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The effect of stair-ascent activity exercise on body fat and muscle mass in university students.

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Abstract

The purpose of this study was to investigate the effect of stair-ascent activity exercises program on body fat and body mass, which is a body composed of university students, and to improve the physical health of university students. The result of the study showed that the body fat mass of university students participating in the stair-ascent activity exercises program showed a significant difference according to the time. That is, the longer the stair-ascent activity exercises program Period of body fat was found to exhibit a significant decrease. In addition, there was a significant difference in the muscle mass of university students participating in the stair-ascent activity exercises program. That is, the longer the stair-ascent activity exercises program application period was also seen as a significant increase in muscle mass. The results of this study showed that the stair-ascent activity exercises program for university students had a positive effect on improvement of body composition by decreasing body fat and increasing muscle mass. Therefore, it is thought that the stair-ascent activity exercises program should be actively utilized as a nursing intervention program that maintains and promotes the health of university students and the general public. It is also fodder-depth research will be needed on how to continue to enforce exercise.

Keywords: Stair-ascent activity exercises, Body fat, Muscle mass, University student.

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Introduction

With advances in technology, people now live lavish and comfortable lives. However, this type of lifestyle leads to excessive nutritional intake and decreased physical activity [1]. As a result, the average body fat mass has increased and chronic diseases. This phenomenon is becoming a social problem [2], that regular exercise is recommended to solve.

Regular exercise not only improves health and stamina, it benefits mental health. These eminent benefits in a person's life are reason enough to regularly exercise. Regular exercise improves body composition by decreasing weight, body fat mass, and body mass index. Furthermore, regular exercise increases muscle mass and decreases blood pressure, blood sugar, total cholesterol, triglyceride level, and low-density lipoprotein cholesterol levels. Last but not least, regular exercise increases high-density lipoprotein cholesterol level, flexibility, and base stamina [3,4]. Improved stamina is directly correlated with health, self-esteem, self-cultivation, and self-confidence and relieves stress and tension [5].

Among different exercise methods, aerobic exercises such as walking and running are the most accessible and can be performed anywhere [6]. Prolonged low-intensity aerobic exercises maximize caloric expenditure [7]. In addition to aerobic exercises, resistance exercises are recognized for their ability to reduce body fat and improve metabolic diseases. As a form of anaerobic exercise, resistance exercise increases muscle tissue activities that lead to increased muscle mass and base metabolic rate and decreases body fat mass and visceral fat [8]. The stair-ascent activity exercise is a resistance exercise that stimulates muscle mass gain by increasing growth hormone release, which helps prevent musculoskeletal diseases and improves strength [9].

The stair-ascent activity exercise in this study reportedly improves lower limb strength and changes gait patterns. Furthermore, it functionally and physically improves the knee joint and increases muscle strength [10]. The stair-ascent activity exercise uses 10-15 times more calories than walking on a flat surface. It also reportedly improves foot stability and improves the functional motion of the knee joint [11,12].

This study analysed the effects of the stair-ascent activity exercise, which has properties of aerobic and resistance exercises, on body fat mass and muscle mass in college students. The study aimed to prove the need for exercise and provide base data for chronic disease prevention and physical health improvement using daily-life exercise methods.

Research Method

Research design

In this study, a non-equivalent control group quasi-experimental design was used to define the effects of stair-ascent activity exercise on college students' body fat mass and muscle mass.

Research subjects

The participants in this study were dorm residents of K University who were recruited through bulletin board advertisements. Written consent was obtained from each participant prior to the study. A minimum total of 22 participants including both the experimental and control groups was calculated using the G*power 3.1.7 program with a significance level of 0.05, the power of 0.80, and a medium effect size of 0.25, the experimental group was left with 18 participants and the control group was left with 17.

Research tools

The stair-ascent activity exercise program was performed by the dorm residents of K University for 8 weeks from October 2017 to December 2017. To determine program efficacy, the stair-ascent activity exercise program was applied in the experimental group only. The control group was instructed to avoid performing any exercise program.

The stair-ascent activity exercise program in this study is an accessible exercise program in daily life. The participants performed the stair-ascent activity exercise on stairs as described by the 48th article of the Enforcement Decree of the Building Act and clause 2 from the 15th article of the Apartment staircase standards, which specify a minimum height of 18 cm and a minimum width of 26 cm. The number of stairs between the floors was 16 in the 10-story building where the participants resided, with each stair having a height of 18 cm and a width of 26 cm.

