

Impact of the Cigarette Smoking on Athlete's Health: A Systematic Review

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Objectives: Athletes' smoking is still an important issue in the field of competitive sports. At present, there are very few studies on Athletes' smoking. By reviewing the articles related to athletes' smoking, we explore the impact of smoking on Athletes' health, so as to provide theoretical reference for the healthy development of athletes. **Methods:** We will use index words related to athletes and smoking to perform literature searches in the Web of Science, PubMed, Medline, China National Knowledge Infrastructure Database (CNKI), China Science and Technology Journal Database and WanFang Database, to include articles indexed as of August 25, 2021, in English and Chinese. **Results:** 1. Cigarette smoking will cause lung function, cardiovascular system, nervous system and other organ damage of athletes, resulting in chronic bronchitis, lung cancer, coronary heart disease, atherosclerotic heart disease, myocardial infarction and other diseases. 2. Cigarette smoking leads to the decline of athletes' physical resistance and immunity, training weakness and sports ability. 3. Cigarette smoking seriously restricts the development of athletes' health and the improvement of sports performance. **Conclusion:** Cigarette smoking is harmful to the health of athletes. Stay away from tobacco and quit smoking is the wisest choice for athletes to keep healthy and improve their sports performance.

Key words: Cigarette smoking; athletes; healthy; physical fitness

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Human use of tobacco can be traced back to Indian sacrifices in the first century BC, and by the 15th century, when the first European explorers arrived in America, tobacco was already widely used. The smoking of tobacco began in China during the Wanli Period of the Ming Dynasty (1573-1620), which was introduced to China by Matteo Ricci, a Missionary of the Italian Catholic Church. With the advent of the era of industrial machinery automation, the invention and technological innovation of cigarette rolling machines have

greatly improved the production of cigarettes, making it more convenient for people to obtain cigarettes, followed by more and more people joining the ranks of smokers. According to statistics, there are about 1.2 billion smokers worldwide^{1,2}. Most of them are adult males. Cigarette smoking is a very common unhealthy habit and one of the most serious public health problems in the world today. Smoking is the main cause of human lung cancer, bronchitis, emphysema, coronary heart disease, laryngeal cancer, esophageal cancer, arteriosclerotic heart disease, myocardial infarction, gastroduodenal ulcer, brain tumor and

cardiovascular disease^{3,4,5,6}. The mortality rate of smokers is generally higher than that of non-smokers, among which male smokers are far more than female smokers, and the annual death toll caused by smoking is as high as 8 million⁷. Cigarette smoking is the main cause of death and disease in the United States⁸, and 700,000 people die of smoking in the European Union every year¹. "Cigarette smoking is harmful to health" has become a global consensus. Competitive sports is a kind of game activity that requires very high physical, technical, tactical and mental ability of human beings. Breaking through the limits of human beings is not only the pursuit of dreams of competitive sports, but also the motivation to maintain the development of competitive sports. competitive sports competition intense increasingly white-hot, technology development is more and more fine, physical demands more and more extreme, is bound to the movement of athletes training level and quality put forward more stringent requirements, especially for athletes of the respiratory system, nervous system, cardiovascular system and digestive system put forward high request. The study found significant differences in health management risks between athletes and non-athletes, with athletes smoking significantly less than non-athletes (10% vs. 15%)⁹. The prevalence of smoking among athletes of different sports is significantly different, and the prevalence of smoking among athletes of team sports (such as football, rugby and ice hockey) is higher¹⁰. Athletes in team sports are three times more likely to smoke than sprinters and resistance athletes. The reason may be psychological: These sports don't focus on individual physical performance and make athletes feel less responsible for team success¹¹. A study by Alaranta A found that 11.4% of Finland's 446 elite Olympic athletes smoked, 3.6% smoked daily and 7.8% smoked occasionally¹². Hessami Z (2012) studied the smoking situation of 738 league athletes of different sports types in Iran, among which 24.6% had smoking experience and 9% were current smokers¹³. The cigarette smoking prevalence among collegiate athletes in the United States is 4%, while the prevalence among varsity athletes and non-varsity athletes is very close at 27.6% and 29.5%, respectively¹⁴. The cigarette smoking

rate of university athletes in Thailand is 37.6% (26.5% male and 11.1% female), among which 13.9% are smokers and 23.8% are currently smokers. The average age of starting smoking is 16.69 ± 2.43 years old, and the average smoking rate is 3.00 ± 3.20 cigarettes per day¹⁵.

