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The Combined Effect of Trachyspermum Supplementation and Jump Rope Exercise on Abdominal Obesity and Cardiovascular Risk Factors in 10-15 Year-Old Boys

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Abstract

Objective: Childhood and adolescent overweight can lead to metabolic syndrome in adulthood. This study aimed to evaluate the effect of Trachyspermum supplement and jump rope exercise on abdominal obesity and cardiovascular risk factors in obese boys aged 10-15.

Materials and Methods: In this clinical trial, 60 obese boys with waist circumference above the 90th percentile were selected using cluster random sampling from schools in Shahroud. The participants were randomly assigned to four groups: (1) supplement + exercise, (2) exercise only, (3) supplement only, and (4) control. The intervention lasted eight weeks. The Jump rope training was done 5 days per week for 30 minutes, with progressive intensity, based on Sung Kim's protocol. Supplement groups received 3g/day of Trachyspermum powder after breakfast. Measurements included waist/abdominal circumference, weight, and blood tests for Low Density Lipoprotein (LDL), High Density Lipoprotein HDL, triglycerides, total cholesterol, and fasting blood sugar before and after the intervention. Statistical analyses included Shapiro-Wilk, Kolmogorov-Smirnov for normality, chi-square, ANOVA, and post hoc tests using SPSS, with significance at $P< 0.05$.

Results: The combination of Trachyspermum and the jump rope exercise significantly improved abdominal obesity ($P< 0.011$), LDL ($P< 0.005$), HDL ($P< 0.029$), triglycerides ($P< 0.005$), and fasting blood sugar ($P< 0.001$), compared to control and exercise-only groups. No significant change was found in total cholesterol ($P< 0.343$).

Conclusion: The combination of Trachyspermum and jump rope training had beneficial effects on obesity and cardiovascular risk factors in adolescents, suggesting its use as a non-pharmacological and complementary treatment for adolescent obesity.

Keywords: Trachyspermum, Abdominal obesity, Cardiovascular risk, Aerobic exercise

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Introduction

Abdominal obesity is a significant risk factor for many chronic diseases, including cardiovascular diseases, type 2 diabetes, hypertension, dyslipidemia, and all-cause mortality (1-3). Abdominal obesity can have negative effects regardless of weigh (4). One of the diagnostic criteria for metabolic syndrome is increased waist circumference as an indicator of abdominal obesity (5). Among the five diagnostic criteria for metabolic syndrome, abdominal obesity is the most prevalent and the strongest predictor of this syndrome in non-diabetic adults (5-6). The presence of abdominal obesity may contribute to other components of metabolic syndrome, such as diabetes, hypertension, and elevated LDL cholesterol levels (7). Compared to general obesity metrics like body mass index (BMI), abdominal obesity is a better predictor of cardiovascular disease-related mortality. Abdominal obesity and general obesity are two common types of obesity, and according to studies, abdominal obesity has a stronger effect on cardiovascular disease and metabolic syndrome than general obesity (8).

The development of obesity is influenced by both genetic and environmental factors. In many populations, including Iran, abdominal obesity is reported to be more prevalent among women than men. This condition reflects an imbalance between energy intake and expenditure (9). Domestic studies indicate that sedentary activities occupy most of people's daily lives, which unfortunately has an upward trend. According to reports from the World Health Organization (WHO) and its cardiovascular disease control center, Iran is among the top seven countries worldwide in terms of adolescent overweight and obesity prevalence.The increase in the prevalence of overweight and obesity in children and adolescents will cause problems (of which we can mention the increase in the prevalence of cardiovascular diseases).

In addition to dietary weight-loss strategies, exercise and behavioral changes, anti-obesity drugs can be employed as a weight-management strategy for overweight and obese individuals. Currently, synthetic chemical drugs are commonly used to treat obesity, but they are associated with significant side effects. As a result, researchers and patients are exploring alternative treatments, such as herbal medicines and their derivatives, as safer and more effective options.

Various types of herbal medicines, including their extracts and active components, have been studied for their potential in weight reduction and prevention of weight gain. However, most herbal remedies and their products have undergone limited clinical trials, and none have been definitively proven as a reliable solution for weight loss. The action mechanisms of many of these herbal medicines remain unknown (10-11). Between 2000 and the present; several clinical trials have been conducted to investigate the effects of herbal medicines, either as compound formulations or individual spices, for weight loss (12).

