

Air Pollution, Health and Sports Performance

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ABSTRACT

In the present era Air pollution is one of the biggest hazards that affects health and sports performance vigorously. Pollution of air directly affects health and sports performances and potential adverse consequences of exposure to air pollutants during exercise include decreased lung function, and exacerbation of asthma and exercise-induced bronchoconstriction. These effects are especially relevant for athletes and during international competitions, as they may impact athletic performance. Individuals, who have pre-existing conditions such as asthma, or other heart or lung ailments, are especially at risk of harm if exercising while in polluted conditions. Let see what are the impacts of air pollution on exercise? How can we protect us from the effects that air pollution will have on our health and performance while exercising? Human controlled and observational studies both lead to the conclusion that air pollution adversely affecting health and athletic performance during training and competition. The dosage of various air pollutants during exercise is much higher due to the marked increase in ventilatory rate and concomitant nasal and oral breathing. This is particularly true for sulfur dioxide which is a highly water-soluble gas and is normally absorbed in the upper airway during nasal breathing. With heavy exercise, oral pharyngeal breathing is the predominant mode of breathing and much larger amounts of sulfur dioxide are delivered to the lower airway resulting in significant impact upon the lower respiratory tract. More recently, several controlled human studies have shown that a combination of exercise and air pollutants such as ozone (O₃) or sulfur dioxides (SO₂) cause a significant increase in bronchoconstriction and air flow obstruction when compared to the same exposure at rest. In strenuous athletic competition such as the Olympic Games where small increments of time often determine the ultimate success of athletes, the impact of air pollutants and subsequent adverse ventilatory changes can affect athletic health and performance.

Key Words : Air pollution, Sports performance, Sports competitions, Olympic Games

INTRODUCTION

Air pollution is a global issue and is believed to kill more people worldwide than AIDS, malaria, breast cancer or tuberculosis. Even though air pollution sometimes results from forest fires or desert sand storms, it is largely associated with urban areas and large cities. Since the population living in urban areas has increased rapidly over the last 2 decades, the health consequences of air pollution are expected to create an increasingly larger illness burden in years to come. Today, around 50% of the global population lives in urban areas, but in the developed world this figure is approaching 80%. Airborne particulate

matter (PM) is especially detrimental to health and has been estimated to cause between 3 to 6 million deaths per year alone, primarily via cardio-respiratory diseases. Exercise is a key ingredient of a healthy lifestyle, but research has shown that air pollution can make exercising a health risk and impact on our performance. Individuals, who have pre-existing conditions such as asthma, or other heart or lung ailments, are especially at risk of harm if exercising while in polluted conditions. Outdoor air pollution comes from many sources including traffic from motor vehicles, burning wood or other materials, pollen from trees and flowers, agricultural or construction operations, and other sources. Exposure to these

pollutants can cause health problems even when a person is not exercising, however, when someone is exercising the potential for health problems amplify. Health concerns from exercising in polluted air include the possibility of developing both upper and lower airway problems. Pun and Ho (2019) suggest that inhalation of suspended particles is associated with an increase in systolic blood pressure after the exercise. Guo and Fu (2019) estimate, for example, that a marathon runner among the top 10 would need almost 5 more minutes (12 minutes in the case of an average runner) to finish the race running in pollution conditions like those experienced in the 2014 Beijing Marathon. Berghmans *et al.* (2009), point out that, in addition to NO₂ and other compounds, cyclists inhale many particles in suspension, finding, however, differences in their concentration along a route. Lichter *et al.* (2017), in a study conducted in the German professional football league, suggest that a 1% increase in PM10 concentration leads to a 0.02% decrease in the performance of professional soccer players (measured by the number of passes in a match), also pointing out that “productivity decreases significantly if the concentration of particles exceeds the EU regulatory threshold of 50 micrograms per cubic meter, [...] starting to materialize at around 20 micrograms per cubic meter”. Rundell (2012) evaluated the effect of pollution in athletes’ performance and concluded that the practice of physical exercises in environments with high levels of pollutants reduces sharply the pulmonary and vascular function both in asthmatic individuals and healthy ones. Therefore, the practice of exercises in long-term in polluted places is associated to the reduction of pulmonary function, being able to induce vascular dysfunction, due to the systemic oxidative stress and in the nasal passages, and, consequently, reduce the athletes’ performance (Rundell, 2012). However, the benefits of exercise are well recognized, and person should not give up exercise unless a person absolutely necessary.

