

LETTER TO THE EDITOR

Modeling and Analysis of the Impact of Smog Pollution on the Training Effect of Intensive Sports

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With the deterioration of air pollution and the frequent occurrence of smog pollution, high-intensity sports training will seriously damage the functions of various organs and body systems, and at the same time affect the training effect. For high-intensity sports training, while actively coping with the impact of bad weather, we should also take effective measures to improve training places, scientifically and rationally arrange the time and area of high-intensity sports training, and carry out new-style sports training activities to ensure the sustainable development of high-intensity sports training behavior. Therefore, prevention and control of air pollution, scientific training arrangements have become a common concern. The purpose of this paper is to introduce the influence of smog pollution on the effect of intensive sports training and the countermeasures to prevent air pollution, so as to provide reasonable suggestions for better selection of training time, place and mode.

Smog Pollution; High Intensity Exercise; Training Effect; Modeling and Analysis

1 Introduction

Nowadays, smog pollution has seriously affected people's normal life. In March 2014, Premier Li Keqiang pointed out that the government, enterprises and the public should take part in the new mechanism to strengthen pollution prevention and control, focusing on a certain area of a mega-city with frequent smog, taking PM2.5 of fine particulate matter and PM10 of inhalable particulate matter as breakthroughs, grasping the key links of industrial structure, energy efficiency, exhaust gas treatment and dust raising, improving the government, enterprises and the public to participate in the new mechanism and implement joint regional prevention and control, and enter the implementation of the air pollution prevention and control action plan. Like the declaration of war on poverty, we should persist in declaring war on pollution. Premier Li Keqiang's analogy between poverty and pollution fully reflects the harmfulness of pollution and pollution control is an urgent matter. Earlier, some scholars have studied the impact of smog pollution and achieved some results.

There are many major air pollution accidents in modern history. Taking London smog incident in 1952 as an example, the number of deaths in the accident is often more than that in the area. Heart and respiratory diseases account for 84% of the deaths, and the number of deaths from tracheitis in urban areas is 10 times higher than usual. This shows the impact of air pollution on the health of citizens and athletes. At present, smog pollution has seriously disturbed people's travel, endangering the health and life of the masses and athletes. Therefore, it is an urgent "century event" to control the current air pollution.

Bin Zhang published an article in the Journal of Ekoloji (Issue 107, 2019) entitled "Modeling and Analysis of the

Effects of Aerobic Exercise on Human Cardiovascular Function in Smog Environment.” In this paper, human cardiovascular models were established to collect cardiovascular markers of aerobic exercisers in smog environments. Taking the maximum oxygen uptake, maximum oxygen ventilation equivalent, oxygen pulse, maximum heart rate as the constraint index, considering the diffusion intensity and penetration strength of the smog, the effects of aerobic exercise on the human cardiovascular in the smog environment were simulated. (Cevizci, 2015)The cardiovascular system of aerobic exercise apparatus in smog environment was modeled by using neural network method, which uses the Matlab and Simulink simulation platform to establish the model of the influence of aerobic exercise on smog environment. Applying the results of this paper to this paper will be helpful to the research of this paper.

Reference (Chi 2016) put forward the influence of exercise on human heart and lung function in severe smog weather environment. In this paper, the comparative method is used to select 20 residents who often take part in physical exercise as the heavy pollution exercise group around the monitoring points of severe smog area, and 20 residents who do not often take part in physical exercise as the heavy pollution control group, sampling supervision in urban areas with good air quality. The method has limitations. Intelligence can verify the effect of smog on human cardiopulmonary function, but cannot validate the effect of smog pollution on athletes' training. Therefore, this paper puts forward the modeling and analysis of the influence of smog pollution on the effect of high-intensity sports training.

