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ORIGINAL ARTICLE

The Effect of Different Types of Resistance Training Combined with BioNaship Supplementation on Ghrelin and Leptin Levels in Obese Women

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KEYWORDS

BioNaship supplementation;
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ABSTRACT

In recent years, lifestyle changes and insufficient physical activity have contributed to an increase in obesity and its related complications among women. This study aimed to investigate the effects of different resistance training programs, combined with BioNaship supplementation, on ghrelin and leptin hormone levels in obese women. This applied semi-experimental study included 60 obese women who were randomly assigned to one of five groups: 1) TheraBand resistance training + BioNaship, 2) TheraBand resistance training + placebo, 3) traditional resistance training + BioNaship, 4) traditional resistance training + placebo, and 5) BioNaship only or placebo only. Anthropometric measurements and blood samples were collected before and after the eight-week intervention. Participants in the resistance training groups performed their respective programs for eight weeks. The BioNaship groups took two BioNaship Nature's only tablets daily after meals, while the placebo groups took two maltodextrin tablets after meals. Data were analyzed using SPSS version 22. The findings indicated significant differences in ghrelin and leptin levels among the groups that combined resistance training with BioNaship supplementation. In contrast, BioNaship supplementation alone did not result in significant changes in ghrelin or leptin levels. These results suggest that combining traditional or TheraBand resistance training with BioNaship supplementation may improve appetite-related hormones, certain glycemic indices, and body composition in obese women.

Introduction

Obesity has become a major global public health challenge, with its prevalence steadily rising over the past few decades. The World Health Organization identifies obesity as a critical health concern, affecting millions of individuals who struggle to maintain a healthy weight. This highlights the importance of effective weight management and the investigation of hormonal changes in obese populations, which has increasingly become a focus of research (Jia *et al*., 2024; Mitoiu *et al*., 2024).

Leptin and ghrelin play key roles in regulating energy balance, appetite, and body weight, and their levels can be significantly altered in obesity (Mendes *et al*., 2024; Wang *et al*., 2024). Understanding the mechanisms that govern these hormones is essential, emphasizing the need for further research in this area.

Leptin, produced by adipose tissue, acts on the hypothalamus to suppress appetite and increase energy expenditure. However, significant weight loss resulting from physical activity, such as resistance

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training, often leads to decreased leptin levels, which can affect appetite regulation and metabolic function. This may increase hunger and reduce energy expenditure, making long-term weight maintenance challenging (Suder *et al*., 2024). Leptin levels are positively correlated with fat mass and overall body weight, with women exhibiting approximately three times higher leptin concentrations than men at similar body fat percentages (Flores *et al*., 2024).

In contrast, ghrelin, mainly secreted by the stomach, stimulates appetite and promotes food intake (Zafarmand *et al*., 2024). Ghrelin is involved in various physiological processes, including growth hormone (GH) secretion, gastric acid production, and gastrointestinal motility. It plays a crucial role in appetite regulation and body weight management. Ghrelin levels increase during fasting and decrease within one hour after food intake (Suder *et al*., 2024). Levels of ghrelin are closely associated with hunger sensations and gastric motility.

Research indicates that resistance training using TheraBand can improve body composition, cardiovascular endurance, muscle strength, and muscular endurance (Varshini *et al*., 2024). TheraBand exercises can be performed in diverse environments and provide elastic resistance that positively affects the muscle stretch–contraction mechanism, enhancing muscle performance and body composition (Hernandez *et al*., 2024).

These progressive resistance exercises using elastic bands enhance neuromuscular function, strength, and overall physical capacity. Studies have shown that such adaptations are particularly beneficial for obese individuals (Colado *et al*., 2014; Pande *et al*., 2022; Uchida *et al*., 2016). Supporting evidence demonstrates improvements in physical fitness and body composition following TheraBand resistance training (Aksen-Cengizhan *et al*., 2018; Lin *et al*., 2015). Additionally, such training can improve balance and motor function (Han *et al*., 2015), as well as increase strength in beginner athletes (Baltich *et al*., 2014; Hall *et al*., 2015). However, some studies suggest that while TheraBand training improves strength, it may not consistently enhance motor performance in all populations.

