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Combined Effects of One Period Resistance Training and Nutritional Knowledge On Muscle Strength

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Abstract: *The purpose of this study was to investigate the effects of resistance training and nutritional knowledge on muscle strength and body composition indices of non-athletic female students. 32 non-athlete female students of Islamic Azad University of Rasht. The variables were re-measured after 8 weeks of resistance training. The Kolmogorov-Smirnov test was used to check the distribution of data. Furthermore, a correlated t-test was used to compare the variables in the pre-test and post-test (intra-group changes); ANOVA and Tukey post hoc tests were used to compare the changes between the groups. Data analysis was performed using SPSS software at a significant level of p≥0.05. The results of this study showed that muscle strength in training groups was significantly increased; this increase was higher in resistance training group with nutritional knowledge.*

Keywords: *Resistance Exercises, Nutritional Knowledge, Physical Composition, Muscle Strength*

INTRODUCTION

Resistance exercises are a kind of sport getting popular in the last two decades. Particularly this role is evident in improving athlete's performance and muscular strength, speed, muscular endurance and muscle coordination (Bakev et al., 2001). Resistance exercises are now a part of the public sport exercises proposed by global health organizations such as the American College of Sports Medicine (1998) for most people, including healthy adults, elderly people and people under medical supervision (those with cardiovascular disease, or musculoskeletal, or cardiovascular disease). Over the past 20 years, the number of women who have tough jobs (military, police, firefighting, industrial jobs, etc.) has increased. It is scientifically demonstrated that resistance exercises can improve body composition -through increasing the net mass or decreasing mass body fat (Park et al., 2003). Therefore, it seems that improving our understanding of potential interventions (such as resistance training) is considered a very important issue in work places as it increases the performance of women in physically hard occupations. It is clear that a variety of resistance training programs can increase and maximize repetition power in women (Chihibeck et al., 1997). In implementing resistance training exercises, some factors should be noted in order to obtain a better result; these factors are adjusted according to the purpose of the exercise, including the amount of load displacement, exercise volume, number of turns, rest time, etc. (Berger, 1963). Another factor contributing to the achievement of more favorable results in resistance exercises and in general is nutrition of the athlete (Berger, 1962). The association of nutrition with exercise is known from the Greek golden age. Paying attention to physical activity, proper nutrition and the general health of the body have attracted the attention of many scientists (Peterson, 2005). It is important to have an appropriate diet; therefore, the lack of information on the role of nutrition in sports activities not only

does not lead to expected outcomes from exercise and athletics, but also causes a lot of harmful effects on athletes (Brouns, 2006). In discussing changes in body composition, it's important to notice that body fat loss depends on the balance between calories consumed and calories recieved. In this regard, we can refer to the study of Sweeny et al. 1993. This study was conducted on obese women, and the result of it showed that the food constraints was either a determining factor in weight loss and body composition but it did not have a significant training in this area (Sweeny et al., 1993). Another study by Keim and others in 1990 showed other results. They reported that physical activity and diet result in an average 1.1 kg weight loss per week, out of which 0.67 was related to fat and 33% was related to lean mass (Keim et al., 1993). Dana Duncan (2005) examined the level of nutritional knowledge and physical activities on elementary and high school students before and after a nutritional knowledge period, he found that the level of primary and advanced knowledge of high school students was significantly higher than those of elementary students; yet, since their BMI was normal, physical activity had no significant effect on weight loss. However, they expected that the level of knowledge and the greater use of mass media such as TV, etc. could have contributed to this outcome. In another study, Barzgari et al. (2011) found that students' nutritional knowledge levels were higher among physical education students than other students (economics, psychology, math, computer, management), and only 2% of subjects- other than physical education students- have completed nutritional courses. In a study on university elite athletes in Iran, Rahmani Nia et al. (2010) realized that there was a significant positive correlation between nutritional knowledge and nutritional attitudes of students (Azizi et al., 2010).