In traditional Indian medicine, in traditional Indian medicine, Trachyspermum has been prescribed for digestive disorders and colic pain. It is considered warm and dry in nature and is used to treat asthma (13). It seems that the significant changes in anthropometric indices and lipid profile (cholesterol, triglycerides, LDL, HDL and blood sugar) in the subjects in this study are due to the presence of flavonoid and saponin proteins as well as the antioxidant properties present in Trachyspermum seeds. Flavonoid and saponin compounds of Trachyspermum have been investigated in previous studies as factors for reducing weight, blood sugar and reducing inflammation (14).

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and saponin compounds of Trachyspermum have been investigated in previous studies as factors for reducing weight, blood sugar and reducing inflammation (15).

In this study, we wanted to investigate the effect of simultaneous consumption of trachyspermum supplement along with rope jumping exercise on cardiovascular risk factors in obese children. The effect of each of these independent variables has been investigated separately, but our goal was to combine these two variables and find out their effects.

Jump rope exercise, on the other hand, is a complete and enjoyable physical activity that can be performed individually, in pairs, or in groups using short or long ropes. This exercise has been popular since the distant past as a game and entertainment among different ages, and the athletes of other fields also used this field for agility, endurance, nerve and muscle coordination, balance and physical fitness.

It is a simple exercise that requires minimal equipment and can be performed anytime, anywhere, by anyone. Given the limited research on the effects of Trachyspermum on body composition, obesity, and cardiovascular disease risk factors in younger age groups, this study investigates whether Trachyspermum supplementation and a period of jump rope exercise can influence these factors in 10-15 year-old individuals.

Material and methods

This clinical study employed a semi-experimental and applied design with four groups: Supplement group, Exercise group, Supplement and exercise group, Control group. The study included two phases for measuring dependent variables.

Population and sampling

The target population comprised approximately 2,000 elementary and middle school students in Shahroud. Participants were selected based on the World Health Organization's (WHO) percentile chart for childhood and adolescent obesity, focusing on those above the 90th percentile. Participants above the 90th percentile for BMI, based on WHO growth charts, were selected through convenience sampling. Eligible participants were then randomly assigned to study groups. Sample size was estimated using the standard formula for comparing two means, considering a 95% confidence level, 80% power, and expected effect size based on previous studies.

Studies among specific groups have their own challenges, one of which is sample recruitment. In this study, since the target population was obese children of a specific age range, finding participants was somewhat difficult. Therefore, a convenience sampling method was used to recruit eligible participants. Once the sample was obtained, participants were randomly assigned to the study groups in order to minimize allocation bias and enhance the validity of the comparisons. From this population, 60 students were randomly selected using a combined cluster sampling method and then assigned to four groups using simple randomization (Through random selection of individuals based on a table of random numbers). The criteria for selecting the samples included having a BMI above the 90th percentile on the World Health Organization chart, meaning they were considered obese children, as well as not having been physically active in the past six months, not having any specific disease, and not having any structural problems.

Inclusion and exclusion criteria

Initially, participants completed a questionnaire regarding their willingness to participate, personal information, and health status. Criteria for inclusion were:

- Interest in participating in the study
- No history of cardiovascular diseases
- No prior injuries, such as fractures or spinal deviations
- No engagement in exercise programs in the past six months or during the study period

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Study design

In this study:

Independent variables: trachyspermum supplementation and jump rope exercise

Dependent variables: Weight, waist circumference, triglycerides, cholesterol, fasting blood glucose, LDL, and HDL levels

The study aimed to assess the combined and individual effects of the interventions on these parameters.

Research implementation method

During the first session, after obtaining written informed consent and completing a general health and information questionnaire by the participants' parents, detailed explanations about the various stages of the research were provided to the participants. Anthropometric measurements, including weight, height, waist circumference, and blood pressure, were recorded.

In the second session, after a 12-hour fasting period, 5 cc of blood was collected from the participants' arm veins while seated.

