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The Effect of Continuous and Interval Aerobic Exercise Combined with Loquat Leaf Consumption on the Oxidative and Antioxidant Capacity in Overweight Women

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A B S T R A C T

The present study aimed to determine the effect of continuous and interval aerobic exercise combined with loquat leaf consumption on the oxidative and antioxidant capacity in overweight women. The research method was quasi-experimental, with a pre-test and post-test design. Sixty overweight women from Qom city were purposefully divided into four equal groups of 15 participants: continuous aerobic exercise, interval aerobic exercise, continuous aerobic exercise combined with loquat leaf consumption, and interval aerobic exercise combined with loquat leaf consumption. The exercise protocol was conducted over eight weeks with three sessions per week. The continuous aerobic exercise program included continuous running without rest at an intensity of 55-60% of the heart rate reserve. The interval training program consisted of interval runs at distances of 100, 200, 300, 400, and 600 meters, with an intensity of 80-85% of the heart rate reserve. Data were analyzed using ANCOVA and Tukey's post-hoc test. The findings showed that continuous aerobic exercise combined with loquat leaf consumption significantly affected the oxidative capacity of overweight women. ANCOVA results indicated a significant difference in oxidative capacity between the four groups. Bonferroni post-hoc test results revealed a significant difference between the continuous and interval exercise groups and the two combined groups (continuous exercise with supplementation and interval exercise with supplementation). Additionally, the results demonstrated that aerobic exercise combined with loquat leaf consumption significantly affected the antioxidant capacity of overweight women. ANCOVA results indicated a significant difference in antioxidant capacity between the four groups, rejecting the null hypothesis and confirming the research hypothesis. The Bonferroni post-hoc test results further revealed a significant difference between the continuous and interval exercise groups and the two combined groups (continuous exercise with supplementation and interval exercise with supplementation). Based on the results, the combination of continuous and interval aerobic exercise with loquat leaf consumption is an effective method for improving the oxidative and antioxidant capacity in overweight women.

Keywords: *Continuous aerobic exercise, interval aerobic exercise, loquat leaf, oxidative capacity, antioxidant capacity.*

1. Introduction

Today, one of the most significant health issues is obesity, which affects many individuals worldwide, and its prevalence is on the rise (1). In fact, obesity is one of the most critical global health challenges (2). Obesity is a major issue in societies, particularly among women, and is one of the key factors in the etiology of chronic diseases. Obesity and overweight are rapidly spreading across the globe (3). Studies have shown that approximately one billion people globally are overweight, with at least 300 million classified as obese (4). According to the latest report from the World Health Organization (WHO), in 2018, more than 1.9 billion (39%) of the adult population were overweight and obese, and the prevalence has more than doubled between 1980 and 2018 (5). Furthermore, in Iran, 28.6% of individuals are overweight, 10.8% are obese, and 3.4% suffer from morbid obesity (6). It is estimated that by 2030, the rates of overweight and obesity will reach 89% in men and 85% in women, respectively (7, 8). Given the rising obesity rates, the associated costly and comorbid diseases that often follow obesity, and the challenges of achieving sustained weight loss, identifying effective strategies to prevent obesity in the first place is crucial (9).

Evidence suggests that obesity is associated with increased oxidative stress and decreased antioxidant capacity in the body. Studies have indicated that obesity elevates myocardial oxidative stress and lipid peroxidation. Additionally, oxidative stress plays a significant role in the metabolic syndrome associated with obesity (10). Oxidative stress occurs due to an imbalance between reactive oxygen species (ROS) and the antioxidant system (11). One effective way to reduce body fat and improve oxidative and antioxidant indices is through the consumption of plants, such as loquat leaves. Loquat leaf extract has shown hepatoprotective effects against ethanol-induced toxicity in liver cancer cells, reducing the formation of intracellular reactive oxygen species, enhancing liver antioxidant activity, and promoting cell survival (12). Loquat leaves possess anti-inflammatory and antioxidant properties that help reduce inflammation and improve immune system function, which plays a role in reducing body fat (13). Man et al. demonstrated that the aqueous extract of loquat leaves significantly inhibits oxidative stress by reducing intracellular ROS and increasing the activity of antioxidant enzymes. Additionally, by balancing free fatty acid (FFA) synthesis and beta-oxidation and restoring fat metabolism, it prevents fat accumulation (14). Moreover, Mohammad Ibrahim's research indicated that loquat leaf extract combined with high-intensity interval training (HIIT) reduces liver enzymes in patients with non-alcoholic fatty liver disease. Given the role of medicinal plants, the use of herbal medicine as a treatment method for enhancing antioxidant status or eliminating free radicals has gained considerable attention (15).