In recent years, alongside various exercise strategies aimed at reducing obesity and its related complications, the application of evidence-based nutritional interventions has received increasing attention in scientific research (Pranoto *et al*., 2024; Woolhiser *et al*., 2024). Among the supplements currently recommended for obese individuals to help control appetite and improve body composition are BioNaship tablets. BioNaship Nature's Only may contribute to reducing unwanted fat accumulation by enhancing metabolic activity, regulating blood sugar and lipid levels, and decreasing the absorption of excess dietary fats.

The supplement contains several bioactive components: Banaba extract, which helps regulate blood glucose and improve insulin sensitivity; white kidney bean extract, which reduces carbohydrate absorption and regulates blood sugar and lipid levels; green tea extract, which provides antioxidant effects to counter oxidative stress associated with obesity; and chromium, which supports appetite regulation, carbohydrate metabolism, and weight management. Despite these unique properties, there is currently no research examining the effects of BioNaship in scientific studies.

Regular physical activity is widely recognized for improving cardiovascular health, enhancing metabolic function, and promoting psychological well-being. In the context of obesity, exercise serves as a complementary intervention to maximize weight loss, preserve lean muscle mass, and improve overall health outcomes. Physical activity is particularly important for obese individuals compared to those with normal weight (Wu *et al*., 2024).

The combined effects of resistance training, supplementation, and hormonal regulation—particularly involving leptin and ghrelin—have attracted growing scientific interest. Numerous studies have shown that exercise positively influences the regulation of obesity-related hormones, emphasizing the need for further investigation. Resistance training can enhance leptin sensitivity, improve appetite control, and support metabolic function, all of which are critical for long-term weight maintenance. Exercise has also been shown to reduce ghrelin secretion, suppress appetite, and improve control over food intake.

Obese individuals who integrate resistance training with supplements such as BioNaship into their routines may better regulate ghrelin levels and reduce cravings for high-calorie foods. Evidence indicates that combining these interventions can enhance leptin sensitivity, decrease ghrelin secretion, and improve overall metabolic outcomes. Engaging in diverse resistance training programs, including TheraBand exercises that recruit multiple major muscle groups, may help obese individuals restore hormonal balance and support sustainable weight loss. However, no research has yet investigated this approach in Iran. Therefore, conducting a study on traditional and TheraBand resistance training combined with BioNaship supplementation is necessary to evaluate their effects on ghrelin and leptin levels in obese women. Such research would not only address the existing gap in the literature but also clarify current uncertainties and limitations in this field.

Materials and Methods

The present study employed a semi-experimental design with a pretest-posttest approach. The study population consisted of obese women aged 20 to 30 years living in Mashhad. Based on the inclusion criteria and initial screening conducted by the researcher, 60 participants voluntarily took part in the study. After completing informed consent and medical-sport history forms, the participants were randomly assigned to six groups of 10 individuals each. The experimental groups included: Experimental Group 1 (TheraBand resistance training + BioNaship supplementation), Experimental Group 2 (TheraBand resistance training + placebo), Experimental Group 3 (BioNaship supplementation only), Experimental Group 4 (Traditional resistance training + BioNaship supplementation), Experimental Group 5 (Traditional resistance training + placebo), and a Placebo Group.

The inclusion criteria for the study were as follows: participants were obese women with regular menstrual cycles, had no history of regular physical activity, and had not used any supplements or their precursors for at least two months prior to the study. Participants had no symptoms of any specific medical conditions, such as respiratory, cardiovascular, or kidney diseases, hypertension, or arthritis. Their ages ranged from 20 to 30 years, with a body mass index (BMI) over 30 kg/m² and body fat percentage between 25 and 35%. All participants were capable of performing resistance exercises. Exclusion criteria included missing four sessions in total or three consecutive sessions of the protocol, risk of injury or personal unwillingness to continue, failure to consume BioNaship or intake of other supplements during the study, experiencing hypoglycemia during exercise or gastrointestinal problems while taking the supplement, and participation in other physical activities concurrent with the research protocol.

After the initial recruitment and registration of interested obese women, participants were verbally provided with all necessary information regarding the nature and procedures of the study, potential risks, and essential considerations for participation. Based on the information obtained from questionnaires on personal characteristics, medical history, physical activity, and fitness status, 60 eligible and interested obese women were selected using purposive and accessible sampling. Prior to the start of the training program, anthropometric and body composition measurements—including body fat percentage, body mass index (BMI), muscle mass, and body weight—were recorded using a stadiometer and body composition analyzer. Additionally, three days before the resistance training protocol, each participant’s one-repetition maximum (1RM) was determined.

