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The enlightenment of American Firefighter Physical Ability Evaluation System to Our country

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Abstract. The physical fitness level of firefighters is the basic element of the comprehensive combat effectiveness of the national fire fighting force, and the highly stressful working condition of firefighters determines that they need to have a higher level of physical function. This paper compares the development and standards of firefighter fitness evaluation system in the United States in recent years, combines the actual situation of firefighter fitness level and evaluation system in China, integrates China's national conditions, puts forward some suggestions to help improve the physical fitness level of firefighters in China, and provides theoretical support for the construction of firefighter fitness evaluation system.

Keywords: China and the United States; firefighters; physical fitness evaluation; system

1. Introduction

Physical fitness is the material basis of health and is a comprehensive and relatively stable characteristic of the morphological structure, physiological functions and psychological factors of the human body expressed on the basis of heredity and acquisition [1]. In recent years, with the rapid economic development, people pay more attention to the simultaneous development of physical function level to ensure a healthier life and work while focusing on the richness of material life. For some specific industries, an excellent level of physical fitness has a role for individuals and society that cannot be ignored. As the main body of the national rescue force, firefighters play a very important role in fire prevention and extinguishing, earthquake relief, rescue and relief. As firefighters face high intensity and quality work and training every day, firefighters should have a higher level of physical fitness to ensure their daily work. Therefore, both the fire department and the firefighters themselves should pay attention to the firefighter physical fitness assessment.

In the United States, research on the development of physical fitness testing standards started earlier than in other countries; the discipline is relatively well developed; and the level of scientific research is high enough [2]. Different physical fitness testing methods and standards should be developed for different age groups and different industries. As early as the last century, the United States has developed a perfect physical fitness test method for firefighters [3], which also provides new ideas for the development of firefighter physical fitness test programs in countries around the world.

With the increasing emphasis on physical health level, more and more scholars are devoted to the research on physical health evaluation system for adolescents and normal adults, but there are fewer studies on the optimization of physical fitness evaluation system for specific groups of people. Therefore, this paper comprehensively analyzes and discusses the development history, content and evaluation standards of the physical fitness assessment system of firefighters in the United States, and provides useful insights and references for the development of physical fitness test standards suitable for the physical fitness level of firefighters in China, aiming to improve the physical fitness level of firefighters in China and enhance the comprehensive combat effectiveness.

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2. Overview of the development of physical fitness assessment systems in China and the United States

2.1 Development of physical fitness evaluation system in the United States

As early as the 1970s, foreign scholars began to use equipment and instruments to examine and assess the physical performance of athletic trainers [4].

The United States is one of the early countries to conduct physical fitness research and has been conducting physical fitness tests for more than 100 years. Its concept of physical fitness has been different at different times; during the two World Wars, the United States defined the concept of physical fitness as being the body's ability to resist disease and physical exercise [5].

Physical fitness testing in the U.S. dates back to the 1860s and has evolved through three stages: introduction of the concept, generalization, and continued development. In the 1980s, the U.S. recognized the importance of physical fitness and was at the forefront of the world by issuing a national standard on "physical fitness and disease prevention". At the same time, more and more scholars in related fields began to work on the evaluation of physical fitness tests, with the aim of determining more applicable standards for physical fitness testing. The items of physical fitness tests in the United States can be broadly divided into two categories [6], one is skill-oriented measurement and evaluation, such as speed, endurance, and agility, and the other is post-health-oriented measurement and evaluation, such as aerobic endurance and body composition.

2.2 Development of China's physical fitness evaluation system

The study of physical fitness in China started late, and its evolution and development are in line with the development of our society, science and technology, culture, etc. The assessment of physical fitness has different requirements in different stages of historical development. At the beginning of the founding of New China, Comrade Mao Zedong put forward the twelve words "develop sports and strengthen people's physical fitness", from then on, people gradually got to know about sports and physical fitness. In the "Health China 2030" plan[7], it is clearly stated that national physical fitness tests should be carried out, the physical health monitoring system should be improved, the big data of national physical health monitoring should be developed and applied, and sports risk assessment should be carried out. In recent years, the public has been paying more and more attention to physical health, and a scientific and healthy physical fitness assessment system needs to be established. However, due to the high starting point of physical fitness testing in China, but due to historical reasons, the constraints of economic development and the limitations of different cultural habits between China and the West, various aspects are not yet perfect. Therefore, it is important to identify our gaps and shortcomings and develop physical fitness assessment based on the actual situation in China.