On the other hand, regular physical activity can serve as a non-pharmacological therapeutic tool for preventing and treating obesity and its related disorders, including aerobic exercises. Exercises that last continuously for an extended period (more than two minutes) and maintain a heart rate of less than 70% of the maximum heart rate during exercise are considered aerobic or submaximal exercises. Running, walking, cycling, and swimming over long distances are examples of aerobic or submaximal exercises. Aerobic exercises can be performed in two methods: 1) Continuous, and 2) Interval. In the continuous method, the individual exercises without rest, such as running continuously for 20 minutes without a break, whereas in the interval method, the individual takes breaks between exercise bouts. The physiological effects of these two exercise methods differ (16). Interval training creates a transient anorexia state, delaying hunger for a short time after exercise; however, this effect is short-lived. Interval training also affects energy expenditure by altering hunger and appetite signals, as well as regulatory peptides, influencing short- and long-term signaling in obese individuals (17). Research has shown that aerobic interval training significantly reduces fat mass and decreases overall exercise volume (18). A key component of weight control programs, aimed at preventing weight gain and its associated risks, is aerobic exercise (19). There is strong evidence suggesting that physical activity, especially aerobic exercises such as running, helps prevent weight gain (20). Over the past decade, attention has increasingly focused on the impact of aerobic exercise on body fat reduction, suggesting that this type of exercise program may reduce body fat percentage in overweight individuals. Studies have shown that performing aerobic exercise in the form of high-intensity interval training (HIIT) has a significant impact on improving cardiovascular fitness,

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obesity, and related diseases. Interval training is sometimes performed in intervals of activity and rest. In addition to requiring less time and providing variability and engagement in the method of execution, interval training involves periods of intense activity and active rest, leading to favorable adaptations in energy systems and improvements in both aerobic and anaerobic fitness (21).

Today, one of the problems that threaten women's health is obesity and its related issues, which constantly affect them. Sometimes, women spend a significant amount of money on obesity treatments, which often prove ineffective and lead to frustration. This has even led to the use of herbal supplements and new training methods to reduce obesity. What is important is that obesity is a societal problem, and identifying solutions to address it is a constant concern for everyone. Therefore, this study seeks to identify the effects of continuous and interval aerobic exercise combined with loquat leaf consumption on the oxidative and antioxidant capacity of overweight women.

2. Methods and Materials

2.1. Study Design and Participants

The present study utilized a quasi-experimental design with a pre-test and post-test approach. The statistical population consisted of overweight women from Qom city. Participants were purposefully selected from among overweight women who were willing to participate in the study and had no history of continuous or interval aerobic training combined with loquat leaf consumption. Inclusion criteria were women aged 20 to 30 years, with a body mass index (BMI) between 25 and 30, in good health, with no history of hypertension, diabetes, or atherosclerosis, and not using supplements (vitamins, minerals, etc.) or weight loss medications. Participants were randomly divided into four groups based on registration time: continuous aerobic exercise (15), interval aerobic exercise (15), continuous aerobic exercise combined with loquat leaf consumption (15), and interval aerobic exercise combined with loquat leaf consumption (15). Exclusion criteria included missing more than three consecutive sessions or four non-consecutive sessions, voluntary withdrawal from the study, injury during exercise, and consumption of other supplements.

