p.233) The following image was taken from that review and shows the dose response effect of outdoor daily cycling benefits vs. risk due to air pollution. [5: p.234)

Figure 1- Illustration of tipping point and break-even point as measured by the relative risk (RR) for all-cause mortality (ACM) combining the effects of air pollution (at 50 µg/m3 PM2.5) and physical activity (cycling). [1]



A more comprehensive review study by Tainio M et al. [2] from 2021 looking at air pollution, physical activity and health supported the findings of the 2016 research that 'in most situations benefits of physical activity outweigh the risks of air pollution, at least in the active transport environment' (147 p1) However the review did find that 'overall evidence on all examined links is weak for low- and middle-income countries, for sensitive subpopulations (children, elderly, pregnant women, people with pre-existing conditions), and for indoor air pollution' (147 p.1)

1.2 General exercise and air quality

A comprehensive review by Giorgini P et al. from 2016 [3] found that in relation to air quality and exercise that 'The overall evidence supports that the risk-to-benefit ratio generally favors that health care providers continue to strongly encourage their patients to perform regular aerobic exercise' (p.84). It did provide a further recommendation that greater effort should be made to educate people about the risk of air pollution during exercise.

In addition to the Giorgini review, a more recent longitudinal cohort study from 2021 by Guo C et al. [4] found that regular exercise can reduce the risk of death regardless of the levels of PM2.5 exposure and summarised by saying that 'exercise is a safe health improvement strategy, even for people residing in relatively polluted regions' (p.1240)

This literature review report also found 4 systematic reviews that cover this subject:

1. The first systematic review from 2018 by An R et al. [5], included a meta-analysis looking at impact of ambient air pollution on physical activity among adults in the USA and UK, reported that high levels of air pollution generally discouraged physical activity and specifically 'those with respiratory disease, self-reported a reduction in outdoor activities to mitigate the detrimental impact of air pollution' (p.1). The findings of this research imply that those of whom physical activity would particularly benefit i.e. with long term health conditions, are also the ones more likely to stop during periods of poor air quality. The study however didn't detail the reason for the fall in activity, for example whether the adults studied, i.e. those with long term heath conditions, were made

aware of local air quality index systems which may tell people to refrain from physical activity during high pollution episodes.

2. In a similar review from 2019 including a meta-analysis looking at exercise and air pollutants exposure, Qin F et al. [6] found that 'The combination effect of air pollution and exercise was found to be associated with the increased risk of potential health problems' (p.153)

3. A third review from 2019 from An R et al. [7] looking at the impact of ambient air pollution on physical activity and sedentary behaviour in China found that a 'decline in overall air quality and increase in $PM_{2.5}$ concentration were found to be associated with reduced daily/weekly duration of outdoor leisure-time and/or transportation-related physical activity such as walking' (p.176). However this review found this to be preliminary evidence and stated that future studies should look at adopting 'objective measures of physical activity and a longitudinal or experimental study design are warranted to examine the impact of air pollution on sensitive sub-populations such as children, older adults and people with pre-existing conditions, and in locations outside China' (p.176)

4. Finally, the fourth and most recent systematic review from August 2019 performed by Madureira J et al. [8] looked at groups that are more susceptible to poor air quality and summarised by saying that 'specific groups of the population have enhanced susceptibility to adverse effects from particulate matter exposure while exercising' (178 p.1)

1.3 Physical activity and indoor air quality

A small cohort study from 2015 in the USA performed by Ramos CA et al. [9] looked at the quality of indoor air for fitness classes and summarised that 'inhalation of pollutants is increased during heavy exercise, demonstrating the need to maintain high indoor air quality in fitness centers' (p.118). This study was supported by a 2020 review by Salonen H et al. [10] into human exposure to air contaminants in sports environments which agreed that 'strict air quality requirements in indoor sports facilities should be maintained' (p.1109) This study went further with a range of recommendations to leisure providers including:

'adequate mechanical ventilation with filters, suitable cleaning practices, a limited number of occupants in fitness centers and gymnasiums, the use of electric resurfacers instead of the engine powered resurfacers in ice hockey arenas, carefully regulated chlorine and temperature levels in indoor swimming pools, properly ventilated pools, and good personal hygiene' (p.1109)

1.4 Future research

Perhaps one of the most pertinent pieces of research has yet to be performed; a new longitudinal prospective cohort study has been planned by Elavsky S et al. (2021)[11] and plans to look specifically at physical activity in an air-polluted environment.

This study is an investigation of both long-term and short-term associations among air pollution, physical inactivity, sleep, running-related injuries and psychosocial factors across the adult lifespan.

This study is due to make findings in ~2022 and ~2027, and therefore should be reviewed at that time with a view to be included in this report.

2.0 Physical activity and climate change

A review performed by Bernard P et al. in 2021 [12] , looked at the wider implications of physical activity and sport on climate change, and supported the findings of the previous reviews showing a 'consistent negative effect of air pollution, extreme temperatures and natural disasters on PA (sic *Physical Activity*) levels. This PA reduction is more severe in adults with chronic diseases, higher body mass index and the elderly' (p.1041)

This review went further to show the wider benefits of sport and physical activity when linked to post-natural disasters 'Sport and PA communities can play an important mitigating role in post-natural disaster contexts' (p.1041) This is of particular relevance in light of the COVID19 pandemic and efforts focusing on recovery.

The study concluded that climate change impacts affect activity at a worldwide scale and that physical activity can play both a mitigation and an amplification role in climate changes. (Due to its potential source of greenhouse gas emissions). Therefore, any additional work on physical activity as recovery from the COVID19 pandemic should also note the potential knock on impacts that it might have on further emissions.

3.0 Summary and potential considerations

- Physically active travel (e.g. cycling and walking) should be considered a positive alternative in all but the most extreme levels of air pollution. However further research is needed on the implications for vulnerable population groups [1][2]

- A reduction in air pollution may support an increase in physical activity levels [5]

- Exercise during periods of poor air quality comes with an enhanced risk [6], particularly for those more susceptible such as those with long term health conditions [8]

- Particular emphasis on physical activity during periods of poor air quality should be given to those with long term health conditions who may automatically reduce their levels of activity to mitigate risk. [5] [7]

- For leisure centre and indoor sports facility providers, consideration should be made into maintaining high levels of good indoor air quality. [9][10]

- Sport and physical activity should play a key role in the recovery from the COVID19 pandemic and on work to mitigate climate change, however the focus should be on sustainable activity which does not increase greenhouse gas emissions. [11]

4.0 References

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