Traditional Resistance Training Protocol

Participants in the experimental groups performed resistance training three times per week for a duration of eight weeks. During this period, the placebo group did not engage in any exercise or consume BioNaship and only received the placebo (dextrin). Maximal strength was estimated using the Brzycki formula (Boyer *et al*., 2003).

$$\text{One-Repetition Maximum (1RM)} = \text{Weight in kg}$$
$$(\text{Repetitions}\times0.0278)-0.0278$$

It should be noted that this measurement was repeated at baseline, at the end of week 4, and at the end of week 8. Over the eight-week period, participants performed three weekly sessions of resistance exercises, which included barbell squats, leg curls, barbell bench press, dumbbell shoulder press, and lat pulldowns, at an intensity of 60–80% of their one-repetition maximum (1RM), with 8–10 repetitions per set and three sets per exercise. Rest periods between sets and exercises were one minute (Table 1).

Table 1. Resistance Training Protocol.

Duration	Week 1	Weeks 2–3	Weeks 4–5	Weeks 6–7	Week 8
Intensity (%1RM)	55	60	65	70	75
Sets	3	3	3	3	3
Repetitions (reps)	8–10	8–10	8–10	8–10	8–10
Rest between sets (minutes)	1	1	1	1	1
Rest between exercises (minutes)	1	1	1	1	1

TheraBand resistance training protocol

The progressive resistance training program was implemented following the principle of overload and the strength training guidelines provided by the American College of Sports Medicine (ACSM) (Richter *et al*., 2021). Due to the use of TheraBand resistance bands (exercise bands available in eight colors with varying resistance levels), the appropriate band color for each participant was determined before the start of training using the Borg scale (Shahidi and Pirhadi, 2014). At the end of each week, if a participant was able to complete the target repetition range with the assigned band, the resistance was increased—either by doubling the band or changing to a higher-resistance color—so that the participant could perform only 12 to 15 repetitions per exercise.

The participants underwent a nine-week TheraBand resistance training program, with three sessions per week. Each session lasted approximately 30 minutes in the morning and consisted of three stages: the first stage was a warm-up, including walking and stretching exercises; the second stage included upper and lower body resistance exercises such as arm flexion, arm extension, abdominal exercises, squats, and hamstring exercises; and the third stage was a cool-down, consisting of walking and stretching exercises.

The groups receiving BioNaship supplementation took two BioNaship Nature's only tablets daily after meals. The supplementation was administered according to the guidelines provided by Abadaro Teb Company, with the product code 6263634900168, under a license from BioPlus, India, and a production date of January 25, 2024. The groups receiving the placebo took two tablets containing maltodextrin after meals, following the instructions of Only Nature Plus Company, India.

All data processing and statistical analyses were performed using SPSS version 22. A significance level of $p < 0.05$ was considered for this study. The principle of confidentiality was strictly maintained for all collected data, particularly regarding participants' personal characteristics.

Results

Descriptive statistics of the participants, including means and standard deviations, are presented in Table 2.

Table 2. Descriptive statistics of the participants (mean ± standard deviation).

Variables		Placebo group	Theraband + Supplement group	Theraband + Placebo group	Supplement group	Traditional + Supplement group	Traditional + Placebo group
Age (years)		26.20 ± 3.11	25.20 ± 2.93	26.20 ± 3.33	26.25 ± 3.19	25.40 ± 3.59	26.20 ± 3.22
Height (m)		1.58 ± 0.02	1.58 ± 0.02	1.58 ± 0.02	1.58 ± 0.02	1.58 ± 0.01	1.58 ± 0.02
Weight (kg) –	**Pre-test**	86.3 ± 1.41	86.5 ± 1.77	86.9 ± 1.66	86.9 ± 1.59	86.0 ± 1.69	86.2 ± 1.75
Body Fat (%) –	**Pre-test**	36.09 ± 1.32	36.1 ± 1.47	36.39 ± 1.46	35.99 ± 1.02	36.09 ± 1.3	36.35 ± 1.4
Muscle Mass (kg) –	**Pre-test**	28.48 ± 0.88	28.28 ± 0.7	28.41 ± 0.8	28.55 ± 0.9	28.09 ± 0.9	28.37 ± 0.7
BMI (kg/m²) –	**Pre-test**	34.45 ± 1.04	34.49 ± 1.1	34.69 ± 1.2	34.4 ± 1.13	34.86 ± 1.1	34.31 ± 0.5

