

Study on the Influence of Body Composition on Constitution and Functional Movement

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Abstract: To investigate the effects of body composition in terms of body fat percentage, waist-to-hip ratio and defatted body weight index on physical fitness and functional movements of college students. Forty-six male and 96 female students were randomly selected as subjects for physical fitness, body composition, and functional movement screening tests. Results: 1) There was no correlation between fat loss and body mass but positive correlation with speed quality ($P<0.05$); 2) Body fat percentage and waist-to-hip ratio were negatively correlated with functional movement scores ($P<0.05$), and there was a negative correlation between body fat percentage, waist-to-hip ratio and functional movement scores ($P<0.05$), and there was no correlation between fat loss and functional movement, but there was a negative correlation with active straight knee leg raise ($P<0.05$). Conclusions: Excessive body fat rate and waist-to-hip ratio will affect the performance of college physical and functional movements. It has obvious influence on body shape, speed, endurance, lower limb explosive force and core stability in physical quality.

1. Introduction

According to the current situation of the physical fitness of young students in recent years, it is still an important task of school sports in the new era to substantially improve the physical fitness of young students on a large scale, and the physical fitness of college students in China is tested and analyzed according to the National Physical Fitness Test Standards. The Functional Movement Screening (FMS) is also commonly used in the evaluation of students' physical quality, and its sub-items are all based on the cornerstone of daily life activities and basic movements, and the vast majority of test movements and physical fitness tests have different focuses in recent years. The conventional obesity screening method, body mass index (BMI), has certain limitations in responding to body composition. Recently, some anthropometric indicators such as body fat percentage, defatted weight and waist-hip ratio are commonly used to supplement the body composition status of human body, and the evaluation of the composition status of body composition can reflect to some extent the degree of physical exercise of adolescents and correlate with their physical fitness and athletic ability. Therefore, this paper explores the characteristics of physical fitness and functional movement of college students based on the perspective of different body composition levels, and provides reference for college students to make lifestyle adjustments

such as diet regulation and physical fitness exercise and functional exercise based on body composition.

2. Research Object and Method

2.1 Research Objects

In this study, 46 male (age: 20.83 ± 1.87 years; height: 1.72 ± 0.05 cm; weight: 66.44 ± 9.50 kg) and 96 female (age: 20.84 ± 2.07 years; height: 1.58 ± 0.05 cm; weight: 53.82 ± 7.82 kg) students from freshman to junior year of a university were randomly selected.

2.2 Research Method

2.2.1 Method of Experiment

A random sample of 46 male and 96 female freshmen to juniors at a university was selected as subjects for the trial from mid-September to mid-October 2020, and the experimental schedule was as follows: body composition testing on weekend mornings on an empty stomach; physical fitness testing and functional screening of movement during other time periods.

Body composition test method: In Body 720 was used to test the body composition of the study subjects, requiring: fasting in the morning or no food or strenuous exercise within two hours; the subjects took off their shoes and socks, removed the metal objects they were carrying, sprayed a small amount of water or alcohol on the two metal pieces on the test platform, keeping the metal pieces slightly moist. The subject stood on the test platform with the front palm touching the front metal piece and the back heel placed on the back round metal piece, both eyes looked forward, after the weight was stabilized the hand grip was held, the thumb touched the upper round metal piece and the remaining four fingers touched the lower metal strip, avoiding a hard grip, the angle between the two arms and the body was 30° , the ID number and other basic information was entered and the test started, the subject was not allowed to talk and no one else was allowed to touch the subject until the test was finished.

Physical fitness test: All testing items should be completed in one day, with a two-hour interval between the 50m and endurance running items before the other items are tested.

Functional Movement Screening: The functional movement screen consisted of seven test movements, including active straight knee leg raise, shoulder flexibility, body rotation stability, stability push-up, overhead squat, straight leg lunge squat, and straddle step-up, and three functional sun screens including shoulder joint row, extension row, and kneeling lower back row. The specific content of the scoring criteria is shown in Table 1 [1].

Table 1: FMS standards and requirements.

test action	FMS grading standards and requirements			
	3 point	2 point	1 point	0 point
Active straight knee lifting	According to the requirements to complete the action, the process did not appear body shaking, action and exclusion test did not appear pain.	Low quality complete action or complete action in a small range	Under the minimum standard to complete the action or complete the action of large shaking,	Pain in action and exclusion tests.
Flexibility of shoulder joint				
Rotation stability				
Stability push-up				
Squat over top				
Squat with straight leg bow				
Step up the hurdle				

2.2.2 Statistics Method

SPSS25.0 was used for data processing and analysis. Independent sample t test was used to compare the scores of inter-sex physical examination and FMS; Pearson correlation analysis was used between body composition and body test scores and functional action scores, and the significant level was set to 0.05. Strong correlation: 0.8 – 1.0, strong correlation: 0.6 – 0.8, medium correlation: 0.4 – 0.6, weak correlation: 0.2 – 0.4, extremely weak correlation or no correlation: 0.0 – 0.2.