Aim and objectives of the study:

The main aim and objectives of the study is to discuss air pollution and its impact on health and sports performance.

Observation:

“When exercising, we’re typically breathing harder and inhaling more air deeper into our lungs. We’re also more likely to breathe through our mouth while exercising,

which causes the air we breathe to evade our nasal passages which usually filters out many airborne particles,” says Kevin Wood, Camfil USA Vice President Sales and Marketing. “These airborne particles then have a greater chance to penetrate into our lungs and cause things like headaches, increased risk of asthma, increased risk of heart attacks or stroke, damage to the lungs themselves, or even death. Research into the damage the air pollution caused in athletes suggests that constant inhalation of dangerous air pollutants can lead to the development of asthma. Extended pollution exposure can also cause airway hyper-responsiveness, a condition associated with both chronic obstructive pulmonary disease as well as asthma. Studies imply that individuals who live in areas with high levels of particulate pollution are more likely to die from heart attacks, which is a concern for athletes who train outdoors and take in large amounts of particulate pollutants. Elite athletes such as Haile Gebrselassie or Paula Radcliffe, who are both asthmatic, have faced this dilemma on numerous occasions. Gebrselassie, for example, decided not to run the marathon at the 2008 Beijing Olympic Games. The reason given was the high pollution levels. This situation, which is common in the Chinese capital, also raised concern among the participants of the aforementioned 2014 marathon. Practising sports brings about changes in a person’s breathing that can worsen the negative effect of pollution. For example, an athlete increases their breathing rate and flow rate, causing the amount of inhaled pollutants to be higher and reach deeper into the respiratory system; in addition, they usually breathe through their mouths, thus they lose the filtering effect of their nasal hair. In a 42 km marathon, for example, and as described by Marr and Ely, ‘an athlete who runs at 70% maximum oxygen uptake capacity during a marathon (~3 h) inhales the same volume of air as a sedentary person in two days. What are the health implications of this overexertion? Inhalation of suspended particles, for example, could lead to inflammation of the airways and the vascular system, damage caused by oxidative stress and a reduction in lung function. The practice of exercises in long-term in polluted places is associated to the reduction of pulmonary function, being able to induce vascular dysfunction, due to the systemic oxidative stress and in the nasal passages, and, consequently, reduce the athletes’ performance (Rundell, 2012). Rundell (2012) evaluated the effect of pollution in athletes’ performance and concluded that the practice of physical exercises in

environments with high levels of pollutants reduces sharply the pulmonary and vascular function both in asthmatic individuals and healthy ones. In recent years, several epidemiological studies in both developed and developing countries (Nwachukwu and Ugwuanyi, 2010; Yelda and Mustafa, 2011; Nwachukwu *et al.*, 2012; Lelieveld *et al.*, 2019) have occurred, showing short-term and long-term exposure to air pollutants and its adverse associated health effects. Similarly, time series studies conducted in Asian cities also showed effects of exposure to particulate matter such as NO₂, SO₂, O₃ on mortality to those explored in Europe, South America and Africa (Vlatka *et al.*, 2011; William, 2012; Menezes *et al.*, 2012; Ibe *et al.*, 2017; Lelieveld *et al.*, 2019). Polluted environments put athletes at risk for chronic heart and lung disease, as reported in 2012 by the British Journal of Sports Medicine. The problem is particularly acute for marathon runners and cyclists training near highways or in large cities where they frequently breathe exhaust fumes from passing vehicles. Immediate effects from pollutants, like carbon monoxide, can include depleted oxygen to the tissues, increased heart rate and elevated blood pressure. Asthma, pulmonary hypertension and cardiovascular disease are possible long-term consequences. Young athletes may develop asthma as a direct result of playing outdoor sports if they live in a community with high levels of air pollution, as suggested by researchers at the University of South Carolina. In fact, results of the USC Children's Health Study released in 2002 indicated that children involved in three or more outdoor athletic teams that compete in neighbour hoods with poor air quality have a three to four times higher risk of developing asthma than non athletes. Consideration of environmental challenges for athletes is not a new issue as in 1968, at the XIX Olympiad in Mexico, studies examined the effect of the high altitude (>2,250 m) running performance (Jokl *et al.*, 1969). Four decades later at the 2008 Beijing Olympics, this deleterious view of the environment still pervaded. The 2008 games were dominated by controversies over anthropogenic contributions to the environment and, in particular, air pollution. Beijing then ranked second among the World's most polluted cities according to Lippi *et al.* (2008).

