Physical fitness effect of three backward walking exercises intervention in overweight male college students

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Abstract. The purpose of this study was to assess the effect of backward walking exercise on physical fitness. 45 freshmen in college whose BMI over 26 voluntarily participated in this study, they were randomly assigned to 3 groups: high volume and low intensity group (H/L), low volume and high intensity group (L/H), high volume and high intensity group (H/H). All three groups received backward walking exercise for 12 weeks, and their BMI and physical fitness index were tested before, after 6 and 12 weeks exercise. The result indicated that (a) BMI of H/L and H/H were significantly lower than L/H after 12 weeks backward walking training, and the value of maximal oxygen uptake were significantly higher in H/L and H/H than in, L/H, and (b) the flexibility and muscle endurance of subjects in all three groups significantly improved and there were no significant difference. This study have drawn the following conclusion that backward walking exercise on BMI and physical fitness related to cardiovascular had an significant positive effect, exercise volume at 240 min each week was more effective than exercise intensity at 60-80%, the proper exercise volume was 160-240 min each week or at 60-90% of maximum heart rate of aerobic exercise intensity, under this condition it were significant effect on the development of flexibility and muscular endurance.

Keywords: backward walking; BMI; physical fitness.

1. Introduction

Backward Walking (BW), also known as reverse walking, retro walking, is the act of walking in reverse, so that one travels in the direction one's back is facing rather than one's front. It is classed as a retro movement, the reverse of any normal movement. Backward walking was first used in the correction training in the rehabilitation of patients with sequelae of asymmetric gait after cerebral hemorrhage, and made a significant effect. In recent years, the Japanese scholars took it as an approach to health care in the elderly population, its effect was significant. Nowadays, backward walking exercise has attracted a wide of attention from many scholars, and it was reported in some relevant fields such as enhancing body balance ability, strengthening cardiovascular system function, and making sports performer more robust in musculoskeletal system [1-4]. Yang's study [5] has shown that the asymmetrical gait in stroke patients can be improved using backward walking exercise. Hackney and Earhart's study [6] confirmed that backward walking exercise can improve the performance of flexibility, gait and balance in patients with Parkinson's disease. From the viewpoint of energy intake and utilization, overweight is a metabolic disorder, when an individual's energy intake is more than energy expenditure in long term, the excess energy will be converted into stored fat, therefore leading to overweight. For a long time, the overweight people will run more risk of chronic diseases such as cardiovascular disease, diabetes, etc. in those who not keep regular physical activity and diet than those who maintain regular physical activity [7-8]. A recent report on the freshman college students' physical examination showed that nearly 50% of the students failed in body weight, among of which amounted to 40% was overweight people [9].

In the literature, there are fewer researches in the effect of backward walking exercise on BMI and physical fitness related to health. The general recommendation of BMI of college students is maintained at the range between 18 to 24. Owing to the inflexible , the overweight people often

ignore the importance of physical exercise, so regular exercise is an important factor to enhance physical fitness, and the effect of regular aerobic exercise such as backward walking on cardiorespiratory fitness and weight control have been anticipated. From the existing reports on the effect of aerobic exercise, the regular exercise and increased physical activity may control body weight, reduce the percentage of body fat, BMI, the lower physical fitness situation caused by the disease or disorders, and improve cardiovascular and muscle performance. Moreover, regular endurance exercise can effectively improve the index related to obese or overweight such as body weight, BMI, waist-hip ratio, body fat percentage, and other obesity-related indicators, as well as enhance cardiorespiratory fitness, it has a positive significance on health promotion and reduce the threat of the risk factors of chronic diseases [10-13].

