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Effects of Combined Resistance-Aerobic Training and Milk Consumption on the Weight Loss of Overweight Female Students

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Abstract

The purpose of this study was to determine the effect of milk consumption following resistance-aerobic training on the weight loss of female students. Information was collected from 80 female students with more than 10 kg overweight in the body composition analysis. Forty eligible students were then randomly divided into two groups of aerobic-resistance training and aerobic-resistance training plus milk consumption. Finally, a total of 30 students remained in the study. The students consumed milk immediately and one hour after aerobic-resistance training. The exercise protocol included aerobic-resistance exercises for six weeks (three days a week). The results of independent *t*-test after six weeks of aerobic-resistance training showed a significant reduction in weight loss indicators, including body fat percentage (P = 0.04), total body fat (P = 0.03), and waist-to-hip ratio (P = 0.03), in addition to an increase in muscle gain (P = 0.002) in the exercise + milk group, compared to the aerobic-resistance training group. Therefore, it seems that a resistance-aerobic training program, along with milk consumption, can improve the body composition and health indicators of individuals.

Keywords: Aerobic Exercise, Resistance Training, Milk Consumption, Body Composition

1. Background

Obesity is recognized as one of the important global health concerns, resulting in diseases, such as diabetes, hypertension, and cancer (1, 2). Over the past two decades, the prevalence of obesity has increased throughout the world, reaching its highest level in the United States (3). In Iran, the prevalence of obesity and overweight has been estimated at 3.61% and 8.32%, respectively (4). Generally, obesity and overweight are major contributors to the development of chronic diseases, such as cardiovascular diseases, type II diabetes, insomnia, and postural disorders, and may result from increased energy intake and decreased physical activity (1, 2, 4, 5).

Sport physiologists and nutritionists describe two major factors associated with weight loss, including workout routine and diet plan. It has been well established that changes in the composition of dietary macronutrients can be effective in weight loss (6). In fact, increased protein density in the diet boosts the feeling of fullness and consequently reduces the intake of energy in individuals (5). On the other hand, muscle is one of the important tissues in the body's motor system. Muscles may lose their strength due to different factors and diseases. In most people, muscle atrophy occurs due to inadequate muscle use. In addition, people with inadequate mobility and limited muscular contraction often experience reduced muscle size and weakness (7). Nevertheless, this type of atrophy can be eliminated by exercise and proper nutrition.

Evidence suggests that morphological and functional adaptation of athletes and non-athletes to resistance exercises is highly desirable (8). Multiple studies have reported that one year of resistance exercise can maintain and increase lean body mass (8). Essentially, resistance exercises have anabolic features and stimulate the muscle protein synthesis pathway. Moreover, consumption of protein-rich foods can prevent muscle atrophy or decelerate the progression of atrophy. More favorable results can be obtained if resistance training is accompanied by the consumption of protein-rich foods, which can contribute to muscle synthesis (9). Studies show that protein-rich diets increase fat loss more than low-protein diets (9), since muscle gain leads to an increase in metabolism and fat burning capacity of the body. On the other hand, different types of protein may affect the outcomes of resistance training due to their variable rates of absorption, differ-

ences in amino acid profiles, unique hormone responses, and effects on antioxidant defense (10).

Our hypothesis in this study was that milk intake immediately and one hour after exercise can improve muscle gain, as the body is possibly at its most favorable state in terms of anabolic responses in this period (11). Limited studies have been carried out on the effects of combined weight loss exercises or resistance training associated with protein intake on weight control, muscle growth, and body composition, and the reported results are contradictory (12). In addition, only protein supplements have been examined in studies performed in Iran and other countries. Since the annual consumption of milk in the Iranian population, especially students, is very low, and the general viewpoint about the use of protein supplements and resistance training is negative (due to poor body image), in this study, we used milk in addition to aerobic and resistance training to evaluate its possible effects on changes in the body composition.

2. Methods

In this semi-experimental study, the statistical population consisted of the students of Imam Khomeini International University. For selecting the study sample, flyers were distributed in the university, and overweight students were invited to the study. After completing a questionnaire on the history of diseases and drug consumption, physical activity, and history of supplementation use, a total of 40 eligible students were selected and randomly divided into two groups: aerobic-resistance training + milk consumption and aerobic-resistance training. It should be noted that thirty students remained in the study by the end of training.