Emily et al. (2011) discovered in a research that the nutritional status, socioeconomic status and the quality of diet of the groups, regardless of a high level of nutritional knowledge, were undesirable. The socioeconomic role and nutritional knowledge along with the low nutritional quality of mothers can endanger the health of future generations; the necessary arrangements concerning diet planning are required for their own health and their families') Emily et al., 2011).

O'dea in a study found that students did not have enough education and information on weight control methods as well as dietary requirements (O' Dea, 2004). On the other hand, Kate showed that people with a normal and healthy weight had a higher score in knowledge and attitudes comparing with others (Georgia et al., 1993). However, according to Michael there is no significant difference between the scores of knowledge and attitudes among overweight women and women with normal weight. In women with normal weight, MBI and body fat were associated with a nutritional attitude (Georgia et al., 1993). Debra et al. (2002) also compared the nutritional knowledge and nutritional habits of physical education female students and non-physical education students; they concluded that nonphysical education students were more likely to use fat. Physical education students consumed a lot of fiber, iron, and vitamin, but iron and calcium intakes in both groups were lower than the daily requirements (Elliott et al., 2002). Staron et al. focused on the impact of a 20-week weight training program on improving strength with hypotrophy in the wide side muscles of college female students (Burger, 2004).

Research by Gettman (1978), Grous (1974) and Pawell (1992) indicated that weight training reduced body fat. The reason can be explained by the fact that, since the training methods of Gettman, Grous and Pawell included circular weight exercises with maximal intensity and long duration, they resulted in an aerobic or endurance method decreasing the body fat. In addition, symptoms of some diseases, including reduced ability in walking and balance, increased skeletal muscle weakness, and fatigue, result in decreased mobility (Romberg et al., 2004), and decreased mobility in these people leads to muscle atrophy, resulting in a decrease in type one cords (Romberg et al., 2004). These symptoms along with other signs, in addition to general health, play an important role in the ability to perform daily life activities (Romberg et al., 2004). The primary goal of exercise in these individuals is to maintain and improve performance (Romberg et al., 2004). But the question is, is there no need for exercise if information about the right nutrition is given to these people? Or, on the other hand, those who start resistance exercising are no longer in need of nutrition knowledge? And the final question is what kind of changes in body composition and muscle strength occur in the people who

receive nutritional knowledge and resistance training versus those who do not receive such information? Accordingly, the purpose of this study is to compare the effects of resistance training program with nutritional knowledge on muscle strength and body composition of non-athlete female students.

Materials and Methods

The statistical sample of this study included 32 non-athlete female students of Islamic Azad University of Rasht, who did not have any acute or chronic diseases, with a body mass index of 19.9 to 25; in addition, they didn't use drugs or amine acids on a regular basis and in the past six months they did not go through any regular training. The participants were randomly divided into 4 groups (resistance training group with nutritional knowledge (8 subjects), resistance training group (8 subjects), nutritional knowledge group (8 subjects) and control group (8 subjects) who neither participated in weight training, nor had nutritional education. In the first session, height, weight, body mass index, waist to hip ratio, body fat percentage and lean mass were measured and recorded. At the second session, the subjects got acquainted with the conditions of the hall and the place where the exercises were taught and how they were properly trained. Also, during this session, one-repetition maximum of the subjects in selected movements and power tests (bench press and leg press tests) were measured.

From the next sessions, subjects of resistance training - nutritional education groups and resistance training without nutritional education performed resistance exercises for 8 weeks and 3 sessions per week. Prior to the training, both resistance training - nutritional education groups and the group that received only nutritional strategies - participated in a nutritional knowledge class for 30 minutes, including nutritional education in the field of sports. These included nutritional classifications, dietary supplements before and after, during and after exercises, description of glycemic index of food and its application, nutrient types (protein, fat and carbohydrates) and their role in weight training as well as the role of mineral salts and vitamins, the role of water supplements, sports supplements and their effects on individuals. After completing the nutritional education session, the subjects of the training groups performed the resistance training in 10 movements in 2 shifts with 12 repetitions (exercises were applied as one-repetition maximum: 5%, for the first two weeks, 60% for the second week and 70% for the third two weeks). The exercises were circular and the rest interval between turns and movements was considered one minute. After training for 8 weeks, the body composition and muscle strength parameters were measured again.

