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A RESEARCH ON INFLUENCES OF NUTRITION INTERVENTION ON TAEKWONDO ATHLETES' PHYSICAL CAPACITY RECOVERY

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ABSTRACT
In this paper, main physical function indexes reflecting qualities including athletes' strength, speed, flexibility, endurance, coordination and sense of rhythm are monitored through sports nutrition intervention in order to study on its major influencing factors for especially aerobic metabolism capacity, find out nutrition intervention methods suitable for high-level college taekwondo athletes' physical capacity promotion, and explore more effective training methods so as to achieve the goal of enhancing college taekwondo athletes' physical capacity.

1. Introduction

With rapid development of modern society, sports have become an indispensable part of people's daily life, and competitive sports have received more and more attention. Taekwondo was firstly a sport promoted to the whole world by Koreans (Fleming and Costarelli, 2009). As a competitive sport with leg actions as its main offensive skills, a delicate body art and effective fitness means, taekwondo boasts extremely high martial arts practicability and ornamental traits. Currently, this new sport and workout has been favored by the majority of youths. Since it was officially named as taekwondo in 1955, this sport has developed at an astonishing speed and started a taekwondo craze all around the world. After several decades of development, it has formed completely independent international sports organizations and regular international games. In 1966, the International Taekwondo Federation was found. In 1973, the World Taekwondo Federation was found. In 2000, taekwondo was listed into an official event of the Olympic game (Pitriani, 2012). At present, the International Taekwondo Federation has 147 member states, which is among the best single sports in the world. The number of people practicing taekwondo around the world has reached 70 million (Chen et al., 2016). Along with prosperous development of taekwondo and its confirmation as a formal sport, our national sports field started to realize the importance and necessity of developing taekwondo. Presently, taekwondo has been listed into the Program of Striving for Olympic Glory (Moreira et al., 2012). Sports colleges from all parts of the country and professional sports associations have all created professional teams, among which participating teams and the number of athletes have hit the best of domestic individual championships for multiple times. Taking Chen Zhong's women's 67kg weightlifting champion at the 2000 Sydney Olympic Games as a symbol, our national taekwondo competitive level has been greatly improved (Chen et al., 2016). Up to date, China's athletes have won 5 Olympic gold medals for individual sport (2 gold medals from Taiwan included) and dozens of world medals (intercontinental) in the Olympic Games, world championships, the World Cup, the Asian Games, etc. With excellent performance of Chinese athletes in arenas, popular taekwondo

has entered a rapid developmental stage. Taekwondo associations all over the world have been established, and a great many of taekwondo clubs and venues have sprung up like mushrooms in various places. There are over 500 taekwondo venues in Beijing and Hangzhou, excluding taekwondo classes in amateur sports schools. Taekwondo has gradually become a fashionable fitness exercise and been favored by the wide public, especially those highly active youths and students. According to incomplete statistics, population practicing taekwondo in China (including Hong Kong, Macao and Taiwan) has surpassed 5 million (Kang, 2014). Continuous development and standardization of public taekwondo have provided solid mass foundation for high-level competitive taekwondo. It is predicted that taekwondo has stepped in to a fast track of healthy development. However, with meanwhile rapid growth of taekwondo, we still cannot ignore those problems and disadvantages existing during the development. However, China is a relative newcomer in taekwondo. Although our taekwondo athletes have taken a share of gold medals in the previous two Olympics, there is a certain difference between them and elite athletes from other countries. In order to adapt to development and enhance competitiveness of taekwondo (Su, 2015), we must find solutions and countermeasures. Nowadays, taekwondo has become a potential advantage program of our national "Program of Striving for Olympic Glory", and we are planning to win 2 gold medals in the 2008 Beijing Olympic Games. China's taekwondo is facing unprecedented opportunities and challenges. Thus, we should find problems and deficiencies existing in development of our taekwondo, seek solutions, prepare our national taekwondo team for competitions in the 2008 Beijing Olympic Games, and strive for greater results.