The students studied and signed the written consent forms and were familiarized with the study protocol and accurate exercise performance in one session. In the aerobic-resistance training + milk group, the students used milk immediately and one hour after aerobic-resistance training. The exercise protocol included six weeks of aerobic and resistance training (using free weights), three days a week. For designing the resistance training program, the one-repetition maximum (1RM) test was performed for all movements in one session (Table 1) to control the intensity of workouts accordingly during the training sessions (Equation 1). In addition, a Polar heart rate monitoring device was used to control the intensity of aerobic workouts, and maximum heart rate was measured based on the Karvonen formula.

$$1\ RM = \frac{Weight}{1.0278} - (reps\ \times 0.0278) \quad (1)$$

Equation 1 represents the 1 RM formula for estimating the maximum power in each training set.

2.1. Study Procedure

The students were asked not to eat any food for two hours before training. The study procedure is presented in Table 1. The students used 200 mL of milk immediately after the exercise and 200 mL one hour after the exercise (735 kJ, 17.5 g protein, 22.7 g carbohydrate, and 0.4 g fat). The body composition was evaluated using the mass-in-body analyzer (Korea).

In total, 24 out of 30 (80%) students were living in dormitories and used self-catering services of the university; the rest lived outside the dormitories. Although most of the students had similar living conditions and nutrition, the self-report method was used for further control to describe the nutritional habits of the subjects. The students were instructed to measure their calorie intake. The HyperDiet program was also used for calorie intake measurements and control of the students' self-reports. For data analysis, independent and paired *t*-tests were performed.

3. Results

As presented in Table 2, the results of independent *t*-test showed no significant difference between the two groups in terms of weight and body mass index (BMI) (P = 0.06 and P = 0.17, respectively), while there was a significant difference in body fat percentage (P = 0.04), waist-to-hip ratio (P = 0.03), total muscle mass (P = 0.002), and body fat mass (P = 0.02) between the groups. The calorie intake measurements are presented in Table 3.

As shown in Figure 1, the results of paired *t*-test showed that both groups lost more fat in the posttest (P = 0.001). On the other hand, the results of independent *t*-test showed that the group consuming milk after exercise lost more fat than the aerobic-resistance training group (P = 0.03).

As presented in Figure 2, paired *t*-test showed that muscle analysis in both groups was significantly improved in the posttest (P = 0.001). Independent *t*-test also showed that the group consuming milk after exercise had more muscle mass than the aerobic-resistance training group (P = 0.03).

4. Discussion

The aim of this study was to investigate the effects of milk consumption following aerobic-resistance training on the weight loss of female students. The results showed that after six weeks of resistance-aerobic training,

Table 1. The Exercise Protocol of the Study

Sessions	Resistance Training	Aerobic Training
1- Chest and biceps exercises	Chest press, upper chest press, flat dumbbell chest press, incline dumbbell press, standing dumbbell press, dumbbell preacher curl, and dumbbell alternate bicep curl	Warm-up, aerobic activity, and cool-down
2- Back and triceps exercises	Horizontal bar, seated cable rows, lat pulldown, cable overhead triceps, lying triceps extensions, seated dumbbell extensions	
3- Legs, shoulders, and abdomen exercises	Squats, leg extensions with a machine, seated leg curl, standing calf stretch, behind the neck shoulder press, standing dumbbell, dumbbell side raise, and crunch	
Week 1	10 - 12 repetitions; 60% 1RM; three sets (one-minute rest between the sets)	Warm-up for 10 minutes; aerobic exercise for 25 minutes at 60% of maximum heart rate; and cool-down for 10 minutes
Week 2	8 - 10 repetitions; 65% 1RM; three sets (1.5-minute rest between the sets)	Warm-up for five minutes; aerobic exercise for 35 minutes at 60% of maximum heart rate; and cool-down for five minutes
Week 3	6 - 8 repetitions; 70% 1RM; four sets (two-minute rest between the sets)	Warm-up for five minutes; aerobic exercise for 35 minutes at 65% of maximum heart rate; and cool-down for five minutes
Week 4	8 - 10 repetitions; 70% 1RM; three sets (1.5-minute rest between the sets)	Warm-up for five minutes; aerobic exercise for 35 minutes at 70% of maximum heart rate; and cool-down for five minutes
Week 5	10 - 12 repetitions; 70% 1RM; three sets (1.5-minute rest between the sets)	Warm-up for five minutes; aerobic exercise for 35 minutes at 70% of maximum heart rate; and cool-down for five minutes
Week 6	10 - 12 repetitions; 70% 1RM; three sets (one-minute rest between the sets)	Warm-up for five minutes; aerobic exercise for 35 minutes at 75% of maximum heart rate; and cool-down for five minutes