3. Result

As shown in Table 2, total physical test score, body weight score, sprint 50m, standing long jump, and endurance running were negatively correlated with body fat percentage ($P < 0.05$); total physical test score, body weight score, sprint 50m score, standing long jump, and endurance running were negatively correlated with waist-to-hip ratio ($P < 0.05$); and sprint 50m score was positively correlated with defatted body weight ($P < 0.05$).

Table 2: Correlation Analysis between Physical Quality and Body Composition (Body Fat Ratio, Waist-hip Ratio, Defatted Weight).

	body fat percentage		waist-hip ratio		fat free mass	
	correlation coefficient	significance	correlation coefficient	significance	correlation coefficient	significance
Total score of physical examination	-0.341*	0.000	-0.399*	0.000	0.051	0.545
Weight score	-0.360*	0.000	-0.453*	0.000	-0.192*	0.022
vital capacity score	-0.017	0.837	-0.060	-0.479	0.189*	0.024
Sit body flexion score	-0.235*	0.005	-0.178*	0.034	0.132	0.117
Sprint 50 meters score	-0.610*	0.000	-0.319*	0.000	0.505*	0.000
standing broad jump	-0.312*	0.000	-0.264*	0.001	0.120	0.156
Endurance running score	-0.275*	0.001	-0.405*	0.000	-0.21	0.802

Note: * indicates $P < 0.05$, showing significant differences.

Table 3: Correlation between functional movements and body composition (body fat rate, waist-hip ratio, lean weight).

	body fat percentage		waist-hip ratio		fat free mass	
	correlation coefficient	significance	correlation coefficient	significance	correlation coefficient	significance
FMS total score	-0.338*	0.000	-0.235*	0.005	-0.05	0.554
Active straight knee lifting	0.121	0.15	0.026	0.761	-0.387*	0.000
Flexibility of shoulder joint	-0.198*	0.018	-0.205*	0.014	0.037	0.66
Rotation stability	-0.169*	0.045	-0.058	0.491	0.118	0.163
push up	-0.304*	0.000	-0.216*	0.01	0.322*	0.000
Step up the hurdle	-0.019	0.821	-0.047	0.582	-0.229*	0.006
Squat over top	-0.196*	0.019	-0.09	0.287	-0.003	0.975
Squat with straight leg bow	-0.266*	0.001	-0.126	0.134	-0.009	0.916

Note: * indicates $P < 0.05$, showing significant differences.

Table 3 showed that FMS total score, stability push-up and straight leg bow squat were negatively correlated with body fat rate ($P < 0.05$). There was a negative correlation between active straight knee lifting and fat removal weight ($P < 0.01$), and a positive correlation between stable

push-up and fat removal weight.

4. Discussion

Although in recent years, the physical health of students has shown a trend of improvement, the overall situation of young students' physical health in China is still not optimistic. It is still an important work of school physical education in the new era to greatly improve the physical health of young students in a large area [2-4]. In recent years, with the development of science and technology and the improvement of living standards, as well as the outbreak of home or school reasons, college students watch screen time is too long, long time sedentary less movement lead to visual acuity, obesity and other issues, the impact of obesity on college students' physique is concerned. Body fat rate, waist-to-hip ratio and weight loss are commonly used to measure obesity. The indicators used to measure the physical fitness of college students are based on the test and calculation results of the National Physical Fitness Test Standard. Among them, the body mass index corresponds to the body shape of college students, and the vital capacity is used to evaluate the physiological function. The vital capacity not only reflects the lung capacity but also reflects the respiratory muscle strength [5]. Other items can show the physical quality of college students, 50m running is to measure the outbreak, speed quality, and neuromuscular reaction speed; endurance running reflects endurance quality; standing long jump reflects lower limb muscle strength and explosive force; 1min lead upward performance is male college students upper limb muscle strength and muscle endurance; one-min sit-up measured the core muscle strength and muscle endurance of female college students, the anteflexion measured the flexibility of lower limbs.

The results of this study showed that there was a negative correlation between physical condition and body fat rate, which was consistent with the results of Zhao Bangwei and others. There was a significant negative correlation between sit-and-reach, sprint 50 m, standing long jump and endurance running and body fat rate. High body fat rate reflected obesity to a certain extent, which proved that high body fat rate, namely obesity, had a negative impact on lower limb flexibility, explosive force and speed quality and endurance quality of college students, which was negatively correlated with Zhao Runshuan and Ping Zhao's research on body fat rate and adult neuromuscular response speed. Excessive body fat rate would affect adult neuromuscular response speed. The endurance running not only affects muscle endurance, but also may be due to the accumulation of fat in the internal organs, which increases the burden of heart and lung and affects the heart and lung function. However, there are studies that 800 m and 1000 m endurance running are not sensitive to the test of heart and lung function. Overall, the results of this study are consistent with Hu et al. [5-9].