Intervention protocol

- **Supplement Groups**: Participants in the supplementation groups were given 3 grams of trachyspermum powder daily after breakfast.
- **Exercise Groups**: Participants in the exercise groups followed a uniform training protocol consisting of 40 minutes of daily activity. This included a 10-minute warm-up followed by 30 minutes of jump rope exercise (Table1).

Over an eight-week period, participants engaged in jump rope exercise five days a week, with progressive increases in duration and intensity. Each week, the duration of each set gradually rose from 1 minute in the first week to 4 minutes and 30 second in the eighth week. The number of skips per set also increased steadily, starting at 60 skips and reaching 120 skips by the final week, while the rest time between sets remained constant at 30 seconds. This protocol was based on the method described by Song Kim (16).

Measurement Timing

All measurements were conducted in two phases:

1. **Baseline measurements:** 24 hours before the start of the intervention
2. **Post-Intervention measurements:** 24 hours after the final training session

Ethical considerations

This study was approved by the Ethics Committee of Shahroud University of Medical Science, Shahroud, with code IR.SHMU.REC. 1398.075. All information collected was kept confidential and anonymous.

This study is a registered randomized controlled trial (RCT) and has been approved and recorded in the UMIN with the registration number: UMIN000058151.

Results

The descriptive characteristics of the research variables in the four studied groups are presented in Table 2.

For inferential analysis, paired sample tests were conducted within each group to compare variables before and after the intervention. Subsequently, two-way repeated measures ANOVA was applied to compare all groups in both pre-test and post-test condition (Table 3).

Table 1. How to perform and schedule the rope jumping exercise

Week	Jumping time per set (minutes)	Number of jumps per set	Rest time between sets (seconds)
First	1	60	30
Second	1.5	70	30
Third	2	80	30
Fourth	2.5	90	30
Fifth	3	100	30
Sixth	3.5	100	30
Seventh	4	110	30
Eighth	4.5	120	30

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Table 2. Descriptive statistics of variables across the four study groups

Variable	Time	Control Group (Mean ± SD)	Supplement Group (Mean ± SD)	Exercise Group (Mean ± SD)	Supplement + Exercise Group (Mean ± SD)	*P*-value
Age	-	13.2 (±1.23)	12.8 (± 0.92)	13.1 (± 1.45)	13.1 (± 1.10)	0.208
Height (cm)	-	160.4 (± 6.77)	159.1 (± 7.01)	162.0 (± 9.22)	161.2 (± 11.12)	0.327
Weight (kg)	Before test	71.51 (± 19.29)	74.56 (± 10.91)	70.50 (± 8.58)	75.35 (± 16.63)	0.200
Waist circumference (cm)	Before test	93.6 (± 13.90)	91.2 (± 9.96)	92.9 (± 5.65)	95.0 (± 12.21)	0.139
LDL level (mg/dL)	Before test	90.9 (± 14.86)	87.4 (± 20.81)	76.2 (± 13.89)	89.1 (± 15.39)	0.200
HDL level (mg/dL)	Before test	48.9 (± 4.89)	51.3 (± 3.46)	53.2 (± 5.33)	51.4 (± 5.06)	0.133
Triglycerides (mg/dL)	Before test	155.7 (± 43.62)	163.5 (± 76.25)	132.5 (± 50.22)	128.8 (± 34.77)	0.244
Cholesterol (mg/dL)	Before test	157.6 (± 23.13)	152.3 (± 27.22)	136.0 (± 16.25)	159.8 (± 28.06)	0.049
Blood glucose (mg/dL)	Before test	82.8 (± 6.65)	81.6 (± 3.89)	86.3 (± 6.15)	89.1 (± 9.06)	0.018