Athletes still cigarette smoking is a major issue in the field of competitive sports, but about athletes smoking related research literature is very limited at present, based on this, this study based on extensive reading related research in the fact that smoking is hazardous to health, smoking on the health effects of athletes systematically reviews the research, in order to provide theoretical reference for the coaches and athletes in sports training.

EFFECTS OF CIGARETTE SMOKING ON LUNG FUNCTION OF ATHLETES

Human metabolism is to obtain the energy needed by oxidizing nutrients in the body. For this purpose, the human body needs to exchange gas with the external environment continuously through breathing, so as to absorb oxygen from the body and expel carbon dioxide generated in the body. Human respiration mainly consists of three physiological processes: external respiration (including lung ventilation and pulmonary ventilation), gas transport in the blood, and internal respiration (tissue ventilation and cellular oxidative metabolism). Oxygen intake and carbon dioxide discharge are realized through blood circulation and coordinated activities of tissues and cells¹⁶. Lung is a ventilator that drives the gas exchange between human tissues and the external environment. The function of lung determines the level of human metabolism.

When smokers smoke, tobacco burning will produce a lot of smoke, and release CO, nicotine, tar, formaldehyde, propylene alcohol and other harmful substances, these substances through the smoke into the respiratory tract, and adhere to the respiratory tract. The respiratory tract is stimulated by smoke. In order to avoid excessive stimulation of the lungs, the mucous membrane of the respiratory tract becomes dry and congested, and the secretion of mucus glands. At the same time, the bronchial epidermal cilia also clean up the smoke particles, and the macrophages destroy the remaining toxins. Long-term smoking will cause respiratory tract secretion disorder, produce large amounts of fluid, forcing bronchial epidermis cilia slow down, or even damage, leading to respiratory tract clean immune system malfunction, forced many carry

oil smoke sputum can't timely education body outside, because the sputum is protein, it provide a hotbed for breeding bacteria, plus bronchial superficial cilia and mucus lose protection, A large number of toxic substances in the smoke directly enter the alveoli and bronchi, causing inflammation or even damage to the respiratory tract, resulting in respiratory diseases, such as chronic bronchitis, lung cancer and chronic obstructive pulmonary disease, and thus affecting the health of the human respiratory system¹⁷.

Existing studies suggest that^{18,19,20}, There was no significant change in lung volume status in smokers compared with non-smokers, but all indicators of lung ventilation and small airway function were significantly decreased in most smokers. Smoker's airway and lung and bronchus overall is a continuous process of inflammation early smoking on lung function mainly smoking causes airway inflammation and the influence of this kind of inflammation, make the air in and out of the airway resistance, leading to small airway function damage and trachea ventilation, small airway and airway inflammation is aggravating, pulmonary ventilation function obstacle, the more serious, thus resulting in a decline in lung function. Early routine lung function examination results of smokers may show normal and no symptoms of respiratory tract lesions, but the phenomenon of small airway obstruction injury exists objectively, and once the symptoms of lesions appear, then the respiratory tract lesions are often moderate. Pathologic examination of the small airways of both nonsmokers and smokers also confirmed that smoking caused varying degrees of respiratory bronchial inflammation in the small airways of both smokers and non-smokers. Both active and passive smoking can damage lung function²¹. For athletes, lung capacity and maximal oxygen uptake are closely related to exercise performance. When lung capacity and maximal oxygen uptake decrease, the oxygen supply capacity during exercise also decreases correspondingly, which affects athletic performance and leads to poor athletic performance. Existing studies have shown that smoking reduces athletic performance because cigarette smoke inhaled into the lungs contains many toxic substances that affect the maximum lung capacity of athletes²². Endurance events require high lung capacity, and the greater the lung capacity, the greater the VO_{2Max} , the

