Research Paper

The Effect of 6-Week Pilates Exercise and Fenugreek Supplement on Total Antioxidant Capacity and Mineral Content in Active Women

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ABSTRACT

Aims Certain exercises can develop the antioxidant system. Fenugreek supplementation containing antioxidant capacity and minerals may increase the benefits of exercises. The current study aimed at investigating the effect of Pilates training with fenugreek supplement on Total Antioxidant Capacity (TAC) and minerals in active women.

Methods & Materials The current study was with a quasi-experimental design was conducted on 36 active women aged 21-28 years randomly assigned into four groups: training, supplement, training plus supplement, and control. The training groups performed six weeks of Pilates training with the intensity of 60%-80% of maximal heart rate, three times a week for six weeks. Supplement groups received 500 mg fenugreek seeds daily for six weeks. Before and after the intervention, TAC and minerals (calcium, phosphorus, and iron) were measured. Data were analyzed by two-way ANOVA, Tukey post hoc test, and paired t-test at significant levels of P<0.05.

Findings In two variables, TAC and calcium, the time effect was significant, in other words, regardless of the group factor, there were significant differences between the post-test and pre-test of TAC and calcium variables in the experimental groups. The interaction of time-group was significant in TAC variable (P<0.05). The effect of the group was not significant in any of the variables.

Conclusion The obtained results suggested that one period of Pilates training and the use of fenugreek supplement alone and in combination could possibly prevent oxidative stress induced by exercise and could be effective in enhancing TAC and increasing calcium levels in active women.

Extended Abstract

1. Introduction

The antioxidant system can be improved as a result of some exercises. Fenugreek herbal supplement also has antioxidant property and mineral contents that can increase the benefits of exercises. It is likely that the antioxidant system can be more improved by combining exercises with fenugreek supplement. It is also possible to increase the level of minerals that athletes require by taking fenugreek supplement rich in minerals.

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2. Methods

Davis et al. in 1982 were the first to report that exercise results in producing free radicals. Aerobic activities are associated with increased oxygen consumption and can lead to increased production of free radicals [1]. Studies show that regular physical activity increases the capability of the antioxidant system of the body and protects it against the destructive properties of oxidative stress resulting from increased exercise. These changes occur over time and in parallel with other adaptations of exercise. Regular exercise creates some adaptation in the antioxidant system which increases resistance to oxidative stress [4, 5].

Some studies are conducted on the effect of using medicinal plants combined with exercise on the antioxidant status of the body. Medicinal plants contain large amounts of antioxidants that can inhibit free radicals. Antioxidant compounds of these plants belong to phenolic compounds such as phenolic acids, flavonoids, tocopherols, and a group of carotenoids [7]. A few studies are also conducted on the various properties of fenugreek and its therapeutic effects on various reported cases, but its effects on the antioxidant level of human samples are not investigated yet [9]; moreover, the effects of using fenugreek supplementation and exercise simultaneously on antioxidant properties are not studied yet [4].

Aim

The current study aimed at evaluating the effect of a Pilates training course with fenugreek supplementation on Total Antioxidant Capacity (TAC) and minerals of active women.

Study design, population, and sample

The current quasi-experimental study with Pre-test-Post-test design was conducted in 2018 on all active and healthy female students aged 21-28 years in Tehran. Of these, 36 students were selected through announcements and on a voluntary basis with regard to the inclusion criteria. These criteria included: having regular exercise (regular physical activity two days a week and at least 2 years of regular exercise), no joint diseases and bone fractures in the past year, not smoking, no supplementary dietary, and no diseases affecting the results. The samples were randomly divided into four groups: Exercise (EX), Supplement (SUP), exercise plus supplement (EX+SUP), and control (Table 1).