Based on Table 2, the results indicated that there were significant differences between the TheraBand + supplement group (p = 0.001), TheraBand + placebo group (p = 0.001), traditional + supplement group (p = 0.001), and traditional + placebo group (p = 0.001) compared to the placebo group. However, no significant difference was observed between the supplement-only group and the placebo group (p = 0.999). Furthermore, statistical analysis showed no significant difference between the TheraBand + supplement group and the TheraBand + placebo group (p = 0.341), nor between the TheraBand + supplement group and the traditional + placebo group (p = 0.999). In addition, the TheraBand + placebo group showed significant differences compared to the supplement-only group (p = 0.044) and the traditional + supplement group (p = 0.001), but no significant difference was found compared to the traditional + placebo group (p = 0.226). The results also revealed that the supplement-only group differed significantly from the traditional + supplement group (p = 0.001) and the traditional + placebo group (p = 0.001). Finally, a significant difference was observed between the traditional + supplement group and the traditional + placebo group (p = 0.001) (Table 3).

Table 3. Results of the Tukey test for between-group comparisons of ghrelin levels.

Significance	Mean Difference	Groups	
Placebo	TheraBand + Supplement	0.001 *	2.00
Placebo	TheraBand + Placebo	0.001 *	1.20
Placebo	Supplement	0.999	0.017
Placebo	Traditional Exercise + Supplement	0.001 *	5.15
Placebo	Traditional Exercise + Placebo	0.001 *	2.09
TheraBand + Placebo	TheraBand + Supplement	0.341	0.801
supplement	TheraBand + Supplement	0.001 *	1.98
Traditional exercise + Supplement	TheraBand + Supplement	0.001 *	3.15
Traditional exercise + Placebo	TheraBand + Supplement	0.999	0.094
supplement	TheraBand + Placebo	0.044 *	1.18
Traditional exercise + Supplement	TheraBand + Placebo	0.001 *	3.95
Traditional exercise + Placebo	TheraBand + Placebo	0.226	0.895
Traditional exercise + Supplement	Supplement	0.001 *	5.14
Traditional exercise + Placebo	Supplement	0.001 *	2.08
Traditional exercise + Placebo	Traditional Exercise + Supplement	0.001 *	3.06

*A significance level of $p < 0.05$ was considered.

Assuming normality of the data, a paired-sample t-test was used to examine within-group changes in ghrelin levels based on Table 3. The results of the paired-sample t-test showed that, compared to the pre-test, ghrelin levels significantly increased in the post-test for the TheraBand + supplement group (p = 0.003), the TheraBand + placebo group (p = 0.024), the traditional + supplement group (p = 0.001), and the traditional + placebo group (p = 0.001). In the supplement-only group, the increase was not significant (p = 0.170), and a non-significant decrease was observed in the placebo group (p = 0.193) (Table 4).

Table 4. Results of the paired-sample t-test for within-group comparisons of ghrelin levels.

	Groups	Pre-test M±SD	Post-test M±SD	df	T-value	Significance P	Result
Ghrelin (Ng/ml)	Placebo	1.51 ± 0.28	1.51 ± 0.58	9	1.406	0.193	Not significant ↓
	Theraband + Supplement	1.47 ± 0.25	4.68 ± 1.27	9	-2.053	0.003 *	Significant ↑
	Theraband + Placebo	1.47 ± 0.26	2.67 ± 1.27	9	-2.709	0.024 *	Significant ↑
	Supplement	1.52 ± 0.29	1.53 ± 0.30	9	-1.492	0.170	Not significant ↑
	Traditional + Supplement	1.48 ± 0.26	6.63 ± 1.35	9	-47.259	0.001 *	Significant ↑
	Traditional + Placebo	1.50 ± 1.09	3.60 ± 1.50	9	-15.654	0.001 *	Significant ↑

Based on Table 5, the results showed that there were significant differences between the TheraBand + supplement group (p = 0.005), the TheraBand + placebo group (p = 0.004), the traditional + supplement group (p = 0.001), and the traditional + placebo group (p = 0.001) compared to the placebo group. However, no significant difference was observed between the supplement-only group and the placebo group (p = 0.974).