Rising level of competitive taekwondo in colleges has put forward higher requirements for physical functions of athletes. Elite taekwondo team in Southwest Jiaotong University (hereinafter referred to as the "Southwest Jiaoda") has won champions for several times in national, provincial, municipal taekwondo matches. Before participating in the First National Students' Health & Vigor Competition in 2004 and International Taekwondo Competition in China, Japan and Korea, in order to enhance athletes' potential athletic abilities and promote fatigue tolerance, we have carried out nutritional intervention for participating members(Qu, 2014), tested varied abilities including speed endurance and strength, so that they can quickly recover physical power and get into next phase of training after intensive training. Major physical function indexes inflecting taekwondo athletes' qualities including strength, speed, flexibility, endurance, coordination and sense of rhythm are monitored through sports nutrition intervention, and its major influencing factors, especially aerobic metabolism capacity, have been studied through principal component analysis, so as to find out nutrition intervention methods suitable for promoting high-level college taekwondo athletes' physical and provide foundation for high-level college taekwondo athletes' training.

2. Materials and methods

2.1. Research Objects

There are 12 athletes (female) in Southwest Jiaoda taekwondo team who have won taekwondo champion in "the First National Students' Health & Vigor Competition" and the second place of "International Invitational Tournament in China, Japan and Korea", and they are divided into the experimental group (8 cases) and the control group (4 cases).

2.2. Research Methods

(1) Nutritional Supplements

Investigate dietetic condition of athletes, determine hemoglobin, and regulate dietary structure and energy intake of students. From the beginning of intensive training until competition, provide on a daily basis 600mg chalybeate, 25g protein, 40f carbohydrates, electrolytes and 500ml microelement beverage for experimental athletes on the basis of regular diets. Provide no supplement for athletes in the control group.

(2) Effectiveness Observation

Observe physical capacity recovery of different training intensities in terms of physiological function indexes, it major index maximal exercise capacity would be tested through America margut te Cordioof electrocardiogram treadmill analysis system test of sports psychology. V.O2max would be calculated through EGH-□constant-motion-rate bicycle measuring and calculation; Maximal anaerobic power would be tested through GC811 bicycle with constant-resistance capacity; height, weight, lung capacity and hemoglobin would be tested through regular checkup equipment.

(3) Training Intensity and Testing Time

Carry out regular training for all members of the experimental group and control group: two months before the competition, three times a week, 2h each time (□regular warm-up, □interval training of set movements, □taekwondo set movements, □set movements of cheering squad, □specialized fitness exercise, □relaxing); Intensive training: one month before the competition, five times a week, 2.5h each time (□warm-up of taekwondo movement combination, □route of set movements,□4 sets of optional and defined competition movements for 2 ~ 3 times, □specialized fitness exercise, □relaxing, test for once one week before the competition during excessive recovery phase)

3. Results and discussions

3.1. Shapes and Physical Capacity of Elite College Taekwondo Athletes

Physique constitution of elite college taekwondo athletes requires their relatively high comprehensive qualities including speed, endurance, flexibility, coordination and rhythmic ability. From a standpoint of body anatomy, it requires aesthetic shape, line and muscle; in terms of aerobic metabolism ability, taekwondo belongs to aerobic exercises but also requires a fine speed explosive force; from the perspective of nutriology, the diet shall not only satisfy athletes' demands for intensive training and cultural course study but also meet the needs of shape. Shapes and physical capacity indexes can be seen in Table 1.

(1) Composition of Physique Components

With heights of around 165cm and weights of about 51kg, female college athletes have showed their fine body shapes through the Body Mass Index. Body fat has accounted for 21% of total body weight. With certain but not much fat, those athletes boast graceful body lines. With a large Lean Body Mass proportion, they are equipped with good muscle strength (Moreira et al. 2012).

(2) Hemoglobin

As an important index in nutrition evaluation, hemoglobin can not only know about nutritional status of athletes, but also assess amount of training from its variation. Due to hematoclasis caused by irrational dietary structure of athletes in the above-mentioned school and perennial heavy-load training, athletes have been in a state of anemia. And this is a common phenomenon among college students (Cho et al., 2013).