Measures

The body-weight of subjects was measured wearing light clothes and no shoes using an analog scale (Beurer, Germany) with an accuracy of 0.1 kg, and their height was measured in standing position without shoes and shoulders and heels touching the wall using a wall mount stadiometer (Seca, China) with an accuracy of 0.1 cm. Their Body Mass Index (BMI) was obtained by dividing the weight in kilograms by the square of the height in meters. During the six-week study period, SUP group received 500 mg of fenugreek powder once a day after dinner [12]. The powdered fenugreek seeds were put into 600-mg gelatin capsule shells in a chemistry lab with a digital scale with an accuracy of 0.001 g. The subjects were asked to refrain from taking any medication during the study. The control group consumed a placebo drug (starch). For the EX group, the Pilates exercise protocol was assigned for six weeks, three sessions per week, and each for 60 minutes.

Pilates exercises included simple movements involving most of the trunk muscles (transverse abdominal muscles, internal and external oblique muscle, diaphragm, quadriceps, iliopsoas muscle, spinal extensors, and buttocks) and were performed in three positions of standing, sitting, and supine with no need to any specific equipment. The exercises started with low intensity and gradually increased every week [6]. To keep the principle of overload, new exercises were added in each session. In the first session, the intensity of exercise, measured with a Polar wristwatch, was about 60%-70% of the maximum heart rate. Over the next two weeks, the rate reached 70-75% and in the end sessions reached 75%-80% of the maximum heart rate. Blood samples were taken from subjects before the intervention and 48 hours after the last training session.

The studied blood factors were TAC and the level of minerals (calcium, phosphorus, magnesium, and iron). The TAC was measured using colorimetric oxidation-reduction method with a sensitivity of 0.1mm; calcium was measured by photometric test using Cresolphthalein Complexone (CPC) with a sensitivity of 0.2 mg/dL; magnesium by photometric test (endpoint method) using xylidyl blue with a sensitivity of 0.5 mg/dL; iron by photometric test with a sensitivity of 0.2 mg/dL; and phosphorus by photometric and ultraviolet test with a sensitivity of 0.7 mg/dL. Collected data, after coding, were analyzed in SPSS V. 20 software. Shapiro-Wilk statistical test was used to examine the normality of data distribution. For analyzing data, two-way ANOVA (Table 2), Tukey post hoc test and paired t-test were used. The significance level was set at 0.05 ($P<0.05$) (Table 3).

3. Results

ANOVA results for the variables of TAC, calcium level, phosphorus level, and iron level are presented in Table 2. Of TAC, results showed that the effect of time and the interaction

Table 1. Mean±SD of Participants' Characteristics

Characteristics	Mean±SD			
	EX	SUP	EX+SUP	Control
Number	9	9	9	9
Age	24.52±6.08	25.11±5.13	24.83±6.25	26.01±4.93
Weight (kg)	59.11±5.46	63.28±508	59.88±5.70	65.55±5.22
Height (cm)	163.65±5.46	167.54±5.08	165.55±5.70	164.66±5.22
BMI (kg/m^2)	22.24±1.48	22.68±1.02	99.21±1.22	21.20±1.15

Table 2. Two-way ANOVA Results for TAC and Levels of Calcium, Phosphorus, and Iron

Variable	Source	Mean squares	F	p
TAC (mM)	Time	0.011	31.124	0.001*
	Group	0.002	0.291	0.831
	Time × group	0.007	6.354	0.002*
Calcium (mg/dL)	Time	2.205	20.334	0.001*
	Group	0.278	1.933	0.144
	Time × group	0.242	2.229	0.104
Iron (µg/dL)	Time	7.540	0.019	0.892
	Group	381.947	0.223	0.880
	Time × group	313.819	0.778	0.515
Phosphorus (mg/dL)	Time	0.036	0.304	0.585
	Group	0.737	2.202	0.107
	Time × group	0.049	0.422	0.739