Furthermore, statistical analysis indicated no significant difference between the TheraBand + supplement group and the TheraBand + placebo group (p = 0.187), nor between the TheraBand + supplement group and the traditional + placebo group (p = 0.995). In addition, the TheraBand + placebo group showed a significant difference compared to the supplement-only group (p = 0.001), but no significant difference compared to the traditional + supplement group (p = 0.464) or the traditional + placebo group (p = 0.839).

The results also revealed that the supplement-only group differed significantly from the traditional + supplement group (p = 0.001) and the traditional + placebo group (p = 0.001). Moreover, no significant difference was observed between the traditional + supplement group and the traditional + placebo group (p = 0.989).

Table 5. Results of the Tukey test for between-group comparisons of leptin levels.

Significance	Mean Difference	Groups	
Placebo	TheraBand + Supplement	0.005 *	0.411
Placebo	TheraBand + Placebo	0.041 *	0.311
Placebo	Supplement	0.974	0.021
Placebo	Traditional exercise + Supplement	0.001 *	0.422
Placebo	Traditional exercise + Placebo	0.001 *	0.354
TheraBand + Placebo	TheraBand + Supplement	0.187	0.528
supplement	TheraBand + Supplement	0.001 *	1.390
Traditional exercise + Supplement	TheraBand + Supplement	0.001 *	0.011
Traditional exercise + Placebo	TheraBand + Supplement	0.995	0.057
supplement	TheraBand + Placebo	0.001 *	0.203
Traditional exercise + Supplement	TheraBand + Placebo	0.464	0.198
Traditional exercise + Placebo	TheraBand + Placebo	0.839	0.130
Traditional exercise + Supplement	Supplement	0.001 *	5.401
Traditional exercise + Placebo	Supplement	0.001 *	0.368
Traditional exercise + Placebo	Traditional exercise + Supplement	0.989	0.068

*A significance level of p < 0.05 was considered.

Based on Table 6, the results of the paired-sample t-test showed that, compared to the pre-test, leptin levels significantly increased in the post-test for the TheraBand + supplement group (p = 0.003), the TheraBand + placebo group (p = 0.024), the traditional + supplement group (p = 0.001), and the traditional + placebo group (p = 0.001). In the supplement-only group (p = 0.170) and the placebo group (p = 0.193), increases were observed but were not statistically significant.

Table 6. Results of the paired-sample t-test for within-group comparisons of leptin levels.

	Groups	Pre-test M±SD	Post-test M±SD	df	T value	Significance P	Result
Leptin (Ng/ml)	Placebo	11.51 ± 0.18	11.55 ± 0.17	9	1.363	0.203	Not significant ↑
	Theraband + Supplement	11.57 ± 0.23	11.19 ± 0.24	9	-2.275	0.010 *	Significant ↓
	Theraband + Placebo	11.46 ± 0.12	11.27 ± 0.22	9	3.042	0.014 *	Significant ↓
	Supplement	11.54 ± 0.24	11.55 ± 0.23	9	-1.452	0.180	Not significant ↑
	Traditional + Supplement	11.56 ± 0.22	11.17 ± 0.23	9	3.824	0.004 *	Significant ↓
	Traditional + Placebo	11.60 ± 0.17	11.28 ± 0.19	9	3.691	0.005 *	Significant ↓