3. Interpretation of Chinese and American firefighter physical fitness evaluation systems

3.1 Interpretation of the U.S. firefighter physical fitness evaluation system

The earliest firefighter fitness assessment method in the United States was to develop firefighters to complete seven actions in accordance with the actual situation at the fire scene, with a standard time of 5′20″. Those who did not exceed the time for perfect movements scored 100 points. The minimum standard is 7′50″ to score 70 points, and each additional 5 seconds to reduce 1 point, through the score evaluation of the firefighter's fitness level [8]. This evaluation method can generally reflect the basic physical condition and adaptability of firefighters to the working environment, but it often seems less feasible in the face of complex and changing rescue environments. Thus, the new fitness level test system solves this problem by comprehensively evaluating all aspects of firefighter physical fitness, enabling a more comprehensive assessment of

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firefighter fitness levels and effectively guiding firefighters to conduct targeted training. In the United States, the government is responsible for the firefighting management system, and there are three levels of firefighting agencies: federal, state, city, and town, which are mainly responsible for

each level of government without direct affiliation with each other [9]. In terms of technical specifications or standards related to firefighter physical training, they are mostly prepared by third-party agencies or organizations, among which the National Fire Protection Association (NFPA) is the main one, and some of its standards are shown in Table 1, among which NFPA 1500 and NFPA 1583 are particularly important, including Aerobic capacity, body composition, muscular strength, muscular endurance, flexibility quality five parts.

Table 1 Current NFPA-related standards

Standard number	Standard name
NFPA 1001-2013	Standard for Fire Fighter Professional Qualifications
NFPA 1051-2016	Standard for Wildland Fire Fighter Professional Qualifications
NFPA 1500-2018	Standard on Fire Department Occupational Safety and Health Program
NFPA 1521-2015	Standard for Fire Department Safety Officer Professional Qualifications
NFPA 1581-2015	Standard on Fire Department Infection Control Program
NFPA 1582-2018	Standard on Comprehensive Occupational Medical Program for Fire Departments
NFPA 1583-2015	Standard on Health-related fitness programs for Fire Department Members
NFPA 1584-2015	Standard for the Rehabilitation Process for Members During Emergency Operations and Training Exercises

Currently, the U.S. firefighter physical training program consists of eight main components: 1) an educational program describing the components and benefits of training and health; 2) individualized exercise prescriptions based on physical fitness test results; 3) warm-up and finishing exercise guidelines; 4) aerobic training programs; 5) muscle resistance (strength, endurance) training programs; 6) flexibility quality training programs; 7) back health training programs; and 8) safety and injury prevention programs. By cooperating with training and monitoring in many aspects, the ultimate goal is to enhance firefighters' physical fitness level, reduce injuries and improve combat effectiveness.

3.2 Interpretation of the Chinese firefighter physical fitness evaluation system

Firefighter physical fitness refers to the ability of firefighters to withstand external loads, including reasonable morphological structure, good physical function reserve, optimal motor quality, excellent psychological quality and strong environmental adaptability, in order to effectively accomplish their tasks [10]. The evaluation of firefighters' physical ability in China is mostly limited to the assessment of quality indicators, but less to the assessment of physical function indicators; in addition, the training standard of firefighters in China is only divided into one grade, with speed and endurance indicators as the main assessment basis, ignoring the direct influence of aerobic and anaerobic functions of firefighters on their working ability. It has been shown [11] that the aerobic and anaerobic capacity of firefighters has become an element of firefighter fitness level, and strengthening aerobic and anaerobic capacity training can help to further improve firefighters' fitness level and better perform their work. Through the assessment of firefighters' physical form, physical function and physical quality [12], it was found that there is a significant gap between the physical health status of firefighters and the expectation, which should attract the high attention of relevant departments; in addition, the decline of firefighters' physical health level has posed a greater challenge to the scientific training level of the force, and it is necessary to focus on mastering some concepts, concepts, principles and methods of scientific training to reduce training injuries and scientifically and effectively Improve the training effect. A firefighter physical fitness

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monitoring mechanism should be established to dynamically grasp the physical health condition of firefighters and revise the relevant standards and norms at the right time.