(3) Anaerobic Metabolism Capacity

Evaluate speed strength and explosive power of athletes in terms of anaerobic power. Anaerobic power can increase the load through Wing ate method; when athletes pedal at a full speed, their metabolism will focus on anaerobic type. Use V.O2max for evaluating aerobic metabolism capacity of athletes, and assess maximal exercise capacity and endurance through maximal exercise capacity; Lung capacity reflects ventilation amount of lung at a single breath which is irrelevant to anaerobic condition and reflects anaerobic metabolism capacity from another perspective. From Table 1, it is shown that lung capacity, anaerobic function, V.O2max and maximal exercise capacity of college taekwondo athletes are over one standard deviation higher than ordinary female students, while their body fat percentage is two standard deviations slightly lower than that of ordinary girls, and hemoglobin level is one standard deviation lower than that of ordinary girls.

Table 1. Outstanding college students taekwondo athletes form function index statistics

		Height	Weight	Hemoglobin	Lung capacity	VO2	Anaerobic work	The biggest sports ability	Body fat
fFmale	The average	165.32	50.21	10.25	3365.25	2.65	356.45	1457.21	21.14
	The standard deviation	1.25	3.25	0.46	115.24	0.36	45.36	130.69	2.36
Ordinary female	The average	153.26	51.24	11.25	2.36	2.36	318.25	1.325	26.36
	The standard deviation	1.25	6.36	0.75	213.58	0.33	51.25	147.58	4.12

3.2. Influences of Nutrition Intervention on Aerobic Metabolism Capacity at Different Training Intensities

Physical growth of college athletes aged between 20 and 23 has been stabilized, and variations in its morphological indexes are non-specific. This paper will focus on analyzing influences of nutrition intervention on aerobic metabolism capacity of athletes at different training intensities.

(1) Influences of Training on Aerobic Metabolism Capacity of Athletes in the Control Group.

Athletes in the control group have carried out simple sports exercises only according to training plan, without any additional conditions in training of any intensity. From Table 2, after intensive training, hemoglobin and maximal exercise capacity of athletes in the control group would markedly decline (Bürger-Mendonça et al., 2015). Decline degree of hemoglobin is directly proportional to training intensity; that is, the greater the intensity is, the quicker the hemoglobin will decline. After one-month intensive training, hemoglobin of athletes in this group decline by 30.5 ~ 1g than regular training, and oxygen transport and fatigue resistance of them would be then affected. During intensive exercises, oxygen consumption would multiplied to 10 ~ 15 times larger than that in regular training, which may lead to increase of free radicals by 2 ~ 3 times (Burton et al., 2006). Free radicals would cause lipid peroxidation of cell membrane (mainly myocytes and erythrocytes) and subsequent premature emergence of fatigue. Athletes in the control group themselves felt overwhelmed by fatigue and caught colds at varying degrees. Under an exhausted state, the decline of maximum exercise capacity turns to be self-evident. Under the same assessment, V. O2max of aerobic metabolism capacity didn't turn on an obvious downward trend, and anaerobic power and lung capacity haven't apparently enhanced. The results were due to that they all belong to anaerobic metabolism and their instantaneous powers have been tested. It is reasonable that all indexes in excessive recovery phase have restored to above conventional level.

(2) Influences of Intensive Training on Athletes' Physical Capacity under Nutritional Intervention