better for athletic performance. Endurance sports athletes smoking rate is the lowest in all sports, almost no daily smokers, possible endurance athletes aware of the dangers of smoking on lung function is very big, it is extremely unfavorable for endurance sports performance athletes, skills class athletes dependence on vital capacity and vo_2 Max lost first and not as strong as endurance athletes. Saiphoklang N (2020) research shows that the Fagerstrom score of nicotine dependence of smoking in college athletes is 0.76 ± 1.47 . Cigarette smoking athletes have higher lung capacity than non-smoking athletes, and smoking athletes are more likely to drink alcohol²³.

EFFECTS OF CIGARETTE SMOKING ON CARDIOVASCULAR FUNCTION OF ATHLETES

Cardiovascular system consists of the heart and blood vessels of the body's blood circulation system, through the contraction of the heart, blood cycle flow within the circulation of the blood system, ensure the body oxygen, carbon dioxide and nutrients, metabolites and various humoral regulation of material transportation, maintaining organization cell metabolism and stable internal environment, to ensure the normal conduct of life activities¹⁶. Heart and cerebrovascular disease aggregate, it is to point to by hypertension, high blood fat, atherosclerosis, blood stickiness the heart, brain and systemic organ organization that wait to bring about is ischemic or give haemorrhagic disease. Cardiovascular disease is a serious threat to human health, with high morbidity, high disability rate and high mortality. Cardiovascular disease is the most common among people aged 35-54 and above. The number of cardiovascular disease deaths in the world is as high as 15 million every year, and the number of cardiovascular disease deaths in China is 3 million, accounting for 40.27% of the national death toll. Cardiovascular disease has become the leading cause of death of various diseases in the world²⁴. A large number of epidemiological studies have shown that smoking is an important pathogenic factor of cardiovascular disease and the only one that can be controlled. The incidence of coronary heart disease, cerebral infarction and subarachnoid hemorrhage in smokers is more than 3 times that in non-smokers. Therefore, quitting smoking is the most effective and economical intervention to avoid cardiovascular death.

Cigarette smoking among athletes is a common social phenomenon in the field of competitive sports.

However, smoking and sports are incompatible. First, the carbon monoxide (CO) produced by smoking greatly reduces the blood's ability to carry oxygen. During exercise, human tissues and organs need blood to provide sufficient oxygen to maintain normal operation. However, smoking will produce a colorless and odorless CO, which affects the blood oxygen conversion and transportation capacity. As a result, the body organs and tissues will suffer from hypoxia, leading to the decline of body functions. Carbon monoxide produced by smoking passes through the respiratory tract to the alveoli, enters the blood through gas exchange, and rapidly combines with the hemoglobin in the blood to produce carbon oxyhemoglobin (HbCO), and then reaches the organs and tissues of the whole body through the pumping function of the heart. Due to carbon monoxide with hemoglobin ability of ambitious and oxygen combined with hemoglobin, when the carbon monoxide combining alveolar into the blood stream quickly and hemoglobin, generate HbCO, grab the position should have the combination of oxygen and hemoglobin, cause lose ability to transport oxygen, about 20% of the hemoglobin in blood oxygen concentration greatly reduced, It greatly affects the efficiency of oxygen exchange in the lungs and makes the body tissues unable to get enough oxygen. At the same time, HbCO prevents the oxygen-carrying hemoglobin from releasing oxygen, further exacerbating hypoxia in the body tissues. This can be extremely detrimental to athletes, especially endurance athletes, who need a lot of oxygen to restore energy reserves in their muscles after exercise.