2 Idea description

2.1 Concepts and causes of smog pollution

“Fog” is a natural phenomenon of the weather. When the atmosphere is stable, the water vapor in the atmosphere is sufficient. When the relative humidity reaches 100%, the water vapor will condense into fine water droplets suspended in the air, causing the visibility of the ground to decrease, the so-called fog weather. “Smog” is a kind of particulate matter generated by a large amount of industrial pollution, dust particles, automobile exhaust gas, garbage burning and other pollution sources suspended in the atmosphere under the conditions of a certain foggy weather. Blending together to form the smog pollution that people see. (Kylili et al., 2018)From the aerodynamic point of view, atmospheric particles with a diameter of $\leq 10\mu\text{m}$ are easily inhaled by the nose and mouth, and further subdivided: coarse particles (PM10) with a diameter of $2.5\text{-}10\mu\text{m}$ can be deposited in the upper respiratory tract; diameter $\leq 2.5\mu\text{m}$ of fine particles (PM2.5) and ultrafine particles (PM0.1) of $\leq 0.1\mu\text{m}$ in diameter can be deposited on the bronchioles and alveoli. The development of industrial society has led to the inhalable particulate matter containing many toxic substances, such as sulfur dioxide, metal compounds, etc., long-term adsorption of harmful substances by human body will endanger the health of the body (Allen et al. 2017).

The first source of toxic particulate matter in cities is automobile exhaust. Diesel-powered motor vehicles are a recidivist of fine particulate matter emissions. Long-term exposure to automobile exhaust can directly stimulate the human respiratory tract, reduce the immunity of the respiratory system, and lead to a series of symptoms such as chronic bronchitis, bronchial asthma and dyspnea in the exposed population. Long-term inhalation of diesel particulate matter in experimental animals can cause a large number of particulate matter in alveoli, alveolar II cells, interstitial assemblage and collagen fibers proliferation, a large number of neutrophils, plasma cells and macrophages engulfed particulate matter, and form patchy spots in the lungs; the half-life of particulate matter removal in the lungs is prolonged, the function of macrophages is reduced, immunity is decreased, and the chance of bacterial infection is enhanced, ultimately impair lung ventilation function, resulting in chronic injury and pathological changes. The life activities and physiological functions of the human body are maintained by continuous gas exchange with the external atmospheric environment. Obviously, the components of air pollution

have become the guarantee of human health. How harmful is physical exercise to the respiratory system in the environment of air pollution? As far as the respiratory system is concerned, the breathing mode of the body in quiet time is basically nasal inspiration, because the nasal cavity filters air into the lungs relatively few pollutants. In air-polluted environment, because of the transition of breathing mode from nasopharyngeal breathing to nasopharyngeal-orpharyngeal mixed breathing mode during exercise, the air entering the lungs through the nasal cavity will decrease while the air entering the lungs through the oropharynx will increase, which will greatly reduce the filtration of air pollutants by the nasal cavity. (Lugo-Vazquez et al., 2017) Deep breathing is often used in exercise, and the depth of breathing depends on the state of human activity, which leads to different ventilation. More inhalable particulates in polluted air enter the body due to the increase of lung capacity, ventilation per minute and respiratory rate during exercise. One part is attached to and deposited on the respiratory wall and epithelial cells; the other part uses the increase of alveolar diffusion area during exercise to enter the alveoli and deposit in the deep part of the lungs, which makes the respiratory function decline and the ventilation function of the lungs decrease, thus aggravating the morbidity and mortality of respiratory diseases (Liu et al. 2017).

2.2 Effect of smog pollution on high intensity sports training

Smog pollution first affects people's visual range. A large number of granular substances are suspended in the atmosphere, making the air turbid, and the transparency of the atmosphere is obviously inadequate, leading to a significant reduction in visibility. As smog pollution becomes more and more serious, visibility decreases from 1 km to 500 m, even 200 m or 100 m. The lack of visibility has a direct impact on people's travel, thus causing potential travel safety hazards. At the same time, a large number of particles in smog will adhere to the retina. The retina is a very weak soft tissue. In the presence of foreign bodies, the particles will cause eye friction to damage the integrity of the retina, and then produce various eye complications, such as retinal damage, visual impairment and so on (Li 2014).

Research shows that during exercise, even under normal breathing conditions, atmospheric particulate matter with diameter less than $10\mu\text{m}$ can easily enter the respiratory system of human body through the breathing action of nostrils and mouth. During the breathing process, particulate matter will adhere to the inner wall of respiratory tract with the breathing action, while smaller particulate matter (PM_{2.5}, PM_{0.1}) will go deeper into the human lungs, lung lobes, alveoli and other organs which play a key role in the respiratory system. Long-term breathing in harsh air environment will produce precipitation and adhesives in the lungs, most of these are harmful, and over time, various respiratory diseases will occur. At the same time, because of the large amount of water vapor in smog, it will produce aerosol liquids when it blends with particulate matter (Li 2015). These fluids are also easy to adhere to the exposed skin surface, if not handled in time, they will affect the skin function. If the skin pore accumulates harmful substances, it will breed more bacteria to endanger the health of the skin, accompanied by various skin diseases.