From the beginning of intensive training until competition, athletes from the experimental group have been provided with nutritional supplements (Hashemvarzi et al., 2014). A large amount of data can demonstrate that their improvement of their lung capacity is relevant to

genetic factor and varied training exercises. This paper focuses on discussing hemoglobin. From Table 3, hemoglobin of athletes in the experimental group hasn't evidently increased, which indicates that training intensity was just suitable. Iron demand of athletes is higher than that of ordinary people. In continuous intensive training, catabolism of protein was then strengthened, and sweat and iron lost. Sports anemia is due to intake deficiency from increasing protein demand and consequential erythrocyte hemolysis. In high-intensity training, athletes were on the one part expending protein and losing iron, and on the other part maintaining a balance between enough protein and iron supplements. Evident increase of hemoglobin indicates that training intensity can be enhanced. Higher hemoglobin can better exert to the maximal aerobic capacity of human body. V.O2max, maximal exercise capacity and anaerobic power have obtained obvious rise in the experimental group, and the results are also closely related to maintenance of nutritional supplement and hemoglobin besides training. During intensive training, athletes in the experimental group were all energetic without any fatigue, and no one has caught a cold.

Table 2. The control group in different training intensity test of significance

Lung capacity	Regular training	Intensive training	t	Excessive adjustment before reply
Hemoglobin	3365	3352	——	3500
VO2	12	10.54	3.25	10.47
Anaerobic work	2.58	2.58	——	3.11
The biggest sports ability	365.69	356.47	——	3.59
Body fat	1785.25	1520	3.25	1158

Table 3. The control group, experimental group intensive training fitness matching test

	The control group	experimental group	t
Hemoglobin	3350	3124	———
VO2	10.25	11.54	2.36
Anaerobic work	2.545	3.254	———
The biggest sports ability	317.25	390.45	2.58
Body fat	1502	1752	4..12

(3) Index Comparison between Experimental and Control Group after Training

The two groups were trained under the same intensity. From Table 3, it can be seen that both two groups were without nutritional supplements during regular training and there was no obvious discrepancy between indexes of the two groups (Hashemvarzi et al., 2014). However, in intensive training, after the experimental group was provided with nutritional supplement, we can easily find that there was obvious discrepancy in its hemoglobin, anaerobic power, V.O2max and maximal exercise capacity. Taking hemoglobin as an example: in regular training, there was no obvious discrepancy in indexes of the two groups; in intensive training, hemoglobin of the experimental group declined while that of the control group increased, and no significant

difference existed among the two groups. The reason for between-group discrepancy in V.O2max, anaerobic power and maximal exercise capacity was also caused by the decline of one group and rise of another group, which has fully reflected the great significance of nutritional supplement on promoting students' aerobic metabolism capacity. If enough nutrition was supplemented, athletes would become energetic and be able to accomplish intensive training and cultural courses' study.

4. Conclusions

China is a relative newcomer in taekwondo. Although our taekwondo athletes have taken a share of gold medals in the previous two Olympics, there is a certain difference between them and elite athletes from other countries. In order to adapt to development and enhance competitiveness of taekwondo, we must find solutions and countermeasures. Nowadays, taekwondo has become a potential advantage program of our national "Program of Striving for Olympic Glory", and we are planning to win 2 gold medals in the 2008 Beijing Olympic Games. China's taekwondo is facing unprecedented opportunities and challenges. Thus, we should find problems and deficiencies existing in development of our taekwondo, seek solutions, prepare our national taekwondo team for competitions in the 2008 Beijing Olympic Games, and strive for greater results.

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(1) Physique constitution of college taekwondo athletes: the Body Mass Index shall be 165:51, and body fat percentage shall be around 20%; their anaerobic power, V.O2max and maximum exercise capacity shall be higher than those of ordinary students by 1 ~ 2 standard deviation.

(2) During intensive training, if without nutritional supplement, hemoglobin will decrease 0.5 ~ 1g each month, and maximal exercise capacity will significantly decline; Within nutritional supplement, hemoglobin will maintain its original level; V.O2max and maximal exercise capacity will increase visibly; Athletes will be energetic, with enhancing disease resistance.

(3) Among the experimental group and control group, hemoglobin, anaerobic power, V.O2max and maximal exercise capacity of the former group have taken on an increasing tendency while those of the latter group decreasing after intensive training. The significant group discrepancy has confirmed the importance of nutritional supplements on aerobic metabolism capacity of human body.

(4) Physique constitution of college taekwondo athletes can serve as the foundation of athlete selection.

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