Second, nicotine (also known as nicotine) stimulates the adrenalin content increases, causing increased blood viscosity, affecting heart function. Nicotine in tobacco can stimulate the secretion of adrenaline in smokers, promote platelet aggregation to the blood vessel wall, causing blood viscosity rise, coupled with nitric oxide "rob" part of hemoglobin, resulting in tissue can not normally obtain sufficient oxygen from the blood, the heart in order to maintain the normal work of body tissue, Getting enough oxygen by "increasing muscle ejection flow by increasing the heartbeat" and "increasing the amount of hemoglobin in the blood" increases the burden on the heart and overdraws its function. Athletes smoking the essence of which is a process of

decline accelerated heart depletion, on the one hand, because of smoking, carbon monoxide and nicotine in the blood, much less cardiac oxygen supply ability, on the other hand, need to work to keep the normal tissues in the movement, stimulate the heart beat faster, increase blood shot and more hemoglobin in the blood involved in transporting oxygen. At present, the Olympic Games is "faster, higher, stronger and more peaceful" direction, the game will become more and more fierce competition between athletes, game will decide the often in between, the physical ability reserve requirements more stringent, is bound to cardiovascular system put forward higher requirements of athletes, but smoking is reduce cardiovascular athletes aerobic capacity, It seriously affects athletes' sports performance, and is easy to cause heart failure, myocardial infarction, coronary heart disease and other cardiovascular disea²⁵.

Cigarette smoking for nicotine, but also produce tar, many of the harmful material such as formaldehyde, propylene glycol, these harmful material through the lung air circulation, the circulation of the blood to the body into the smokers organizations, toxicity of harmful substance attacks make smokers cardiovascular disease and even death, smoking, the more the high risk of cardiovascular disease death. In addition, smoking can inhibit one, called "high density cholesterol" substances beneficial to human health, it is clearly important substances harmful cholesterol in the human body, which is good for your health material (high density cholesterol) special substances of the human body movement,, and the high density cholesterol and protein together into the arteries, Can effectively prevent the cholesterol in the artery wall thickening, ensure blood flow is smooth, if high density cholesterol reduction, against cholesterol levels in the human body will increase, will be harmful cholesterol clogged arteries and thinner, so blood flow resistance increases, the slow, cardiovascular energy supply capacity will drop, tissue can not get adequate oxygen and energy, Performance is impaired. Existing studies have shown that nonsmokers have much higher levels of LDL cholesterol than athletes and smokers who exercise regularly.

EFFECTS OF CIGARETTE SMOKING ON THE NERVOUS SYSTEM OF ATHLETES

Nervous system made up of neurons and glial cells in the nervous tissue, controls and coordinates all the activities of the whole body each function is important

to central nervous system, muscle movement is mainly composed of spinal cord, brain stem and cerebral cortex tertiary regulation of nerve tissue, by monitoring the cerebellum and basal ganglia, make human body movement function and the function of autonomic nervous system integration coordinated, Rapid and perfect adaptive responses to changes in the body's internal and external environment¹⁶. The essence of the movement of sports is the result of muscle activity with coordination as the soul. Athletes' physical strength, technology, tactics and other sports abilities are displayed through muscle activity, and muscle function can only play a role by relying on flexible coordination and precise control of the nervous system. With more and more difficult movements in modern competitive sports and more and more sophisticated movements, athletes are required to make precise and rapid movement feedback in a very short time, which requires high agility, flexibility and coordination of athletes' nervous system. For example, Triple Salto backward piked named after Russian male competitive gymnast Nikita Nagornyy, the difficulty value up to H group.