American College of Sports Medicine's guidelines for health recommends [14] that the exercise intensity of regular physical activities should be between 50-90% of maximum heart rate of sports performer, and that the moderate intensity of prolonged exercise is better than the high intensity of short-term exercise. Some scholars believed that backward walking exercise had little effect on the improvement of cardiorespiratory performance because of the limitation of exercise intensity [15]. However, there was considerable evidence showed that the backward walking exercise had health benefits regardless of age and gender, especially those who lack of movement, menopausal women etc. population [16]. In summary, the health benefits such the improvement of physical fitness, reduce of overweight, reduce the risk of cardiovascular disease of backward walking exercise in different intensity and volume should be explored. The findings can be benefits for the overweight population, the sports performers, and appropriate government departments related to police decision for health guidelines.

2. Subjects and method

2.1 Subjects

45 overweight college freshmen from Southwest University voluntarily participated in this study. All subjects have no training experience with backward walking exercise and without organic diseases. All subjects signed a written consent. They were randomly assigned to three groups of 15 subjects in each group: high volume and low intensity group (H/ L) : 4 times/week, 60 min/time, amount to 240 min/week, exercise intensity at 60-70% of maximum heart rate of individual subject; low volume and high intensity group (L/H) : 4 times/ week, 40 min/time, a total of 160 min /week, exercise intensity at 75-80% of maximum heart rate of individual subject ; high volume and high intensity group (H/ H), 4 times/week, 50 min/time , a total of 200 min/week, exercise intensity at 85-90% of maximum heart rate of individual subject . The basic information is listed in table 1.

Table 1 Basic information for subjects

Group(sample Size)	Age(yrs)	Body Height (cm)	Body weight(kg)	BMI(Kg/m2)
H/L (15)	20.31±1.68	176.24±5.56	82.58±3.12	27.35±2.11
L/H (15)	21.30±2.51	174.42±4.41	82.66±4.12	27.02±3.37
H/H(15)	19.98±2.27	175.27±3.68	83.24±3.55	26.98±3.56

2.2 Experiment design and method

Experiment designs. Subjects in all three groups received backward walking exercise for 12 weeks. All subjects were told the procedure before experiment. The requirement of backward walking exercise was as follows: walking with body upright and raise his/her head, median to long steps, arms swings as possible as can, the highest point of center of palm in each swing should be higher than the position of heart.

To ensure his exercise went well and avoid some disturbing factors, three fitness instructors were assigned to each group for supervision and guide as follows: 1) the exercise time was determined within 18: 00 to 20: 00, all subjects with polar heart meter during exercise, the exercise intensity was limited according to the requirements of the experiment design of each group during backward walking , 2) to emphasize as much as possible to make strides and correct those who not meet the

requirement of experiment design, 3) during the experiment subjects are not allowed to take any diet pills.

Testing on related index. The following index were tested before, after 6 and 12 weeks backward walking intervention:

1) Body mass index: BMI = body weight (Kg)/ body height (m 2); 2). Muscle strength and muscular endurance test: sit-ups with knee flexion (times/min); 3) flexibility test: sit and reach (cm); 4) maximal oxygen uptake (cardiovascular endurance): the distance for 12-minute running.

2.3 Statistical method

SPSS for Windows 16.0 was used and one-way ANOVA test was used in this study, significant difference was set at a=0.05.

3. Results

3.1 BMI change comparison between groups

It was indicated (see fig. 1 left) that (1) there were no significant difference between groups in BMI before exercise intervention(F=3.69,P=0.158>0.05), there were significant difference between groups in BMI after 6 weeks and 12 weeks exercise intervention(F=26.38,P=0.000<0.05;F=31.25,P=0.000<0.05). The result showed that the longer the exercise intervention, the significant decrease the BMI, (2) there are no significant difference in BMI within groups between before and after 6 weeks exercise intervention(27.18Kg/m2v vs.27.31Kg/m2,P>0.05),however, significant difference after 12 weeks exercise intervention(27.31Kg/m2 vs 26.44Kg/m2,P<0.05) in L/H; there are significant difference in BMI within groups between before and after 12 weeks exercise intervention(27.53Kg/m2 vs. 26.26 Kg/m2,P<0.05; 27.56Kg/m2 vs.26.24Kg/m2, P<0.05, respectively), and significant difference after 12 weeks exercise intervention (27.53Kg/m2vs.25.25Kg/m2, P<0.01;27.56Kg/m2 vs.24.98 Kg/m2,P<0.01,respectively) in H/L and H/H. It is obvious that the BMI nearly reached the standard range 18-24 Kg/m2 (25.25Kg/m2 and 24.98Kg/m2) in H/L and H/H; (3) there was significant lower in BMI in H/L and H/H than L/H within groups after 6 weeks and 12 weeks backward walking, however, there was no significant difference in BMI between H/L and H/H (P>0.05).