The waist-to-hip ratio is also one of the commonly used indicators to measure obesity. In the correlation analysis, the correlation between the waist-to-hip ratio and the physical test results is generally consistent with the correlation between the body fat rate and the physical test results. The results of the waist-to-hip ratio and the speed, outbreak and neuromuscular reaction speed are consistent with the research results of Zhao and Ping. There is a certain correlation between the reaction speed and the waist-to-hip ratio. The increase of the waist-to-hip ratio increases the reaction time, and the high waist-to-hip ratio leads to the decline of physical quality. The waist-to-hip ratio reflects obesity to a certain extent, which further confirms the influence of obesity on the physical quality of college students [10].

The indexes related to weight loss include muscle mass and bone mineral content [11]. Studies have shown that the reduction of fat-free weight will have a potential negative impact on activities of daily living, emotion, psychology and neuromuscular function. In this study, 50 meters score was positively correlated with fat-free weight. In this study, fat-free weight was positively correlated

with 50 meters running, that is, speed quality, which was consistent with the results of Chen Wei and Xu Yilin. The fat-free weight was positively correlated with straight line speed, but in his study, fat-free weight was negatively correlated with lower limb eruption, which did not appear in this study, which may be related to indicators and subjects. The research objects of Chen Wei and Xu Yilin are young male basketball players, and the research objects of this paper are ordinary college students. Basketball players have strong explosive force, and the high content of muscle is higher than that of ordinary college students, so it is easier to show the relationship between the two. Chen Wei and Xu Yilin used the in-situ longitudinal jump in the study of explosive force evaluation index to investigate the outbreak in the vertical direction, and used the standing long jump in this study, which is the outbreak in the horizontal and vertical directions. Different directions have different muscle recruitment in different parts. Therefore, the reason for the inconsistency between the two results may be that the selection indexes are different [12,13]. Before the experiment, it was speculated that the fat-free body weight was positively correlated with vital capacity, which not only reflected lung capacity but also reflected respiratory muscle strength [5]. Feng Kui and Chen Li et al.'s studies have shown that defatted weight is an independent factor affecting pulmonary ventilation function, reflecting that defatted weight of skeletal muscle strength is positively correlated with pulmonary ventilation function. However, no similar results in this experiment may be due to the different emphasis and sensitivity of lung ventilation volume and vital capacity selected in the two experiments [14].

FMS total score, push-up and straight leg squat were negatively correlated with body fat rate; FMS test is the basic action mode and functional action, total score and body fat rate showed a negative correlation that body fat rate is too high will have a negative impact on college students' basic action mode and functional action, namely obesity will affect the basic action mode and functional action performance. The stability proneness test is to test the core strength and core stability of the human body. The results show that too high body fat rate will have a negative impact on the core strength and core stability of the human body, which is related to the research results of Yang Hongjie and Yang Yan et al: stability proneness is negatively correlated with body fat rate, and the influence of body fat rate on functional action is similar. Some studies have shown that the influence of body fat rate on bone health is negatively correlated in adults. In this study, body fat rate on shoulder joint flexibility [15]. There was a negative correlation between straight knee lifting, hurdle walking and fat removal ($P < 0.05$). Step on the hurdle, in the process of completing the action, the center of gravity from back to front and back to the origin of the center of gravity shift, and the change of the balance support surface from the double foot support to the single foot support, especially the test of neuromuscular control ability of the whole body and the core strength of the whole body stability control, better neuromuscular control posture and core stability contribute to the functional movement of specific movement, the negative correlation results may be due to the influence of obese people in the random sample of this experiment, obese people due to their body adaptability, fat weight in their own proportion is higher, but due to obesity. It also has an impact on their own core stability and physical control ability, thus affecting the performance of active straight knee lifting and hurdle walking. The impact of defatted weight on neuromuscular control and core stability needs to be further studied after removing the influence of obesity factors. There is a positive correlation between proneness and fat-free body weight. It is because high fat-free body weight may lead to high muscle content and strong core strength, which leads to better neuromuscular control ability and core stability, thus showing good body balance and back muscle strength, resulting in good stability of proneness [16]. Both hurdle step-up and stable proneness have certain requirements for core stability. However, hurdle step-up may be negatively correlated due to obesity, but stable proneness does not have a negative correlation. The reason may be that most obese people in the random sample of this experiment are abdominal obesity, and the back

muscle strength is not affected.

5. Conclusions

We hope you find the information in this template useful in the preparation of your submission. From the perspective of body composition level, the following conclusions are drawn from the analysis of college students' physical and functional movements: too high body fat rate and waist-hip ratio will affect the performance of college physical and functional movements. It has obvious influence on body shape, speed, endurance, lower limb explosive force and core stability in physical quality. Appropriate increase in fat removal weight is conducive to the development of college students' speed quality and heart and lung function.

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