One Repetition Maximum Test: One Repetition Maximum is the maximum amount of weight which can be moved in a full repetition of any weight training. A trial and error (in the range of 3 to 5 tests) was used in order to measure this index in subjects in the following trainings (after warm up); leg press, chest press, front and back triceps extension, front and back leg extension. The maximum weight that was successfully lifted in the final test of each exercise was recorded as a repetition in that exercise (American college of sports medicine, 1998).

Results

The results of this study showed that muscle strength in training groups was significantly increased; this increase was higher in resistance training group with nutritional knowledge. There were no significant changes in other groups. In addition, the results of the body composition showed that the percentage of body fat, waist to hip ratio, decreased significantly in all groups, except for the control group. Additionally, lean mass in training groups was significantly increased. In addition, changes of all variables were higher in the resistance training group with nutritional knowledge.

Table 1. The comparison of upper and lower body strength in pretest and posttest of the resistance training group with nutritional knowledge

Index	Test	Mean	SD	N	Mean Diff	T	Df	Sig
Chest press (KG)	Pretest	8.59	0.74	8	-0.67	-8.20	7	0.00*
	Posttest	10.26	0.65					
Front triceps (KG)	Pretest	2.42	0.87	8	-0.73	-2.68	7	0.16
	Posttest	3.15	0.66					
Back triceps (KG)	Pretest	4.00	0.57	8	-0.80	-1.40	7	0.17
	Posttest	5.80	0.36					
Back leg (KG)	Pretest	24.09	8.05	8	-4.96	-1.18	7	0.21
	Posttest	29.06	7.92					
Leg press (KG)	Pretest	31.98	6.44	8	-5.13	-5.18	7	0.00*
	Posttest	37.12	5.52					

Table 2. The comparison of body composition in pretest and posttest of the resistance training group with nutritional knowledge

Index	Test	Mean	SD	N	Mean Diff	T	Df	Sig
Body mass index (kg / m 2)	Pretest	22.16	0.96	8	1.55	1.70	7	0.17
	Posttest	20.61	0.77					
waist to hip ratio	Pretest	0.65	0.07	8	0.21	3.14	7	0.00*
	Posttest	0.61	0.07					
Subcutaneous fat percentage	Pretest	21.87	0.83	8	1.67	7.60	7	0.00*
	Posttest	20.20	1.07					
Lean body mass	Pretest	47.35	1.40	8	2.96	1.24	7	0.15
	Posttest	48.38	1.68					

Table 3. The comparison of upper and lower body strength before and after resistance training

Index	Test	Mean	SD	N	Mean Diff	T	Df	Sig
Chest press (KG)	Pretest	8.74	0.37	8	-0.54	-6.82	7	0.00*
	Posttest	9.29	0.40					
Front triceps (KG)	Pretest	2.62	0.55	8	-0.25	-1.11	7	0.21
	Posttest	3.09	0.34					
Back triceps (KG)	Pretest	4.02	0.48	8	-0.81	-1.41	7	0.26
	Posttest	4.84	0.41					
Back leg (KG)	Pretest	24.69	3.73	8	-7.77	-1.13	7	0.41
	Posttest	26.46	6.82					
Leg press (KG)	Pretest	30.12	5.89	8	-6.09	-4.55	7	0.00*
	Posttest	36.22	7.17					

Table 4. The comparison of body composition in pretest and posttest of the resistance training group