*P <0.05

Table 3. Paired t-test results of variables

Variable	Group	Post-test	Pre-test	P
TAC (mM)	EX	0.0±32.05	0.1±35.05	0.012*
	SUP	0.0±33.05	0.0±37.06	0.001*
	EX+SUP	0.0±33.04	0.1±36.06	0.001*
	Control	0.0±33.06	0.0±32.05	0.496
Calcium (mg/dL)	EX	9±46.45	9±72.49	0.029*
	SUP	8±98.36	9±38.35	0.002*
	EX+SUP	9±6.38	9±46.30	0.001*
	Control	9±13.38	9±15.47	0.14
Iron (µg/dL)	EX	93.29±87.77	89.23±88.38	0.571
	SUP	95.41±44.23	88.30±55.99	0.475
	EX+SUP	86.33±77.77	98.31±44.52	0.187
	Control	100.3±82.20	100.34±88.87	0.994
Phosphorus (mg/dL)	EX	3±87.44	3±92.62	0.760
	SUP	4±27.50	4±33.52	0.567
	EX+SUP	4±31.64	4±24.5	0.567
	Control	3±90.47	4±00.46	0.063

*P <0.05

effect between group and time was significant but the group had no significant effect on TAC. Paired t-test results reported that in the Post-test phase, the TAC increased significantly in all experimental groups (EX, SUP and EX + SUP) compared to the Pre-test phase ($P<0.05$). The results of the Tukey post hoc test and pairwise comparisons showed no significant difference among the experimental groups in terms of TAC changes. Regarding calcium level, only the effect of time was significant. A significant difference was observed between the Post-test and the Pre-test calcium levels. Paired t-test results showed that in all experimental and control groups, calcium level increased significantly after the intervention compared to the Pre-test scores ($P<0.05$). Regarding phosphorus and iron levels, effects of time, group, and time-group were not significant. In all groups, iron and phosphorus did not change significantly and there was no significant difference between calcium, phosphorus, and iron levels in all groups ($P>0.05$).

4. Discussion

Regarding the effect of exercise on TAC, results of the current study were in agreement with those of some other studies [13, 14] while they were inconsistent with those of some others [15, 16]. Nakhaee et al. [17] in their study reported the increased TAC after a six-week aerobic training with 60-80% VO2 max intensity in active women, while Jahani et al. reported that TAC levels decreased significantly after eight weeks of continuous and regular exercise in soccer players [18]. Kumar et al. in a study evaluated antioxidant and anti-fatigue properties of fenugreek in rats subjected to weight loaded forced swim test, and concluded that fenugreek hydro-alcoholic extract reduces free radicals and increases the activity of antioxidant enzymes [21]. The study by Adibi et al. also showed that endurance training and fenugreek supplementation in male diabetic rats can improve their plasma antioxidants, but their simultaneous use results in synergistic effects and strengthens the antioxidant system [22].

In a study, it was observed that the serum iron level enhanced in rats fed by wheat biscuit supplemented by fenugreek seed flour [24]. Regarding the results for serum phosphorus level, the results of Al-Sultan and El-Bahr were similar to those of the current study [26]. They found no significant difference in serum phosphorus level of rats using aqueous extract of fenugreek. However, the current study results were not consistent with those of Townsend et al. and Tartibian et al. where no significant change in serum calcium levels was reported [28- 30]. The current study showed that six-week Pilates training resulted in a slight decrease in serum iron level but this effect was not statistically significant, which was consistent with the results of Inoue et al. and Kabasakalis et al. but contrary to the findings of Liu et al. Goto et al. and Alikarami et al. [33-37].

To obtain more conclusive results the effect of fenugreek supplementation on the TAC and levels of minerals, further studies with more careful control and data collection, larger sample size, or different doses of fenugreek are recommended. The present study had some limitations such as lack of the supervision of the physical activity of participants at the time out of study and lack of precise control of their nutritional status.

5. Conclusion

A Pilates exercise course alone or in combination with fenugreek supplementation may significantly increase TAC and calcium level in active women aged 21-28 years. The combined effects of supplementation and Pilates training had no synergistic effect on improving antioxidant status.

Ethical Considerations

Compliance with ethical guidelines

This study obtained its ethical clearance from the Ethics Committee of Alzahra University. All ethical principles were in accordance with the Declaration of Helsinki.

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Authors' contributions

All authors contributed in preparing this article.

Conflicts of interest

The authors declare no conflict of interests.