Data on height, weight, body fat percentage, and BMI were measured 24 hours before the start of the protocol. Consent forms, medical history, and sports history forms were also collected from participants, ensuring they had no prior history of illness.

Participants attended the Hejab Sports Club in Qom for the exercise protocol, which lasted eight weeks with three training sessions per week. The project supervisor was present at the club from 8:00 AM to 12:00 PM, and participants could choose three alternating days for their training. Training sessions started between the specified hours and lasted for one hour. All participants followed the prescribed training program and consumed loquat leaf extract (each capsule containing 250 mg of LLE), provided by the researcher according to the determined intensity. Each training session consisted of three stages: 1) warm-up, 2) main exercise, and 3) cool-down. The warm-up involved 5 minutes of light walking (at 20% of maximum heart rate), followed by 5 minutes of dynamic warm-up movements targeting the upper and lower limbs to prevent injury and prepare the musculoskeletal system. The cool-down included 5 minutes of stretching exercises.

One week before the start of the training, blood samples were collected from all participants between 8:00 and 9:00 AM to minimize the effects of food consumption, time of day, and circadian rhythms. The participants fasted for 12 hours overnight and refrained from consuming loquat extract for 48 hours prior. In a seated position, 5 cc of blood was drawn from the antecubital vein. The blood sample was placed in a test tube containing an anticoagulant and centrifuged at 3,000 RPM for 15 minutes. The obtained serum was stored at -20°C for subsequent analysis. In this study, malondialdehyde (MDA) and glutathione peroxidase were measured using Pars Azmoon kits at -70°C to assess oxidative and antioxidant indices. Blood samples were collected again 48 hours after the final training session. All measurements were conducted under identical conditions.

2.2. Measures

Maximum heart rate was calculated using the formula (220 - age), and the training heart rate for each participant was determined using the Karvonen method. The formula for target heart rate was: (maximum heart rate - resting heart rate) × exercise intensity + resting heart rate. Exercise

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intensity was monitored in each session using Polar heart rate monitors (22).

Body fat percentage was measured by skinfold thickness at three sites (triceps, suprailiac, and thigh) using calipers and the Jackson-Pollock three-point equation (23).

2.3. *Interventions*

Continuous Aerobic Exercise Group: The training involved two phases: a) microcycle planning based on cardiovascular programs and distance covered, with the principle of overload applied. During the first week, 100 meters were added to the running distance in each session. This continued for 20 sessions, up to the beginning of the eighth week. b) To maintain general physical fitness, the progression followed a wave pattern, increasing by 500 meters in one session and decreasing by 400 meters in the next (24).

Interval Aerobic Exercise Group: This group performed a combination of 100, 200, 300, 400, and 600-meter intervals, with each round consisting of 3 to 4 laps and 2 to 5 repetitions per lap, depending on the distance. The starting heart rate for each repetition was set at 140 beats per minute, and for each round, it was 120 beats per minute. Rest intervals between repetitions and rounds were sufficient to allow the heart rate to return to 140 and 120 beats per minute, respectively, before beginning the next repetition or round. Continuous aerobic exercise involved similar distances performed continuously without rest after the warm-up. Exercise intensity was calculated for participants based on a percentage of their heart rate reserve using the Karvonen method. During interval aerobic exercise, the heart rate was set at 80-85% of the heart rate reserve, and during continuous aerobic exercise, it was 55-60%. Heart rates were monitored using POLAR heart rate monitors from Finland (25).

The loquat leaf group received loquat leaf extract capsules, each containing 250 mg of LLE, manufactured by Chopharm Co., South Korea (26).

2.4. *Data Analysis*

For statistical analysis, the Shapiro-Wilk test was used to assess data normality (mean and standard deviation), and paired t-tests, ANCOVA, and Tukey's post-hoc tests were used for within-group comparisons. Statistical analyses were conducted at a significance level of 0.05 using SPSS version 24.