The stair-ascent activity exercise program was developed with consideration of intensity, duration of each set, frequency, and method. Since the stair-ascent exercise is considered an endurance and aerobic exercise, the intensity was set to 40-60% of the maximal heart rate determined using the Kavonen equation. Maximal heart rate was calculated using 220-age/number of sets, while target heart rate was calculated as intensity (%) × (maximal heart rate-baseline heart rate)+ (baseline heart rate). To address safety and stamina, the duration of each set was set to 40 min for the first 1-2 w and gradually increased to 60 min in the third week. The frequency was set to 4 times a week. The exercise rules stated that less than half of the plantar surface should come in contact with the stair surface, the posterior foot should bear the body weight and the participants should proceed to the next stair after the weight bearing leg's knee is fully extended an the upper body is anteriorly tilted to about 3-4º. The arms were moved naturally and swung backward rather than forward to gain propulsion.

To determine the effects of the stair-ascent activity exercise program, the heights and the weights of the participants were measured using an automatic digital measurer (HM-200; Korea). The body fat mass and muscle mass were measured using a bioelectrical impedance analyzer (Inbody 3.0). On the day prior to the measurement, the participants were asked to avoid strenuous activities and abstain from food and caffeine at least 2 h prior to the measurements. Furthermore, the measurements were taken while the participants were wearing simple athletic attire. To accurately determine the effects of stair-ascent activity exercise on the participants, their nutritional intake (breakfast, lunch, dinner, snacks, and other consumptions) were recorded. A checklist was provided to the participants to allow them to keep track of their exercise frequency.

Statistical analysis

The collected data were analysed using the SPSS 21.0 program. To determine the participants' demographics and health-related properties, the actual number, percentage, mean, and standard deviations were calculated. The experimental and control groups were compared using the chi-squared test and independent t-test. Normality of the experimental variables was tested using the Kolmogorov-Smimov test and the intergroup differences were analysed using two-way repeated-measures analysis of variance.

Results

Homogeneity verification of general characteristics

The experimental group included 4 males (22.2%) and 14 females (77.7%), while the control group included 4 males (23.5%) and 13 females (76.5%). The experimental group included 13 participants aged 20-24 years (72.2%) and 5 participants aged 25-29 y (27.7%), while the control group included 13 participants aged 20-24 y (76.5%) and 4 participants aged 25-29 y (23.5%). When asked about exercise habits, 5 participants in the experimental group responded "yes" (27.7%), while 13 participants responded "no" (72.2%). In the control group, 3 participants responded that they exercised (17.6%), while 14 participants responded that they do not exercise (82.4%). No significant difference was observed between the two groups, proving that the two groups were homogeneous (Table 1).

Homogeneity verification for variables

The average body fat masses for the experimental and control groups were 18.29 ± 6.36 and 19.79 ± 8.03, respectively, while the average muscle masses were 23.32 ± 7.16 and 24.07 ± 5.65, respectively. The homogeneity analysis showed no significant intergroup differences in body fat mass and muscle mass (Table 2).

Comparison of outcome variables between two groups

The body fat mass was measured every 2 w after initiation of the stair-ascent activity exercise. In terms of body fat mass, although correlations between the two groups and between each group and time period showed no significant differences, the time period itself showed significant difference (F=11.344; $p \leq 0.001$). In terms of muscle mass, correlations between the two groups and between each group and time period showed significant differences (F=16.502, $p \leq 0.001$) (Table 3).

Table 1. *Homogeneity for general characteristics (N=35).*

Classification	Subdivision	Experimental group (n=18)		Control group (n=17)		χ^2/t	P
		N	(%)	n	(%)		
Gender	M	4	22.2	4	23.5	1	0.62
	F	14	77.7	13	76.5		
Age	20-24 y	13	72.2	13	76.5	1	0.54
	25-29 y	5	27.7	4	23.5		
Exercise	Yes	5	27.7	3	17.6	0.691	0.38
	No	13	7	14	82.4		

Table 2. *Homogeneity for subject variables (N=35).*

Classification	Experimental group (n=18)	Control group (n=17)	t	P
Body fat	18.29 ± 6.36	19.79 ± 8.03	0.377	0.545
Muscle mass	23.32 ± 7.16	24.07 ± 5.65	0.117	0.735