Table 3. Results of inferential statistics of dependent variables in groups

Variable	Time	Supplement Group (Mean ± SD)	Exercise Group (Mean ± SD)	Supplement + Exercise Group (Mean ± SD)	*P*-value
Waist Circumference (cm)	Pre	91.2 (±9.96)	92.9 (±5.65)	95.0 (±12.21)	0.001*
	Post	88.7 (±10.75)	87.2 ±(3.82)	89.8 ± (10.21)	
		Significant reduction (*P*= 0.031)	Significant reduction (*P*=0.001)	Significant reduction (*P*= 0.011)	
LDL (Low-Density Lipoprotein) (mg/dL)	pre	87.4 (±20.81)	76.2 (±13.89)	89.1 (± 15.39)	0.001*
	post	79.7 (± 17.84)	72 (± 10.39)	81.07 (± 10.09)	
		Significant reduction (*P*= 0.005)	Non-significant reduction (*P*= 0.193)	Significant reduction (*P*= 0.047)	
HDL (High-Density Lipoprotein) (mg/dL)	pre	51.3(± 3.46)	53.2 (± 5.33)	51.4 (± 5.06)	0.001*
	post	53.7(± 4.00)	54.5 (± 4.38)	54.9 (± 4.95)	
		Significant increase (*P*= 0.029)	Non-significant increase (*P*= 0.309)	Significant increase (*P*= 0.025)	
Weight (kg)	pre	74.56 (± 10.91)	70.50 (± 8.58)	75.35 (± 16.63)	0.001*
	post	72.43 (± 11.67)	66.38 (± 6.43)	70.29 (± 17.08)	
		Significant reduction (*P*= 0.011)	Significant reduction (*P*= 0.014)	Significant reduction (*P*= 0.005)	
Triglycerides (TG) (mg/dL)	pre	163.5(± 76.25)	132.5 (± 50.22)	128.8 (± 34.77)	0.001*
	post	120.6 (± 30.91)	124.4 (± 27.23)	125.0 (± 30.53)	
		Significant reduction (*P*= 0.005)	Non-significant reduction (*P*= 0.262)	Non-significant reduction (*P*= 0.647)	
Total Cholesterol (mg/dL)	pre	152.3 (± 27.22)	136.0 (±16.25)	159.8 (± 28.06)	0.411
	post	148.5 (±25.47)	137.9 (±21.01)	152 (± 24.25)	
		Non-significant reduction (*P*= 0.185)	Non-significant increase (*P*= 0.646)	Non-significant reduction (*P*= 0.343)	
Blood Glucose (mg/dL)	pre	81.6 (± 3.89)	86.3 (± 6.15)	89.1 (± 9.06)	0.001*
	post	77.9 (± 3.81)	84.9 (±6.44)	78 (± 6.29)	
		Borderline significant reduction (*P*= 0.051)	Non-significant reduction (*P*= 0.408)	Significant reduction (*P*= 0.001)	

The combination of trachyspermum supplementation and jump rope exercise yielded the most comprehensive positive outcomes, especially for HDL, LDL, waist circumference, weight, and blood glucose. Trachyspermum supplementation alone was effective in reducing LDL, triglycerides, and weight.

Jump rope exercise alone was particularly effective for reducing abdominal fat and weight, but less impact on biochemical markers like triglycerides and LDL and finally none of the interventions significantly impacted on total cholesterol.

Discussion

The aim of this study was to investigate the combined effect of trachyspermum supplementation and jump rope exercise on certain cardiovascular risk factors in obese male students aged 10-15 years.

The findings of this research can be discussed from two perspectives: The first point of view is related to the effect of trachyspermum supplements on indicators that are considered as cardiovascular risk factors in obese individuals. Trachyspermum is well-known for

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its abundance of vital vitamins and minerals, together with its concentration of health-improving plant compounds which includes carotenoids (β-carotene and lutein) and flavonoids, which give potent antioxidant utility (17,18). Although there is limited research on Trachyspermum supplementation alone in human populations, a 2022 study demonstrated that tea made from Trachyspermum seeds significantly improved BMI and lipid parameters in obese individuals (19). The findings demonstrated that eight weeks of trachyspermum supplementation induced significant changes in all studied indices. The results suggest that trachyspermum can notably enhance the metabolism of triglycerides released into the bloodstream from fat sources during exercise, compared to the exercise group.

A study by Valizadeh and colleagues (20) examined the effects of Mahzel (an herbal supplement containing trachyspermum, black cumin, and cumin) and dietary intervention on anthropometric parameters in obese individuals. Their findings indicated that this supplement significantly impacted weight, body mass index, body fat mass, and waist-to-hip ratio. Other studies on the effects of herbal supplements with properties similar to trachyspermum showed significant changes in post-intervention indices in groups combining supplementation with exercise. It appears that the significant changes observed in anthropometric indices and lipid profiles (cholesterol, triglycerides, LDL, HDL, and blood glucose) in this study's participants are attributable to flavonoids, saponins, and antioxidant properties found in trachyspermum seeds (21). Flavonoid and saponin compounds in trachyspermum have been studied for their effects on weight reduction, blood glucose regulation, and inflammation reduction. Additionally, trachyspermum has been historically referred to as "Mahzel" (a slimming agent) in Avicenna's traditional medicine and other traditional medicine sources (15).