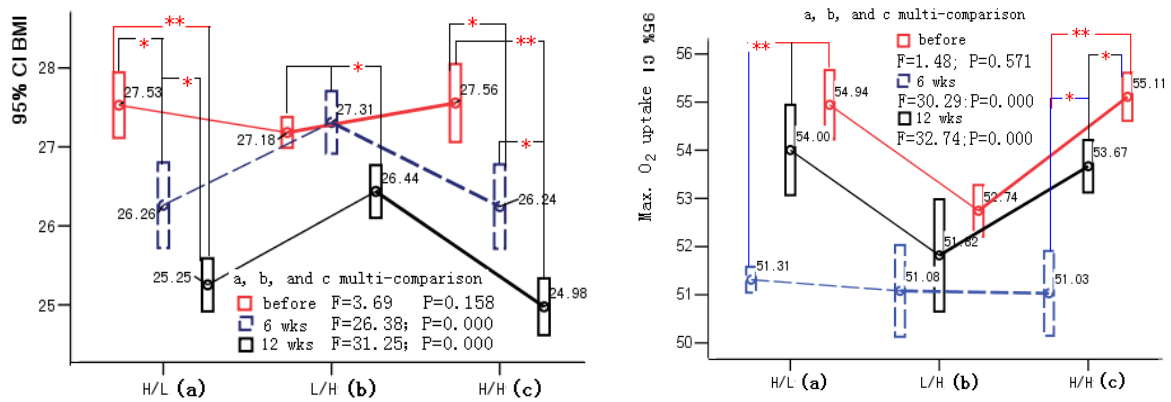

Fig. 1. Left: left BMI change comparison between three backward walking exercise intervention after 12 weeks right: Maximal oxygen uptake change comparison between three backward walking exercises intervention after 12 weeks

3.2 Maximal oxygen uptake (VO2Max) change comparison between groups after backward walking intervention

It was indicated (see fig. 2) that (1) there were no significant difference between groups in VO2Max before exercise intervention(F=1.48,P=0.571>0.05), there were significant difference between groups in VO2Max after 6 weeks and 12 weeks exercise intervention (F=30.29,P=0.000<0.05;F=32.74,P=0.000<0.05). The result showed that the longer the exercise intervention, the significant increase the VO2Max, (2) there were significant improvement in

VO2Max within groups between before and after 6 weeks exercise intervention (54.00ml/kg/min vs.51.31ml/kg/min, P<0.05), after that, the VO2Max increased slowly, it reached 54.94 ml/kg/min after 12 weeks exercise intervention in H/L; there are no effect in VO2Max in L/H after 6 and 12 weeks exercise intervention (51.08ml/kg/min at baseline, 51.62ml/kg/min after 6 weeks and 52.74ml/kg/min at 12 weeks);there were significant improvement in VO2Max after 6 weeks and 12 weeks backward walking intervention(51.03ml/kg/min vs.53.67ml/kg/min, P<0.05;51.03ml/kg/min vs.55.11ml/kg/min, P<0.05) in H/H; (3) there was significant higher in VO2Max in H/L and H/H than L/H within groups after 6 weeks and 12 weeks backward walking, however, there was no significant difference in VO2Max between H/L and H/H(P>0.05).