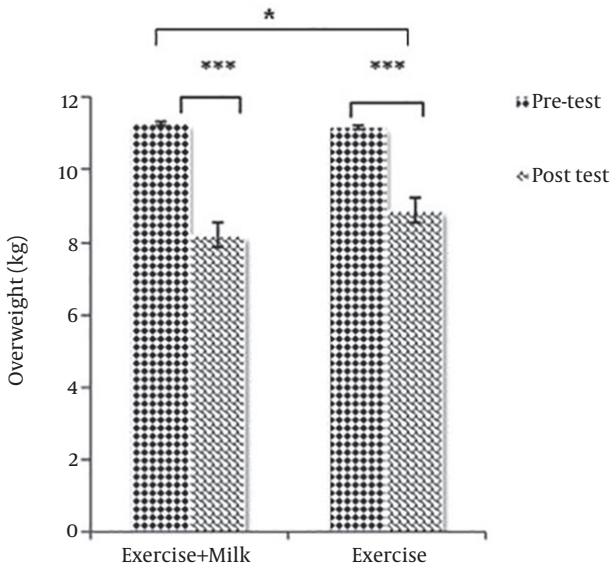

Figure 1. The results of paired *t*-test (pretest-posttest) and independent *t*-test (mean difference of the groups in the pretest and posttest) regarding overweight in the groups after six weeks of training. * Significance level at P < 0.05; *** significance level at P < 0.005.

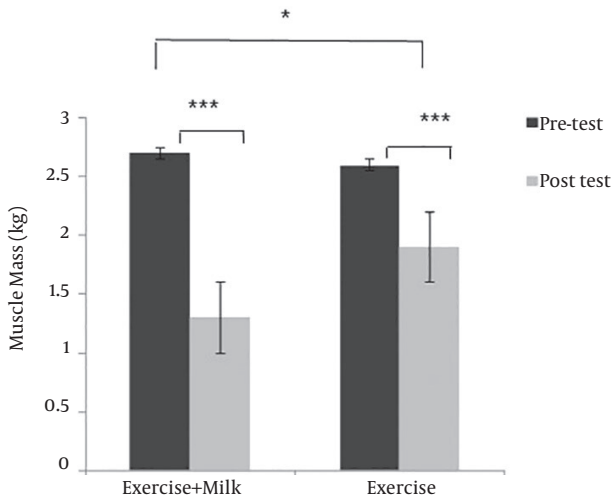

Figure 2. The results of paired *t*-test (pretest-posttest) and independent *t*-test (mean difference of the two groups in the pretest and posttest) for muscle analysis after six weeks of training. * Significance level at P < 0.05; *** significance level at P < 0.005.

body composition significantly changed in both groups (reduced body fat percentage, increased muscle gain, and reduce fat mass).