Flavonoids and phenolic compounds present in trachyspermum seeds may exert therapeutic effects through various mechanisms, such as strong antioxidant properties. Research has shown that obesity can lead to antioxidant deficiencies in the body, which can be addressed by incorporating antioxidant-rich compounds into the diets of obese individuals to aid in fat elimination, increase metabolism, and promote weight loss (22) **.**For example, a study by Riahi et al. (2016) examined the impact of cumin extract on weight management in obese men (23). Another study by Lopez Legarrea et al. (2013) explored the short-term effects of hypocaloric diets on obese individuals with metabolic syndrome and concluded that antioxidants, as supplements, can be an effective therapeutic strategy for obesity. Trachyspermum antioxidant properties, along with its anti-inflammatory effects, may reduce lipid oxidation susceptibility, stabilize membrane lipids, and alleviate oxidative stress (24).

The second point of view is related to the effect of jump rope exercise on overweight indicators**.**The present study revealed that aerobic jump rope exercise produced significant changes in weight, waist-to-hip ratio, and certain lipid profile indices. These changes might be attributed to increased adiponectin enzyme levels in the participants. A direct relationship between plasma adiponectin levels and fat metabolism has been established, with increased adiponectin associated with enhanced fat metabolize**.** A supporting study by Pischon et al. (2004) investigated the effect of plasma adiponectin levels on cardiovascular risks in men (25) and confirmed the results of the present study. Evidence also indicates that physical activity raises catecholamine and growth hormone levels, which, in turn, enhance lipolysis. Furthermore, aerobic exercise increases beta-adrenergic receptor density in adipose tissue, improving their sensitivity to lipolysis (26).

Moreover, jump rope exercise at moderate intensity, as applied in the present study, has been linked with improved lipid metabolism. Notably, the reduction in triglycerides observed here may reflect enhanced uptake and

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utilization of free fatty acids by skeletal muscle following aerobic training (27)

Findings from this study suggest that aerobic exercises (generally) and jump rope exercise (specifically), when performed at appropriate intensity, can significantly influence lipid profile indices and cardiovascular fitness. Among the findings were a significant reduction in triglycerides, no significant reduction in total cholesterol, and minimal changes in LDL compared to the control group. The significant reduction in triglycerides may be due to improved uptake and utilization mechanisms in muscle tissue following exercise (28).

Changes in LDL and HDL levels were significant at the end of the eight-week exercise protocol performed at 60–70% of maximum heart rate. Arnet et al. (2009) indicated that high-intensity interval jump rope exercise are more effective in reducing weight and body mass index in overweight adolescents (29). Similarly, a study by Daryoush Sheikh Eslami et al. (2014) showed that eight weeks of interval jump rope exercise significantly reduced the waist-to-hip ratio in overweight adolescents (30). Another study by Behlol Ghorbanians et al. (2017) demonstrated that eight weeks of interval aerobic jump rope exercise significantly improved most studied variables, including triglycerides, HDL, and LDL, ultimately reducing participants' weight (31).

Conclusion

Considering the results of the present study, it can be concluded that empagliflozin, in addition to its antihyperglycemic effects, is a beneficial therapeutic option for improving lipid panels in patients with T2DM. Further studies with larger sample sizes are recommended to investigate the wide-range effects of SGLT2 inhibitors.

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Conflict of Interest

The authors declare no conflicts of interest regarding this study or its publication.

Authors' contributions

All authors contributed significantly to the development of this manuscript. M.M implemented the exercise protocol and conducted the study on the participants, as well as collected the data. A.Y designed the study and wrote the manuscript. H.N supervised the proper administration of the supplement. Sh.G contributed to data analysis. All authors participated in drafting the manuscript, reviewed the final version, and approved it for submission.

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