



## Sport physiological factor index measurement and evaluation in physical education teaching

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### ABSTRACT

*In the process of participating in the sports, people's operational capacity and some organs would have a series of regular changes that already start before exercising and would continue last to sometime after exercise ending. According to the sequence when it occurs, define them respectively as pre-competition state, steady state, fatigued state and recovery process. This paper would analysis common used sport physiological parameters in physical education teaching, entirely consider physiological features influence in sports training, combine with training method physiological analysis to explore how to collect and handle sport physiological parameters with the purpose of improving athletes' skill level and providing important decisive impact on physical education teaching and training by deepen researching on sport physiological factors.*

**Key words:** Sport physiological factor, sport load domain, metabolism, adaptability

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### INTRODUCTION

Through long-term practice and research, human have already verified that play sports can promote metabolism. Physical exercise is good-directed and planned to offer human body a certain sport load ,propel changes occur to body and organ system's metabolism so as to improve each organ system structure and functions, make it a series of higher adaptability that run in circles, then human physical quality can strengthen.

Adapt is the condition for biology survival, biological evolutionism has proofed that all animals' organisms have a certain ability to adapt to environment and their own exercise needs. Meanwhile, during continuously adapting process, some tissues and functions in body would gradually be changed. Physical exercise effects as strengthen physical quality is that human organism gradually arrive adaptation after experienced sport load from exercise, then increase load capacity so as to make organism arrive adaptation in a higher level. In such continuously adaptation process, body organs, system functions and structures have been perfected and improved constantly. In sports process human would have some changes in their physiological features, such as muscle excitement, breathe speed increasing, heart rate promotion, perspiration, temperature changed and so on. These physiological features have close relationships with sports amount and sport process duration. Get acknowledge of sport physiological factors change is helpful for physical education teaching and sports training [1, 2].

Lots of sport physiological parameters can be got through sensor, by analyzing which athletes and physiological parameters correlations can be known. For daily training, it can work out feasible exercise amount, enable PE teachers master students sports state, also let athlete maintain good conditions, and ensure sports performance in competitions through analyzing these special parameters. At present, college students under heavy learning burden, great learning pressure that cause them in tight schedule so no time to exercise. In this way physical quality gets worse so that cannot support heavy learning, vicious circles generate. It can be seen that physical exercise is very important to college students. Through researching physical education exercise influences on body physiology, it

would provide a new direction and guide to college students exercise.

### **RELATIONS BETWEEN SPORT PHYSIOLOGICAL FACTORS AND SPORT LOAD**

Load threshold refers to in sports exercising or training process, sport load would stimulate body in a proper impact range so as to ensure each organ system inside body can effectively produce adaptation changes. The impact range has upper and lower limits. Many factors influence load threshold, the most important one is sport intensity. Sport intensity is defined as work completed in unit time in sport process. Generally speaking, periodical exercise mostly represents with immediate heart rate in or after exercising. Non periodical exercise will use load amount or repetition times to calculate. Among them, the maximum heart rate is normally estimated through 220 minus age maximum heart rate (time/min) [1]. And its maximum stroke output would be achieved when sport intensity arrives to VO<sub>2</sub>max around 40(heart rate nearly 120-140 times), and not continue increase as sport intensity increases. Physiological load and psychological load will choose "rating of perceived exertion" to define sport intensity, influence factors to RPE are oxygen absorption, heart rate, ventilator capacity and blood lactate levels etc [2]. It used to evaluate endurance training's sport intensity.

Cardiac peak theory and best heart rate range theory are key factors in physical education teaching load threshold. From which cardiac peak refers to the maximum stroke volume. Generally speaking, it is around 90-100ml. Of course, excellent maximum stroke volume can arrive at 200ml. Restraint factors of load threshold are ventricular volume and returned blood volume [3]. The best heart rate range is when heart rate can arrive at 180 times or more, stroke volume is in the reduce trends and heart output would not rise any more, which is one of the important VO<sub>2</sub>max factors.

### **Relations between sport physiological factors and sport load**

There is close connection between sport physiological factors and sport load. Though definition and significance of the two is far from each other, they are make interactions. In physical education sport process, human will naturally lead to physiological function changes after receiving sport load. That is very important [3]. Measurement criteria of physiological functions change is evaluate sport physiological factors changes. Its concrete practice is measure sport load amount through sport physiological index. Sport load is an action that makes initial stimulation to human body, which leads to human internal physiological system changes. The increase of sport load will propel sport psychological load increase. By comparing, sport physiological load has a certain delay in measurement criteria.

### **Training method physiological analysis**

A human motion is complete purposeful training in some special environments. Improve muscle exercise, consume energy, internal environment would be changed, then further lead to entire changes on local tissues, breathe, circulation and adjusting system. The entire function changes including changes that produced when human take exercises as well as in recovery process, which is also the reaction that generated. It is different from one-off physical training; it is the irreversible changes appear to body shape and function in a short time in a series, and planned repetition process of sport training [4]. Gradually reduce the reaction that generated by sport stimulation so that fulfils function efficacy, which refers to a certain adaptation that human produce to sport.