Index	Test	Mean	SD	N	Mean Diff	T	Df	Sig
Body mass index (kg / m 2)	Pretest	22.66	1.57	8	0.10	1.00	7	0.35
	Posttest	22.56	1.50					
waist to hip ratio	Pretest	0.67	0.07	8	0.00	3.12	7	0.02*
	Posttest	0.66	0.07					
Subcutaneous fat percentage	Pretest	22.56	1.34	8	0.00	2.03	7	0.03*
	Posttest	21.35	1.34					
Lean body mass	Pretest	47.86	2.99	8	0.00	0.00	7	1.00
	Posttest	48.45	2.85					

Table 5. The comparison of upper and lower body strength in nutritional knowledge group

Index	Test	Mean	SD	N	Mean Diff	T	Df	Sig
Chest press (KG)	Pretest	9.91	0.49	8	0.037	0.99	7	0.35
	Posttest	9.87	0.51					
Front triceps	Pretest	2.70	0.66	8	-0.042	-1.00	7	0.35

(KG)	Posttest	3.74	0.62					
Back triceps (KG)	Pretest	5.00	0.93	8	-0.14	-1.10	7	0.30
	Posttest	6.14	0.87					
Back leg (KG)	Pretest	22.38	6.52	8	-0.50	-1.64	7	0.053
	Posttest	22.88	6.28					
Leg press (KG)	Pretest	31.88	7.30	8	0.00	0.00	7	1.00
	Posttest	31.80	7.63					

Table 6. The comparison of body composition in pretest and posttest of the resistance training group with nutritional knowledge

Index	Test	Mean	SD	N	Mean Diff	T	Df	Sig
Body mass index (kg / m 2)	Pretest	22.65	1.99	8	0.45	1.19	7	0.09*
	Posttest	22.20	2.19					
waist to hip ratio	Pretest	0.66	0.07	8	0.01	1.00	7	0.05*
	Posttest	0.65	0.07					
Subcutaneous fat percentage	Pretest	22.25	1.33	8	0.68	2.02	7	0.08*
	Posttest	21.56	1.69					
Lean body mass	Pretest	49.31	3.82	8	0.18	1.52	7	0.75
	Posttest	49.13	4.37					

Table 7. The comparison of the effect of resistance training program, nutritional knowledge and resistance training with nutritional knowledge on muscle strength

	Group	Mean	SD	Mean square	F	Df	Sig
The difference in the chest press records (KG)	Resistance with nutritional knowledge	0.67	0.23	1.06	36.77	3	0.00*
	Resistance	0.54	0.22				
	Nutritional	-0.03	0.10				
	Control	0.002	0.004				
The difference in the front triceps records (KG)	Resistance with nutritional knowledge	0.73	0.31	0.98	21.84	3	0.00*
	Resistance	0.47	0.26				
	Nutritional	0.04	0.12				
	Control	0.007	0.02				
The difference in the back triceps records (KG)	Resistance with nutritional knowledge	0.80	0.42	1.04	6.35	3	0.00*
	Nutritional	0.81	0.35				
	Control	0.14	0.35				
	Resistance	0.23	0..47				
The difference in the back leg records (KG)	Resistance with nutritional knowledge	4.96	2.70	110.65	12.33	3	0.00*
	Resistance	7.77	5.31				
	Nutritional	0.50	0.53				
	Control	0.00	0.00				
The difference in the leg press records (KG)	Resistance with nutritional knowledge	5.13	2.80	83.52	14.95	3	0.00*
	Resistance	6.09	3.79				
	Nutritional	0.00	0.00				
	Control	0.12	3.62				

p≤0.05

Table 8. The comparison of the effect of resistance training program, nutritional knowledge and resistance training with nutritional knowledge on body composition

	Group	Mean	SD	Mean square	F	Df	Sig
Body mass index (kg / m 2)	Resistance with nutritional knowledge	-1.55	0.76	4.03	14.48	3	0.00*