3 Results

3.1 The effect of smog pollution on the improvement of high-intensity exercise training

Sport training is a process of repeated circulation and spiral rise. This process requires constant stimulation of the amount and intensity of exercise in order to improve the role of sports training. American University Sports Medicine has established 53% VO₂max and 65% HRmax intensity exercise as the lowest intensity to improve cardiovascular system function. The lowest intensity proposed by the organization is 40% VO₂max and 55% HRmax. Research shows that short time, low intensity, and small amount of sports content cannot play a strong body effect. For people who want to improve their sports training, they need enough intensity and amount of exercise to ensure that they can increase the physical load required for sports training.

Affected by smog pollution, the days of environmental pollution index in the normal range are less and less, and the accumulation of time cannot guarantee long-term exercise time. In addition, under bad weather conditions, the respiratory system will be affected, especially during exercise, breathing is much stronger than the body's normal condition to maintain metabolism. Poor air quality increases to a certain extent in the respiratory system, which will have a negative effect, indirectly causing the exercise intensity to not go up, and the exercise process is terminated. Under the condition of high intensity training, it is very difficult for athletes to improve their training effect.

3.2 Smog pollution affects athletes' mental health

In the environment of heavy smog, people's fear of smog will come into being, and the groups who used to take part in physical exercise will no longer be happy to talk about the health and happiness brought by sports. Conversion to frequent training in the smog environment will lead to the occurrence of various physical diseases, emotional depression, and ultimately affect the enthusiasm of training.

If the illness of the body is intuitive and obvious, then the psychological shadow produced by bad weather environment will be deep-seated. The result of psychological obstacles is a chain reaction, which has a long latency period, or affects various living conditions. As sports workers, it will have a more far-reaching impact. They will no longer instill the concept that sports are beneficial to health, especially in the sports teachers' industry. Long-term exposure to smog outdoors and weather aversion will affect sports teaching.

4 Discussion

4.1 Countermeasure of influencing the effect of high strength sports training under smog pollution

A large number of studies show that coal and petroleum are the main energy components in China. With the continuous development of China's economy, the demand for energy has increased dramatically, and the demand for traditional energy such as coal and petroleum has increased dramatically, resulting in more burning garbage, a large number of dust and harmful gases discharged into the atmosphere, aggravating atmospheric pollution. Therefore, if we want to completely change the impact of smog pollution, the fundamental problem is to control the current sources of air pollution, control pollution emissions, put pollution issues on the legal level, and governs according to law. For our country, changing the traditional energy supply structure, developing and encouraging the use of clean energy is the key to solve the problem of air pollution. Developing new energy and utilizing low-polluting energy have become the top priority of smog control in our country.

4.2 Increase indoor training venues

Indoor activity space and content have limitations, and cannot replace household training fundamentally. In addition to the need for high-intensity sports training to improve the effect of sports training, there is also a strong demand for social communication and sports communication. Indoor training mainly focuses on ball games, and the content of activities is limited. Therefore, it is necessary to enrich the contents of indoor training activities.

4.3 Arrange training time and place scientifically

Relevant research literature shows that the occurrence of smog pollution has obvious seasonal and temporal characteristics. During the cycle of four seasons in a year, the air quality in November, December, January and February is the worst, and the air quality in June-August is the best. Therefore, the smog weather mostly occurs in the late autumn, winter and early spring. During this period, the climate is cold and the air fluidity is poor, which is not conducive to the self-purification of the air. Among the periodic changes of the day, there are more cases of high pollution in the morning and evening, while in other periods, the air pollution index is relatively small. Therefore, the time arrangement of high-intensity sports training should avoid the time period of high pollution, so as to reduce the influence of air pollution on the effect of high-intensity sports training.

5 Conclusion

In order to solve the problem of smog pollution affecting the effect of intensive sports training, it is essential to control pollution. Increasing indoor training places is an effective measure. At the same time, attention should be paid to the increase and improvement of air filtration equipment in indoor sports venues. According to the temporal and regional laws of smog pollution, we can arrange high-intensity sports training activities scientifically and reasonably.

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