4. Comparison of Chinese and American firefighter physical fitness evaluation systems

The physical fitness evaluation system in China is different from that in the United States in terms of the target population and assessment methods [13], so it is important to develop a reasonable evaluation system that is applicable in both theory and method and can effectively reflect the physical fitness level. First of all, the indicators selected for firefighter physical fitness tests are different between China and the United States. China pays more attention to physical form, physiological function and physical quality, such as height, weight, lung capacity, endurance running, etc. These indicators are simple, time-consuming and labor-saving, but they are often less convincing when analyzing the scores; while the United States pays more attention to the testing and evaluation of health-related fitness and skill-related fitness, such as body composition, muscle strength, reaction time, cardiopulmonary These indicators are the basis for the level of physical function, and the measurement equipment is more complex and the results are more accurate, which can fundamentally reflect the fitness level of the measured personnel.

Secondly, the methods selected for firefighter physical fitness tests in China and the United States are different. China usually uses manual measurement when conducting physical fitness tests, which often causes changes in test results due to changes in the psychological and physiological conditions of the testers, and the results are more subjective, while the United States uses almost all machine measurement index data, which only has systematic errors and less measurement errors. In addition, the analysis methods used in conducting firefighter fitness tests in China and the United States are different. If the conclusions are drawn only based on mathematical and statistical methods, they are often unsatisfactory. The United States uses horizontal comparison methods to analyze the data while adding longitudinal comparisons, which can analyze the physical condition of the testers in all aspects and reflect the true level more accurately. Finally, the evaluation standards for firefighter fitness tests are different between the United States and China. Chinese physical fitness evaluation standards are often based on large sample size surveys and are scored using a percentage system [14]; whereas the U.S. physical fitness tests link the indicators to health risks and reflect health risks through the indicator data results. These two different evaluation methods sometimes result in completely opposite measurement results; a single reference to big data for scoring ignores the physiological differences among individuals, and a single evaluation of risk levels based on indicator results can also be biased, resulting in inaccurate measurement results. Therefore, a scientific and rigorous evaluation system should be developed by combining several factors to determine the physical fitness level of firefighter occupations based on the determination of basic physical health indicators of firefighters.

5. The inspiration of U.S. firefighter physical fitness evaluation system to China

In terms of physical fitness assessment, the United States has always been a world leader. In addition, as the most mature country in the world in the development of firefighting professionalism, the system of firefighter pre-service training, physical fitness measurement and physical training in the United States is particularly mature, and thus its advanced technical means and application principles can be used for our reference and reference.

5.1 Set scientific selection and assessment standards and establish pre-service training system

During the initial selection of firefighters, scientific and reasonable test items and assessment standards are set to ensure that each reserve firefighter has good physical ability. Before the

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firefighters are formally put on duty, they are trained in pre-service professional physical fitness, including speed, strength, endurance, sensitivity and other aspects of physical skills training. After the training is completed, the firefighters are selected on the basis of their performance and merit during the pre-service training training. This helps to stimulate the potential ability of firefighters and lay the foundation for just quality work.

5.2 Establish personalized physical training program to improve firefighters‘ physical fitness level

Professional and personalized physical training programs are of great significance for the improvement of firefighters' physical fitness level. Conventional physical training programs have a positive effect on improving physical fitness, but due to the differences in physical and physiological mechanisms of different individuals, it is difficult to develop physical fitness at a higher level with ordinary physical training programs. Therefore, special physical training programs can be set up for firefighters according to their age, gender, and basic physical level, which can better improve their physical fitness level.

5.3 Application of professional protective equipment to reduce firefighter sports injuries

Firefighters often suffer from different degrees of sports injuries, both during daily physical training and in specific work environments[15] . Due to the special nature of firefighters' occupations, it is particularly important to reduce sports injuries and the complications they bring. Therefore, while firefighters conduct physical training exercises to improve their fitness level, the use of protective equipment should be enhanced to reduce unnecessary injuries.

5.4 Construct specialized firefighter action procedures to reduce stress

Although firefighters work in a dangerous and complex environment, their operational processes are generally consistent. Therefore, firefighters can be more adapted to the operating environment and improve the efficiency and quality of their work through more simulated operational training and the construction of specialized firefighting operational procedures. At the same time, specialized operational procedures can also reduce firefighters' stress response and improve their operational capabilities.

5.5 Multidisciplinary cross-collaborative research to build a physical fitness evaluation system

While training firefighters to obtain a higher level of physical fitness, the construction of a physical fitness evaluation system in the process should be strengthened. The firefighter physical fitness evaluation system is structured with three parts: evaluation indicators, indicator weights and indicator criteria [16]. It can reflect the common characteristics and problems of firefighters in the level of physical fitness development. The process can combine the intersection of biomedical, computer, mathematics and other related fields to obtain more comprehensive and accurate data, and provide theoretical support for the construction of a professional physical fitness evaluation system.

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