(1) Interval time training, larger stimulation is applied to body that is the remarkable method in interval time training. It is the training method that mutual alternate intermittent high intensity exercises with rest. That would lead to stronger reaction and adaptation. In the meanwhile, it can relieve and postpone fatigue. Make heart output into high level. Physiological effect reflects as aerobic ability promotion, breathe, circulation and other system functions' improvement. Changes of anaerobic ability represents as the improvement of anaerobic energy supply and lactate clearance. Choose intensity and time based on different purpose under proper arrangement [5]. Phosphate system's energy supply ability would be greatly promoted. Rest time after short time maximum intensity exercising should be 30 seconds that half energy phosphate can be recovered.

(2) Continuous training method, lasting low intensity exercise mainly fit for improving aerobic ability; improve heart and lungs functions. Simple anaerobic threshold heart rate is calculated as following. With quantitative lactate threshold quantization endurance training, standard lactate threshold training usually takes 30 to 45 minutes. Widely endurance just should take above 30m intensity exercise that lowers than lactate threshold 10 to 15.

(3) Repetitive training method, same as interval training, also is take intermittent exercise and its characteristic is implement full rest in training time. Physiological effect is constantly strengthen conditioned reflex propels sport skills improvement. And body quality as well as each organ function level get effective development and play [6].

(4) Circuit training method, plenty of exercise contents. This training can last its influence to heart and blood vessel to some seconds or more, it would lead to human complicated heart and blood vessel functions adjusting. The adjust

range is depend on training intensity. Its role is to meet muscle demands to oxygen and energy substance in movements and fulfill metabolite clearing, and maintain normal muscle broker environment.

### COMMON SPORT PHYSIOLOGICAL PARAMETERS AND MEASUREMENT

There are many human physiological features, from which some factors are greatly influenced by sports, and easier to get data. The concrete sport physiological parameters are heart rate, temperature; breathe frequency, blood oxygenation (SP02) and 3 lead electrocardiograms. Though analysis of physical education exercise features, after discovering the needed measurement sport physiological parameters, make real time analysis of such data can play important information transfer role in physical education training and matches, build firm empirical basis for scientific decisions, and provide important guarantee to effective development of physical education teaching [7].

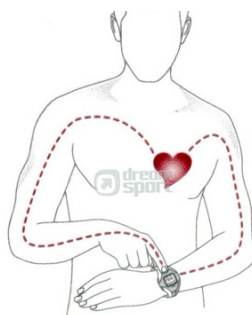
#### Reference effect of heart rate on Sports

Heart rate is defined as heart beat times per minutes. Normal adults' heart rate in resting state can arrive at 70 to 80 times per minute. Usually, lower limit is 60 times per minutes, upper limit is 100 times per minutes. If adult heart rate goes beyond 100 times per minute, it would be regarded as tachycardia, normally including sport, exciting, pains, infection, fever, anemia, hyperthyroidism, acute bleeding, shock, cardiac insufficiency, myocarditis as well as it happened after take some drugs. Bradycardia is heart rate lower than 60 times, people with such heart rate are mostly athletes, old man, or someone in illness as obstructive jaundice, increased intracranial pressure, hypothyroidism, and excess digitalis so on [5]. In daily training arrangement process summarizing, it should control athletes proper heart rate in sport, and according to individual differences, choose reserve athletes, or in physical education teaching, control students sport time, heart rate influence factor analysis as Table 1 shows.

**Table 1: Heart Rate influence factor analysis**

Influence factor		Heart rate	
		resting	movement
Temperature (50%humidity)	21 °C	60	165
	35 °C	70	190
humidity (21 °C)	50%	60	165
	90%	65	175
noise (21 °C、50% humidity)	Low	60	165
	high	70	165
eat (21 °C、50%humidity)	eat less in 3h before movement	60	165
	eat more in 30min before movement	70	175
sleep (21 °C、50%humidity)	8h or more	60	165
	6h or less	65	175

Figure 1 is applying device with infrared detection technique in heart rate measuring, it can make phototube into ring so as easier to carry. The principle here is through changes generated by infrared light absorption which induced after the tested finger vessel end blood getting plentiful, then measure heart rate changes. It is easy operating and reliable in such way.



**Figure 1: Sport heart rate detect**

#### Temperature importance to athletes

Heat center lies in the position of human hypothalamus, it functions as adjust human to produce heat and dissipate heat. If in the state of heat balance, then human temperature would be steady. But if heat production is higher than heat dissipation, then temperature would rise, on the contrary it would reduce. Heat production process by exercise is including skeletal muscle shrink so as to propel heat rise. While environmental temperature reduces or gets cold stimulation, muscle would appear shrinking and shiver, heat production also increases. Besides, if important visceral organ, such as liver makes high-impact metabolism, heat would be produced. Heat dissipation process is including 4 ways, which are convection, conduction, radiation and evaporation etc. Since square of skin surface is bigger, it is the main heat sink. Temperature would seriously influence on athletes' sport performance, especially to some

explosive items, such as long jump etc [7].