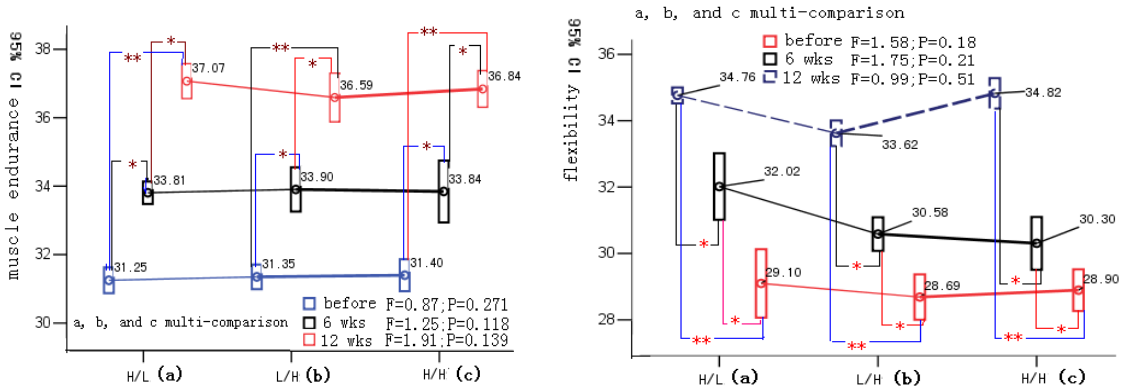

Fig. 2. Left: Muscle endurance change comparison between three backward walking exercises intervention after 12 weeks right: Flexibility change comparison between three backward walking exercises intervention after 12 weeks

3.3 Muscle endurance comparison between groups after backward walking exercise intervention

It was indicated (see fig. 2 left) that (1) there were no significant difference between groups in muscle endurance before, after 6 and 12 weeks exercise intervention (F=0.87,P=0.271>0.05; F=1.25,P=0.118>0.05;F=1.91, P=0.139>0.05). The result showed that the longer the exercise intervention, the significant increase the muscle endurance, (2) Compared with before intervention, muscular endurance increased from 31.25 times / min to 33.81 times / min (P <0.05) after 6 weeks , reach 37.07 times/min (P <0.01) after 12 weeks in H / L; muscular endurance increased from 31.35times / min to 33.90 times / min (P <0.05) after 6 weeks , and reach 36.84 times / min after 12 weeks in L /H; muscular endurance increased from 31.40 times/ min to 33.84 times / min (P <0.05) after 6 weeks , reach 36.84 times / min after 12 weeks in H / H, (3)there was no significant difference in muscle endurance between H/L, H/H and L/H within groups after 6 and 12 weeks backward walking, however, it showed that the effect of three design is familiar in muscle endurance.

3.4 Flexibility change comparison between groups after backward walking exercise intervention

It was indicated (see fig. 2 right) that (1) there were no significant difference between groups in flexibility before, after 6 weeks and 12 weeks exercise intervention(F=1.58,P=0.18>0.05; F=1.75, P=0.21>0.05; F=0.99, P=0.51>0.05). The result showed that the longer the exercise intervention, significantly increase the flexibility, (2) Compared with before intervention, sit and reach increased from 29.10cm to 32.02cm (P <0.05) after 6 weeks , reach 34.76cm after 12 weeks in H / L; sit and reach increased from 28.69cm to 30.58cm (P <0.05) after 6 weeks , and reach 33.62cm after 12 weeks in L /H; flexibility increased from 28.90cm to 30.30cm (P <0.05) after 6 weeks , reach 34.82cm after 12 weeks in H / H, (3)there was significant higher in flexibility in H/L than H/H and L/H between groups after 6 and 12 weeks backward walking, however, there was no significant difference in flexibility between H/L and H/H(P>0.05).