Nicotine is a stimulation of toxic substances, whether smokers are active, smoking or passive smoking or injection of nicotine, small dose of smoking stimulates the brain and central nervous system excitement and plant nerve, make smokers mental activity hyper-function, make breathing is accelerated, the adrenaline secretion increased, increased levels of dopamine in the brain, let a person produce pleasure and happiness²⁶. Make smokers have the illusion of "full of spirit and keen thinking", which is the main reason why smokers become addicted to smoking and fail to quit smoking. The essence of this illusion is the toxic stimulus effect of nicotine. High-dose smoking or smokers for a long time, because of nicotine by raising blood viscous, carbon monoxide makes blood carry oxygen ability is abate, make human body tissues and organs can't get enough oxygen, easy to hypoxia of brain tissue, damage the central nervous system and plant nerve, affect human mind unresponsive, headache, insomnia, memory loss and low work efficiency, etc.

EFFECTS OF CIGARETTE SMOKING ON PHYSICAL FITNESS OF ATHLETES

Physical main body shape, body function and physical quality of three elements, the body is the body shape and physical quality, the source of the power of the development of smoking affects physical mainly through to the body function, namely the smoking to human body by pulmonary respiratory system, nervous system and cardiovascular system, digestion and absorption system and so on influence of the stack. Smoking on the impact of cardiopulmonary endurance and muscular endurance athletes is most obvious, because of toxic materials such as carbon monoxide and nicotine in tobacco can let the airway Narrows, destroy alveolar carry oxygen into the blood stream, hinder the haemoglobin transports oxygen in the blood to the body tissues and organs, make the athletes training muscle can't get enough oxygen, resulting in a decline in endurance athletes. Cigarette smoking also affects muscle growth in athletes, leading to lower levels of testosterone, a hormone that stimulates muscle growth. Existing studies have shown that, cigarette smoking is associated with poor physical health and muscle strength²⁷, athletes smoking can increase muscle fatigue, back strength injury, affect physical health and fitness^{28,29}.

CONCLUSIONS

Cigarette smoking is harmful to health, tobacco contains nicotine, hydrocyanic acid, tobacco tar, carbon monoxide, aromatic compounds and a large number of toxic substances will lead to athletes' respiratory system, cardiovascular system, nervous system and immune system lesions or even failure, affecting the normal operation of athletes' heart, lungs, brain, stomach and other tissues and organs. It is easy to lead to decreased immunity, decreased appetite, tired of training, decreased athletic ability, and seriously affect the physical health of athletes and sports performance. Therefore, it is the wisest choice for athletes to say no to tobacco, stay away from tobacco poisoning and quit smoking. Quitting smoking is also an important foundation for athletes to maintain their health, maintain and improve their athletic performance, and prolong their athletic life.

Conflicts of Interest Disclosure Statement

The authors declare no conflict of interest in the authorship or publication of this work. The authors declare no sponsored financial sources for the undertaken study.