3. Findings and Results

A total of 60 participants took part in this study, all of whom were women aged between 20 and 30 years. The descriptive statistics, including the mean and standard deviation of the participants, are presented in Table 1.

Table 1

Mean and Standard Deviation of Baseline Variables of Participants

Variable	Group	N	Mean	Standard Deviation
Weight (kg)	Continuous Training	15	71.86	5.16
	Interval Training	15	74.53	3.77
	Continuous Training + Supplement	15	73.93	5.57
	Interval Training + Supplement	15	74.33	4.30
Height (cm)	Continuous Training	15	162.86	5.15
	Interval Training	15	164.33	4.99
	Continuous Training + Supplement	15	164.93	5.47
	Interval Training + Supplement	15	165.66	6.43
Body Mass Index (BMI)	Continuous Training	15	27.08	1.34
	Interval Training	15	27.61	1.22
	Continuous Training + Supplement	15	27.15	1.17
	Interval Training + Supplement	15	27.10	1.20

Table 2 shows the mean and standard deviation of research variables at two measurement points.

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Table 2

Descriptive Statistics of Variables in Research Groups at Two Measurement Points

Variables	Groups	N	Pre-test (Mean ± SD)	Post-test (Mean ± SD)
Oxidative Capacity	Continuous Training	15	3.43 ± 0.16	2.99 ± 0.13
	Interval Training	15	3.43 ± 0.19	3.00 ± 0.17
	Continuous Training + Supplement	15	3.39 ± 0.19	2.74 ± 0.25
	Interval Training + Supplement	15	3.42 ± 0.17	2.74 ± 0.27
Antioxidant Capacity	Continuous Training	15	114.26 ± 6.82	120.46 ± 6.20
	Interval Training	15	112.13 ± 6.88	120.86 ± 8.14
	Continuous Training + Supplement	15	114.86 ± 6.95	131.33 ± 6.75
	Interval Training + Supplement	15	114.53 ± 6.49	128.66 ± 6.71

The Shapiro-Wilk test was used to assess the normal distribution of the data. Based on this test, if the significance level is greater than the critical value at 0.05, the data distribution is considered normal. The results of the Shapiro-Wilk test indicated that the research data followed a normal distribution ($p > 0.05$). Thus, parametric tests were used to analyze the research hypotheses.

Table 3

Results of ANCOVA for Changes in Oxidative Capacity Across Research Groups

Test	Levene's Test (F)	Levene's Test (Significance)	ANCOVA Sum of Squares	Degrees of Freedom	ANCOVA F Statistic	ANCOVA Significance	Test Result
Oxidative Capacity	2.616	0.060	0.791	3	37.005	0.001	Significant Difference

Based on the results of Levene's test, we conclude that the assumption of homogeneity of variances is met, allowing for the use of ANCOVA. The ANCOVA results show a significant difference in oxidative capacity across the four groups.

Table 4

Bonferroni Post-Hoc Test for Comparing Oxidative Capacity Changes Across Research Groups

Variable	Groups	Mean Difference	p	Test Result
Oxidative Capacity	Continuous Training vs. Interval Training	-0.014	1.000	-
	Continuous Training vs. Continuous Training + Supplement	0.203	0.001	Significant Difference
	Continuous Training vs. Interval Training + Supplement	0.239	0.001	Significant Difference
	Interval Training vs. Continuous Training	0.014	1.000	-
	Interval Training vs. Continuous Training + Supplement	0.217	0.001	Significant Difference
	Interval Training vs. Interval Training + Supplement	0.253	0.001	Significant Difference
	Continuous Training + Supplement vs. Continuous Training	-0.203	0.001	Significant Difference
	Continuous Training + Supplement vs. Interval Training	-0.217	0.001	Significant Difference
	Continuous Training + Supplement vs. Interval Training + Supplement	0.036	1.000	-
	Interval Training + Supplement vs. Continuous Training	-0.239	0.001	Significant Difference
	Interval Training + Supplement vs. Interval Training	-0.253	0.001	Significant Difference
	Interval Training + Supplement vs. Continuous Training + Supplement	-0.036	1.000	-

The intergroup changes and Bonferroni post-hoc test results for oxidative capacity revealed the following significant differences:

- A significant difference exists between the continuous training group and the two groups (continuous training + supplement, interval training + supplement).
- A significant difference exists between the interval training group and the two groups (continuous

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training + supplement, interval training + supplement).