In addition, milk consumption along with exercise significantly decreased body composition indicators, including body fat percentage, waist-to-hip ratio, and total body fat, and increased muscle weight gain and metabolism. In

Table 2. The Demographic Characteristics of the Students

Variables	Pretest	Posttest	P Value
Weight			0.06
Exercise + milk	76.3 ± 4.0	75.2 ± 4.9	
Exercise	76.2 ± 1.8	75.2 ± 3.6	
BMI, kg/m^2			0.17
Exercise + milk	30.2 ± 4.1	29.2 ± 1.1	
Exercise	30.2 ± 3.1	29.2 ± 3.1	
Body fat percentage, %			0.04*
Exercise + milk	35.2 ± 6.1	32.2 ± 1.1	
Exercise	35.2 ± 4.1	33.2 ± 1.1	
Waist-to-hip ratio			0.03*
Exercise + milk	0.86	0.0 ± 82.02	
Exercise	0.0 ± 86.01	0.0 ± 86.01	
Total body mass, kg			0.002*
Exercise + milk	24.2 ± 6.1	26.1 ± 1.5	
Exercise	24.2 ± 6.1	25.1 ± 5.6	
Fat mass, kg			0.02*
Exercise + milk	17.1 ± 6.4	14.1 ± 1.3	
Exercise	17.1 ± 4.3	14.1 ± 9.1	
Metabolism, kcal/day			0.04*
Exercise + milk	1475	1503	
Exercise	1469	1492	

Abbreviation: BMI, body mass index.

Table 3. Comparison of Calorie Intake and Dietary Composition in the Two Groups Based on Independent *t*-Test

Dietary Composition (Mean Daily Intake During The Intervention)	Exercise + Milk Group	Exercise Group	P Value
Energy intake, kcal	2254 ± 27	2249 ± 31	0.18
Protein, energy percentage	20.0 ± 1.3	18.0 ± 3.4	0.03*
Total fat, energy percentage	31.2 ± 8.1	32.2 ± 5.2	0.07
Carbohydrate, energy percentage	48.4 ± 5.5	48.3 ± 9.2	0.12
Cholesterol, mg	14.2 ± 7.1	14.2 ± 4.0	0.15
Fiber, g	31.2 ± 8.7	32.2 ± 6.1	0.06
Fruits, servings per day	2.0 ± 1.5	1.0 ± 9.2	0.08

the literature, milk has been found to be useful in the synthesis of proteins and glycogen, as the body returns to its primary state after exercise (13). Therefore, the important role of proteins, such as milk which has the richest amino acids for muscle synthesis (9), is established.

In addition, one of the interesting findings of this study is the significant difference in the body fat percentage, waist-to-hip ratio, and total body fat of the two groups, while there was no significant difference in the BMI and weight of the two groups. As indicated in Table 3, fat mass reduced and muscle weight increased significantly in the group consuming milk. This highlights the importance of measuring body composition indicators (fat and muscle mass) instead of raw weight in the improvement of health indicators.

One of the reasons for the reduced fat burning capacity of the body in the exercise + milk group might be the increased muscle mass, as it improves metabolism, fat burn-

ing capacity, and energy requirements of the body during exercise. Fujita et al. (2007) showed that protein consumption after a resistance training session increased the use of amino acids for protein production, which could lead to a systemic increase in insulin and further muscle synthesis (14). The results of this study regarding the increased muscle strength following exercise and protein consumption are consistent with the results reported by Pennings et al. (2012), who showed that use of protein substances, such as albumin, pinto beans, milk, or cheese, could improve muscle synthesis after resistance exercises (15).

An important question in the use of protein substances during training is the proper time for the use of proteins during training intervals to maximize proper responses to exercise adaptations (16). This can have positive outcomes, such as muscle repair and strengthening due to muscle hypertrophy, which ultimately leads to improved weight loss (17). As stated earlier, the timing of food intake has greater effects on the body composition, compared to the type of dietary supplementation (18); this finding should be considered by health policymakers.

4.1. Conclusions

Since the use of simple and effective methods for improving the body composition and health of female students is very important, it seems that aerobic-resistance training, combined with milk consumption, can improve the body composition and consequently health indicators of these students.

Footnotes

Authors' Contribution: Study concept and design, Amin Asadi; acquisition of data, Ehsan Zarandi; analysis and interpretation of data, Mohammad Ghasemi; drafting of the manuscript, Mohammad Mahdikhanjari; critical revision of the manuscript for important intellectual content, Amin Asadi; statistical analysis, Sahar Bayat; administrative, technical, and material support, Samaneh Malekmohammadi; study supervision, Mohammad Ghasemi.

Conflict of Interests: It is not declared by the author.

Ethical Approval: This study approved by Imam Khomeini International University.

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