Discussion:

Winning is an aspiration associated with professional sport. It is the culmination of a path forged through perseverance, effort, and sacrifice. Now imagine not

being able to reach that goal because the moment a person required his/her body to function at 100%, bad air quality prevented it. Like those Sri Lankan cricketers who fell ill due to the pollution, they endured in Delhi. Research into the effects of air pollution on exercise performance has correlated air pollution with reduced athletic performance. "One of the pollutants in smog is carbon monoxide, which has a measurable degrading effect on a person's ability to transport oxygen throughout their body, since it impacts red blood cells," says Camfil's Wood. "Carbon monoxide enters into the blood through the lungs and occupies the sites where oxygen-carrying red blood cells usually bond. As the amount of carbon monoxide in the blood increases, athletic performance will drop linearly in correlation, since the blood is transporting less oxygen." Particularly high levels of carbon monoxide, such as is found in areas with heavy smog problems like Beijing or Los Angeles, can degrade a person's muscular coordination. Mental functioning can also be negatively affected, due to the fact that up to 5% of the red blood cells in a person's body can be weighed down by carbon monoxide. Other pollutants such as hydrocarbons and ozone can irritate a person's throat, nose, lungs, and air passages. This likewise reduces the amount of oxygen in the body and reduces athletic performance. Research into exposure to ozone, carbon monoxide, and sulfur oxides has linked the substances to inhibited athletic performance. A study which examined race times among high school students in the Los Angeles area found that exposure to high levels of oxidants was positively correlated with slower race times. Regardless of its geographical origin, air pollution moves freely around and respects neither city nor national borders. Most often it is a mix of several pollutants that come from multiple sources. Local topography (mountains, deserts, sea, etc.), climate (temperature and humidity) and weather conditions (sun, rain, wind) may have a significant impact on the magnitude of air pollution in a geographical area. However, it is the amount of particles and gases emitted into the air from different sources that constitutes the root cause of air pollution. Consequently, air quality is most often compromised in heavily industrialised areas with large populations.

Conclusion:

Researchers found that the practice of exercises in long-term in polluted places is associated to the reduction of pulmonary function, being able to induce vascular dysfunction, due to the systemic oxidative stress and in

the nasal passages, and, consequently, reduce the athletes' performance (Rundell, 2012).

Rundell (2012) evaluated the effect of pollution in athletes' performance and concluded that the practice of physical exercises in environments with high levels of pollutants reduces sharply the pulmonary and vascular function both in asthmatic individuals and healthy ones.

It is also found that "One of the pollutants in smog is carbon monoxide, which has a measurable degrading effect on a person's ability to transport oxygen throughout their body, since it impacts red blood cells."

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Planners and organisers should perform detailed measurements of air quality before deciding on the location of a sport facility or event site.

Choosing of practice fields and competition venues

should be as far removed from a pollution source as possible.

Should be avoided all use of fossil-fuelled vehicles and machinery inside a sports arena.

Detailed measurements of air quality should be taken before deciding on the location of a sport facility or event site.

Teams and athletes should do avoid exercising along or nearby roads with heavy traffic or in areas with industrial pollution.

One should avoid high-intensity or long-duration exercise on days with poor air quality.

Candidate should wear a face mask on days with poor air quality.

Athletes with asthma, allergies or other airway illnesses should be diligent about keeping to their treatment plan and adjust their medication according to changes in air quality and illness symptoms.

If experiencing symptoms of respiratory infections, be extra cautious about minimising exposure to air pollutants.

Antioxidant supplementation in moderate amounts and/or small doses of inhaled corticoids may be considered, if otherwise healthy athletes are experiencing airway symptoms due to a sudden increase in air pollution.

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The benefits of exercise are well recognized, and person should not give up exercise unless a person

absolutely necessary.

However, protecting ourselves from the impacts of air pollution on exercise is important. "Exercise should be done in either the early morning or late evening. This is when air pollution levels, especially ozone levels, are at their lowest. Likewise, runners should avoid the most heavily trafficked roads, where levels of combustion pollutants are highest." Training should be done indoors if possible, and in a room with a high-efficiency air purifier.

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