Discussion

The present study demonstrated a significant effect of various resistance training protocols combined with BioNaship supplementation on plasma ghrelin levels in obese women. These findings are consistent with those of Sajjad *et al*. (2022), Zafarmand *et al*. (2024), Suder *et al*. (2024), Wang *et al*. (2024), Mitoiu *et al*. (2024), and Bengin *et al*. (2024), but they contrast with the results reported by Abassi *et al*. (2025) and Mendes *et al*. (2024). Such discrepancies may be due to differences in participant characteristics. For instance, Ghaedi *et al*. (2019) also studied obese women undergoing resistance training, but the type of supplement used differed. Plasma acylated ghrelin levels show a significant negative correlation with baseline metabolic indices, including visceral, subcutaneous, and total fat, as well as serum insulin. In obese individuals, acylated ghrelin, adjusted for BMI, is significantly associated with serum insulin levels. Plasma ghrelin concentrations increase following weight loss, and the magnitude of this increase positively correlates with the amount of weight lost. Ghrelin likely plays a role in adaptive mechanisms that limit weight loss induced by diet. That is, reductions in body weight, fat mass, and BMI are accompanied by increased ghrelin levels (Behm *et al*., 2024), which aligns with the findings of this study. Some studies have indicated that resistance training reduces insulin and ketone bodies, which in turn affects ghrelin secretion. Supporting this, Ataei-Nasrat *et al*. (2022) reported that resistance training of any intensity increases ghrelin levels, attributing the rise to reductions in body weight and fat mass. Similarly, Zouhal *et al*. (2020) noted that exercise intensity influences ghrelin secretion through catecholamine-related mechanisms. In the present study, the training intensity was sufficient to stimulate significant increases in ghrelin following both resistance training models. Overall, previous research suggests that exercise intensity, fat mass, BMI, and the secretion of hormones such as insulin and catecholamines are key contributors to increased ghrelin levels after resistance training in obese women. Additionally, the study found that BioNaship supplementation alone had a non-significant effect on plasma ghrelin levels in obese women. However, when combined with resistance training, its effect was enhanced. This may be explained by reductions in blood glucose caused by the supplement, as glucose lowering is a known stimulus for ghrelin secretion. Further molecular and cellular research is needed to clarify this mechanism, which represents a limitation of the current study.

The study also demonstrated a significant effect of different resistance training protocols combined with BioNaship supplementation on plasma leptin levels. These results are in agreement with Alvarez *et al*. (2025), Anderson *et al*. (2025), Bengin *et al*. (2024), Makiel *et al*. (2023), Foster *et al*. (2005), Ghaedi *et al*. (2019), and Ramazankhani *et al*. (2011), but contrast with Wang *et al*. (2024) and Mitoiu *et al*. (2024). Differences in participant characteristics likely explain the discrepancies. For example, Turgut *et al*. (2021) studied male athletes, whereas the present research focused on obese women. Similarly, McCarthy *et al*. (2024) included non-training obese men. Research has shown that cortisol levels are positively associated with leptin secretion, as isolated adipocytes respond to glucocorticoids by increasing leptin production (Bengin *et al*., 2024). One effect of obesity that elevates leptin is increased cortisol. Resistance training reduces cortisol, which may consequently decrease leptin levels and mitigate obesity-related complications (Makiel *et al*., 2023). Biochemically, increased glucose transporter activity during resistance training facilitates glucose uptake into adipocytes, reducing leptin secretion and increasing leptin receptor expression (Li *et al*., 2024). Other studies suggest that leptin transport across the blood-brain barrier is enhanced in response to epinephrine following resistance training, further contributing to lower plasma leptin levels. Resistance training also improves blood flow to adipose tissue, increasing fat oxidation, adiponectin secretion, and reducing inflammatory factors, all of which contribute to decreased leptin secretion (Babayi-Benab *et al*., 2020). Overall, reductions in fat mass, decreased OB gene expression, increased growth hormone and catecholamine levels, and lower cortisol are likely responsible for the decline in leptin following resistance training. These findings are supported by Khalafi and Symonds (2020) and Shahidi *et al*. (2014), who reported that physical activity reduces leptin secretion and leptin resistance through cellular, inflammatory, and hormonal mechanisms.

Conclusions

Based on the results of the present study and supporting literature, it can be concluded that a course of resistance training—both traditional and with Theraband—combined with BioNaship supplementation can positively influence body composition and appetite regulation in obese women. These effects appear to be mediated through reductions in blood glucose, favorable changes in insulin levels, and alterations in hormonal markers such as ghrelin and leptin.

It is recommended to use both traditional resistance training and Theraband-based resistance training to reduce leptin levels in obese women. Additionally, these training modalities can be employed to increase ghrelin levels in this population. Future research is suggested to investigate the effects of other forms of exercise, such as endurance training, in combination with BioNaship supplementation, on appetite-related indices and glycemic parameters.

Conflict of interests

No conflict.

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