	Resistance	-0.10	0.28				
	Nutritional	-0.45	0.66				
	Control	0.00	0.00				
waist to hip ratio	Resistance with nutritional knowledge	0.00	0.05	0.00	0.30	3	0.82
	Resistance	0.00	0.00				
	Nutritional	-0.01	0.03				
	Control	0.00	0.00				
Subcutaneous fat percentage Lean body mass	Resistance with nutritional knowledge	-1.67	0.62	6.78	15.31	3	0.00*
	Nutritional	0.00	0.00				
	Control	0.68	0.96				
	Resistance	0.43	0.67				
Lean body mass (KG)	Resistance with nutritional knowledge	-2.96	0.81	15.96	18.75	3	0.00*
	Resistance	0.00	0.00				
	Nutritional	-0.18	1.59				
	Control	-0.27	0.42				

$p \leq 0.05$

Discussion and Conclusion

The purpose of this study was to investigate the effects of resistance training and nutritional knowledge on muscle strength and body composition indices of non-athletic female students. The results of this study showed that the muscle strength of upper and lower body in the group that performed resistance training with nutritional education increased significantly in posttest compared to pre-test. In contrast, in the control group, the results of power tests in posttest were not significantly different from the pre-test. In addition, the results of the present study showed that the muscle strength of upper and lower body in the group that performed resistance training along with nutritional education increased significantly in post- test compared to pre-test. However, there was no significant difference between the results of post-test and pre-test in the case of the group which received only nutritional education. In addition, by comparing these three groups- resistance training group with nutritional education, the resistance training group and the group that merely received nutritional education- with the control group, it comes to realize that there is a significant difference between resistance training groups with nutrition education, resistance training group and the control group; in both groups the strength of the subjects has increased significantly.

The results of this study showed that body composition indices including body fat percentage and waist to hip ratio in the group that carried out resistance training with nutritional education decreased significantly in the post-test phase compared to the pre-test. However, BMI, lean body mass and subjects' weight in this group did not change significantly. In contrast, in the control group, the results of the body composition indices in the post test were not significantly different from the pre-test.

Moreover, there was a significant decrease in the percentage of body fat and waist to hip ratio in the group that performed merely resistance training. But no significant changes were observed in body weight, lean body mass index and body mass index. In addition, the results of this study showed that body composition indices including; BMI, body fat percentage and waist to hip ratio significantly decreased in the group that received only nutritional education. However, the lean body mass in this group did not change significantly.

Furthermore, by comparing three groups - strength training with nutritional education, resistance training group and the group that merely received nutrition education- with the control group we realized that there was a significant difference between these groups and the control group. In all three groups, the body composition indices of the subjects were significantly improved. However, the rate of changes in all indices in the group that carried out resistance exercises with nutritional education was higher than other groups.

Increasing the percentage of fat in the body being one of the most common risk factors of important diseases and nutritional problems, is an independent factor, increases the risk of mortality. The body mass index, fat percentage, and the waist to hip ratio (WHR) are also a tool for showing the adult weight, which is used as a simple indicator of body fat or obesity. Today, the low mobility of people in the community has caused many diseases. Therefore, in different studies, the effects of different exercises on obesity indices have been studied and compared.

In general, the present study showed that body composition and muscle strength indices in both groups of resistance training with nutritional education and the group that had merely resistance training had a significant increase compared to the control group. However, by comparing the variation between the groups, it was found that the increase in the power factor and the improvement of the body composition were higher in the group that received the nutritional strategies along with the implementation of resistance training exercises. Increasing the strength and decreasing the percentage of lean body mass resulting from a variety of resistance exercises in various studies have been well illustrated. However, some contradictions in the study with other studies can be attributed to subjects.

In line with most studies, the results of this study showed that performing resistance exercises can decrease the body fat percentage and risk factors concerning obesity of non-athlete individuals and its consequences, it can also improve the physical condition of these individuals. In addition, adequate knowledge of nutritional factors helps to make the impacts of resistance exercises more effective; moreover, it is effective in retreatment between training sessions and the prevention of complications such as over-training and boredom of beginners.

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