Table 3. *Comparison of outcome variables between two groups (N=35).*

Subject		Pre-test (M ± SD)	2 w (M ± SD)	4 w (M ± SD)	6 w (M ± SD)	8 w (M ± SD)	Source	F	P
Body fat	Experimental group (n=18)	18.29 ± 6.36	17.92 ± 6.35	18.65 ± 6.32	18.52 ± 6.55	18.10 ± 6.37	Group	0.391	0.536
	Control group (n=17)	19.79 ± 8.03	18.94 ± 7.78	20.21 ± 7.93	20.24 ± 8.07	19.94 ± 8.12	Time	11.344	<0.001
Muscle mass	Experimental group (n=18)	23.32 ± 7.16	23.39 ± 7.04	23.08 ± 7.12	23.64 ± 7.19	24.10 ± 7.23	Group	0.03	0.865
	Control group (n=17)	24.07 ± 5.65	23.91 ± 5.56	23.57 ± 5.68	23.91 ± 5.40	23.94 ± 5.76	Time	16.502	<0.00001
							Group × time	0.98	0.329

Discussion

The body fat masses of the participants were monitored every 2 w after initiating the stair-ascent activity exercise program. The largest decrease in body fat mass was 2 w after the initiation of the exercise program, with a decrease of 0.37. At w 8, at the completion of the exercise program, a decrease of 0.18 was observed. The control group showed a mean body fat mass at w 6, the largest increase was observed with a change of 0.45. At w 8, at the completion of the exercise program, an increase of 0.15 was observed. The largest difference in body fat mass between the two groups was observed in w 8 at 0.63. At w 2, the largest decrease in body fat mass was observed in the experimental group, which is most likely the result of the initial emphasis on the importance and need for the exercise program.

The mean muscle mass of the control group was an overall decrease in muscle mass. When the stair-ascent activity exercise program was initiated, the mean muscle mass of the experimental group was an overall increase was observed; at w 8, the largest increase of 0.78 was observed. At w 8, the difference between the body fat masses between the two groups was large (0.91). These results indicate that stair-ascent activity exercise over a prolonged period of time increases one's muscle mass.

The body fat mass of the college student participating in stair-ascent activity exercises program showed significant changes over time. In other words, as the length of the stair-ascent activity exercise program increased, the body fat mass significantly decreased. The results of this study are consistent with those of previous studies that reported the significant

decrease in body fat mass, body fat percentage, and abdominal fat percentage in a walking exercise program [3,4].

The muscle mass of college students who participated in the stair-ascent activity exercise program differed at different time periods. In other words, as the length of the stair-ascent activity exercise program increased, the muscle mass significantly increased. The results of this study are consistent with those of previous studies that reported a significant increase in musculoskeletal mass after a 12 w walking exercise program [7]. Furthermore, the results of this study are also consistent with the results of previous studies that reported improvements in body composition and muscle strength in males in their 20 s after a combination of aerobic and resistance exercises [13,14].

Tokmakidis et al. reported that increased body activity through exercise leads to decreased body fat and increased metabolism, which in turn increases muscle mass and prevents musculoskeletal diseases [15]. Furthermore, increased body activity through exercise decreases the incidence of cardiovascular and neurological complications. Increased body activity promotes improved stamina, which has a positive impact on body composition and improves muscle strength through increased muscle mass. The increased muscle strength improves body imbalance, exercise ability, and stamina [11].

The results of this study showed that the stair-ascent activity exercise program positively impacts college students' body fat mass, muscle mass, and body composition. Therefore, a stair-ascent activity exercise program should be aggressively promoted to maintain or improve college students' or other people's health. Furthermore, a more thorough study should be conducted to determine ways to encourage consistent exercise.

Conclusion

The purpose of this study was to investigate the effect of stair-ascent activity exercises program on body fat and body mass, which is a body composed of university students.

The result of the study showed that the body fat mass of university students participating in the stair-ascent activity exercises program showed a significant difference according to the time. That is, the longer the stair-ascent activity exercises program Period of body fat was found to exhibit a significant decrease. In addition, there was a significant difference in the muscle mass of university students participating in the stair-ascent activity exercises program. That is, the longer the stair-ascent activity exercises program application period was also seen as a significant increase in muscle mass.

The results of this study showed that the stair-ascent activity exercises program for university students had a positive effect on improvement of body composition. Therefore, it is thought that the stair-ascent activity exercises program should be actively utilized as a nursing intervention program that maintains and promotes the health of university students and the general public. It is also fodder-depth research will be needed on how to continue to enforce exercise.

Conflict of Interest

The authors report no conflicts of interest related to this study. The author does not have any financial interest in the companies whose materials are included in the article.

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