4. Analysis and discussion

Regular exercise can contribute to energy consumption, also increase basal metabolism, and improve body fat and lean body weight, so it is able to effectively change the body composition. BMI is a simple measure of the degree of fat to understand the body, either men or women BMI are over 26 belonging to overweight. Under this situation, it runs a risk of causing a variety of health problems, it is worth attention. In this study, subjects performed backward walking for 12 weeks, the differences comparison between groups in different periods showed that BMI in H / L, H / H are significant lower after 6 weeks than before intervention, and the BMI value is very close to the standard value after 12 weeks. BMI was significant lower in H / L and H / H than L/H after 6 weeks, it came to the conclusion that the exercise volume is a key factor in lowering BMI, this result is similar to An Nan's study [17]. Jiang Yan [18] explored the effect of different exercise intensity on physical fitness in normal weight girls from colleges, after six weeks exercise intervention, the author found out that there were significant change in moderate and high exercise intensity in body composition, while the low exercise intensity did not appear to change. Thong [13] have shown that there was no significant change in BMI after 6 weeks backward walking (not emphasize strode back, chest-style)($P>0.05$).

It is obvious that the size of exercise volume was a very important factor in the design of weight loss, the volume related to the exercise frequency each week and time of exercise each time. From the findings of many scholars, it showed that it is the ideal design to exercise 3-5 times per week, and more than 40 min each time. In this study the intervention design lasted for 12 weeks, the result showed that there was significant effect on H / L group and H / H. There was no significant effect in Thong's study, it may be the time of intervention is short, or didn't emphasize walking posture. The present study emphasized higher stride style and long step backward walking. The subjects feel that the backward walking was more tired than the forward walking when they walk around a 400m runway.

Cardiorespiratory fitness is one of the important factors in physical fitness, many foreign studies have shown that it was positive correlation between physical exercise and cardiorespiratory fitness [19, 20]. In this study, it was significant higher on maximal oxygen in H/H and then in L/H for 12 weeks intervention under different physical exercise, and the results was similar to that of Malhotra et al. [21 22] . However, some scholars believed that in spite of somewhat improvement of maximal oxygen uptake, there was no significant improvement on it under backward walking intervention. There are some different findings in these studies. It may be caused by the different exercise intensity and exercise time. Thus, the higher exercise intensity can significantly improve cardiorespiratory fitness. In this study, the exercise volume was set up to 200 min/week in H / L and H / H, it can ensure to receive optimal cardiorespiratory fitness in overweight male college students.

Muscle endurance is the ability of a muscle or group of muscles to sustain repeated contractions against a resistance for an extended period of time. Which consists of two aspects: muscular endurance and cardiovascular endurance. Flexibility refers to the absolute range of movement in a joint or series of joints, and length in muscles that cross the joints to induce a bending movement or motion. In order to maintain or increase flexibility, one has to do specific physical exercise. Backward walking intervention can increase the opportunities of physical activity and the capacity of stretching, and also effectively enhance muscle endurance and flexibility fitness. In this study, subjects in H/L and H/H muscular endurance and flexibility significantly increase in fitness after 12 weeks intervention, this result was similar to that of many scholars [23-24]. In summary, the aerobic exercise of appropriate exercise volume or intensity can significantly enhance muscle endurance and flexibility fitness. As a consequence, whether it is backward walking, swimming, cycling, ball games, or other exercise, when the cumulative daily consumption of calories is enough, the physical fitness will be improved from the energy perspective.

5. Conclusion

1) Either moderate or higher intensity exercise, it is the better recommendation to exercise at 200 min/week in order to lower BMI for overweight college students and enhance cardiorespiratory performance compared with 160 min/week; and the exercise at 160-240 min / week with the aerobics

exercise intensity at 85-90% of maximum heart rate can achieve significant benefits in the improvement of flexibility and muscular endurance,.

2) In the exercise intensity at 60-80% of maximum heart rate, the exercise at 240 min/week is the most conducive to enhancing maximal oxygen uptake (cardiorespiratory fitness), and higher intensity exercise such as at 85-90% have a lower benefit on cardiorespiratory fitness, there are no significant effect on flexibility and muscle endurance between H / L, L/H, and H / H.

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