Author Declaration

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References

1. Jayes L, Haslam PL, Gratziou CG, et al. SmokeHaz: systematic reviews and meta-analyses of the effects of smoking on respiratory health. *Chest* 2016; 150: 164-79.
2. Edwards R. The problem of tobacco smoking. *BMJ*, 2004; 328: 217-9.
3. Rennard, S.I, Weiss, et al. Smoking or Health. 1977.
4. Gomes R , F Luís, Tavares A , et al. Respiratory functional evaluation and pulmonary hyperinflation in asymptomatic smokers: Preliminary study. *Revista Portuguesa de Pneumologia*, 2015(21):126-31.
5. Gong Youlong. Effects of smoking on health. *Chinese Journal of Social Medicine*, 1985(2):71-74
6. Maritz G S, Mutemwa M. Tobacco Smoking: Patterns, Health Consequences for Adults, and the Long-term Health of the Offspring. *Global Journal of Health Science*, 2012(4):62-75.
7. Li Jinxuan, Liu Chao, Cheng Anqi, et al. Smoking and COVID-19: Progress and prospects. *Chin J Health Management*, 201, 15(05):509-513.
8. Mokdad AH, Marks JS, Stroup DF, et al. Actual causes of death in the United States, 2000. *J Am Med Assoc* 2004; 291: 1238-45.
9. Baumert P W, Henderson J M, Thompson N J. Health risk behaviors of adolescent participants in organized sports. *Journal of Adolescent Health*, 1998, 22(6):460-465.
10. Pacifici R, Pichini S, et al. Smoking habits of Italian athletes undergoing anti-doping control. *Drug Test and Analysis*, 2016(8):133-135.
11. Nitto S D, Stefanizzi P, Bianchi F P, et al. Prevalence of cigarette smoking: a cross-sectional survey between individual and team sport athletes. *Annali di Igiene: Medicina Preventiva e di Comunità*, 2020, 32(2):132-140.
12. Alaranta A, Alaranta H, Patja K. et al. Snuf use and smoking in Finnish olympic athletes. *Medicine & Science in Sports & Exercise*. 2006(27): 581-586.
13. Hessami Z, Aryanpur M, Emami H, et al. Behavior and knowledge of Iranian professional athletes towards smoking. *Asian J Sports Med*, 2012(3):297-300.
14. Primack B A , Fertman C I , Rice K R , et al. Waterpipe and Cigarette Smoking Among College Athletes in the United States. *J Adolesc Health*, 2010, 46(1):45-51.
15. Saiphoklang N, Poachanukoon O, Soorapan S. Smoking characteristics and lung functions among university athletes. *Scientific Reports*, 2020(10):1-6.
16. Wang Ruiyuan. Exercise Physiology, *People's Sports Publishing House*, 2012.
17. Yang Li. Discussion on the Physiological Mechanism of Smoking Affecting Sports Performance of Athletes. *Journal of Capital University of Physical Education*, 2003, 015(001):102-104.
18. He Shijie, Yu Sumin, Zhang Xiuyi, et al. Effects of smoking on lung function in healthy people. *Chinese Modern Distance Education of Traditional Chinese Medicine*, 2010, 08(016):115-116.
19. U. TYLÉN, Boijesen M, Ekberg-Jansson A, et al. Emphysematous lesions and lung function in healthy smokers 60 years of age. *Respiratory Medicine*, 2000, 94(1):38-43.
20. Li Zhongming, Chen Li, et al. Effects of smoking on lung function in healthy adults. *Chinese Journal of Preventive Medicine*, 2005, 6(4):306-309.
21. Maritz G S, Mutemwa M. Tobacco Smoking: Patterns, Health Consequences for Adults, and the Long-term Health of the Offspring. *Global Journal of Health Science*, 2012(4): 62-75.
22. Tchissambou B P, Massamba A, Babela J R, et al. The effects of smoking and the degree of nicotine dependence on aerobic capacity in sportsmen]. *Revue Des Maladies Respiratoires*, 2004, 21(1):59-66.
23. Saiphoklang N, Poachanukoon O, Soorapan S. Smoking characteristics and lung functions among university athletes. *Scientific Reports*, 2020(10):1-6.
24. Hu Dayi. Consensus of Chinese experts on primary prevention of cardiovascular disease. *Chinese Journal of Internal Medicine*, 2010(02):174-185.
25. Luo Yangyang, Nie Shaoping, et al. Study on the relationship between smoking and coronary heart disease. *Chinese journal of interventional cardiology*, 2008, 16(06):328-331.
26. Benowitz, N. L., & Jacob, P., 3rd. (1984). Nicotine and carbon monoxide intake from high- and low-yield cigarettes. *Clin Pharmacol Ther*, 36(2), 265-270.
27. Al-Obaidi S, Al-Zoabi B A, et al. Fatigue Susceptibility of the Lumbar Extensor Muscles among Smokers. *Physiotherapy*, 2003, 89(4):238-248.
28. Wen Bo, Wang Qingming, Fang Xiaohua, et al. Effect of smoking on zinc content in serum, red blood cell and white blood cell of professional athletes. *Ice and Snow Sports*, 1999(01):49-51.
29. Adedoyin R A, Mbada C E, et al. Differences in back extensor muscles fatigability for smoking and non-smoking athletes. *Isokinetics and Exercise Science*, 2010(18):149-155.