Temperature measurement can adopt semiconductor temperature sensor because of its features as low cost and high response. Due to smaller differences existing on individual temperature, only need to ensure measure in the range of  $37 \pm 3 \text{ }^\circ\text{C}$ . This circuit has high sensitiveness, low consumption, easy circuit, quick response and other features.

### **Breathe influence on movement**

When human in metabolism, it need to continuously take in oxygen from outside world while meanwhile eliminate carbon dioxide, such gas exchange between body and environment is called as breathe. Respiratory rate refers to respiratory times per minute. Normal adult respiratory rate in resting state is normally  $20 \pm 2$  times per min. And normal respiratory is self-motion of chest wall, and its rate and depth are very steady and uniformed with rhythmic rise and fall. Define per time respiratory as one breath in one breath out. Adult in resting state arrives 60 to 120 times per min, and ratio of respiratory rate and pulse rate is 4 to 1. Influence factors for breathe including exercise, emotion and so on that will cause rate and depth changes. Such respiratory rate and depth show athlete physical ability consumptions. If breathe hard and shallow that is due to metabolism get disturbed and muscle exercise is short of strength.

Respiratory measurement normally is use thermostat to measure respiratory rate. It is mainly utilize temperature difference produced by breathe airflow to measure thermostat temperature changes. And magnify it and sort out, fulfill breathe impulsion. Use computer to calculate breathe impulsion period, so that can measure athlete respiratory rate. The circuit has features as low consumption, light volume, easier fixing. But it cannot measure respiratory depth.

### **Blood oxygenation**

Blood oxygenation refers to the content of blood's oxygen combinative ox hemoglobin percentage covers to all combinative hemoglobin capacity. Blood oxygenation in blood is a important physiological parameters in breath circle. Traditional blood oxygenation calculation method is very complicated and cannot implement continuously monitor. However, with the development of science and technology, presently infrared measurement techniques can meet quick and continuous monitor to blood oxygenation. Such parameter can detect that when athlete gets close to sport extreme, his breath circle system would appear disturbance.

### **Electrocardiogram**

As an important organ in circle system, heart is just due to its rhythmic shrinking and relaxing movement to ensure blood continuously flow in closed circle system. Before heart produces mechanical shrinking, first appears electrical excitation. Myocardial excitation can produce slight current, and can arrive at body surface through body tissue so that body surface different parts would appear different electric potentials. Therefore, place two electrodes in body surface, respectively use conducting line to connect them to the two ends of electrocardiograph, and then can record body surface two point's electrode differences according to heart excitation time sequence. In athlete exercise process, the electrocardiogram samples changes have important values to sport research.

Detection of electrocardiogram can use three-lead electrocardiograph to test circuit. Select measurement amplifier can avoid common mode interference, measure electrode will choose conductive medicine rubber so as to avoid electrode peel off due to athlete largely fiercely movements in sport process, so choose special underwear to wear close to skins, and use lead fix measurement electrode on underwear. Sport physiological signals after enlarge filtering should use A/D to exchange so that fulfill digital signals handling. Usually single-chip computer is chosen to do the task. Because single-chip computer chips have A/D converter and digital handling functions, sport physiological signal can be handled; abnormal signals and sport disturbance can be filtered so as to guarantee accuracy of measurement data.

Sport physiological parameters real-time collect can meet training and match demands. Through wireless data collecting, it is helpful for physical sport research deeper development, and provides important decisive effect to physical education teaching and training. Wireless of sport physiological parameter can use modern wireless communication network and also establish special data transmission channel. Due to communication block problems would occur to wireless communication network, too many wireless equipment applied in spots in large-scale sport competition easier cause channel block. Therefore, establish simple data transmission channel has larger advantage. But it has a certain limits, small cover ranges, and short communication distance.

After receiving relative sport physiological parameters through computer background, can make data handling, and then vividly describe data changes with curve graph. It can save analysis results and named with athlete name as well as coding and data collecting information, which is helpful for long time observing athlete sport physiological

parameters. And short time sport physiological parameters is helpful for deeply seizing relationships between athlete physical ability and sport physiological parameter so that learn sport amount and sport intensity influence on physical ability, then can let coaches select proper training plan to athlete. While long time data statistics and analysis, it can help athlete adjust pre-competition state and enable them to enter into the best state. Data handling work can be handled by laptop and widely applied.

### CONCLUSION

Human exercise should be done timely and properly and at the same time with a purpose and scheduled, therefore get acknowledge of himself physiological changes in training is of great help to improve training effects. College students' learning and living habits have very remarkable features, research on which can get many useful results to help college students arrive best training effect in minimum time during busy learning life. Sport physiological parameters play important role in sport training. Through relative parameters testing, it can get acknowledge and seize athletes' state, combine with circuit collecting way can real-time master athletes' physiological parameters, meanwhile it can make data handling and analysis, play an important decisive role in sport training plan designing and provide important guarantee for effective physical education teaching.

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