- A significant difference exists between the continuous training + supplement group and the two groups (continuous training, interval training).
- A significant difference exists between the interval training + supplement group and the two groups (continuous training, interval training).

Table 5

Results of ANCOVA for Changes in Antioxidant Capacity Across Research Groups

Test	Levene's Test (F)	Levene's Test (Significance)	ANCOVA Sum of Squares	Degrees of Freedom	ANCOVA F Statistic	ANCOVA Significance	Test Result
Antioxidant Capacity	0.751	0.527	1384.508	3	9.352	0.001	Significant Difference

Based on Levene's test results, we conclude that the assumption of homogeneity of variances is met. The ANCOVA results show a significant difference in antioxidant capacity across the four groups.

Table 6

Bonferroni Post-Hoc Test for Comparing Antioxidant Capacity Changes Across Research Groups

Variable	Groups	Mean Difference	p	Test Result
Antioxidant Capacity	Continuous Training vs. Interval Training	-0.195	1.000	-
	Continuous Training vs. Continuous Training + Supplement	-10.924	0.001	Significant Difference
	Continuous Training vs. Interval Training + Supplement	-8.226	0.013	Significant Difference
	Interval Training vs. Continuous Training	0.195	1.000	-
	Interval Training vs. Continuous Training + Supplement	-10.729	0.001	Significant Difference
	Interval Training vs. Interval Training + Supplement	-8.031	0.018	Significant Difference
	Continuous Training + Supplement vs. Continuous Training	10.924	0.001	Significant Difference
	Continuous Training + Supplement vs. Interval Training	10.729	0.001	Significant Difference
	Continuous Training + Supplement vs. Interval Training + Supplement	2.699	1.000	-
	Interval Training + Supplement vs. Continuous Training	8.226	0.013	Significant Difference
	Interval Training + Supplement vs. Interval Training	8.031	0.018	Significant Difference
	Interval Training + Supplement vs. Continuous Training + Supplement	-2.699	1.000	-

The intergroup changes and Bonferroni post-hoc test results for antioxidant capacity revealed the following significant differences:

- A significant difference exists between the continuous training group and the two groups (continuous training + supplement, interval training + supplement).
- A significant difference exists between the interval training group and the two groups (continuous training + supplement, interval training + supplement).
- A significant difference exists between the continuous training + supplement group and the two groups (continuous training, interval training).
- A significant difference exists between the interval training + supplement group and the two groups (continuous training, interval training).

4. Discussion and Conclusion

This quasi-experimental study examined the effect of continuous and interval aerobic exercise combined with loquat leaf consumption on the oxidative and antioxidant capacity of overweight women.

The results indicated that aerobic exercise combined with loquat leaf consumption significantly affects the oxidative capacity of overweight women. The ANCOVA results showed a significant difference in oxidative capacity between the four groups, thus rejecting the null hypothesis and confirming the research hypothesis (F = 37.005, P = 0.001). Additionally, Bonferroni post-hoc test results

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revealed significant differences between the continuous and interval exercise groups and the two groups (continuous exercise + supplement, interval exercise + supplement). The results also demonstrated that aerobic exercise combined with loquat leaf consumption significantly affects the antioxidant capacity of overweight women. The ANCOVA results showed a significant difference in antioxidant capacity between the four groups, thus rejecting the null hypothesis and confirming the research hypothesis ($F = 9.352$, $P = 0.001$). Similarly, Bonferroni post-hoc test results revealed significant differences between the continuous and interval exercise groups and the two groups (continuous exercise + supplement, interval exercise + supplement).

Similarly, Roozbahan et al. (2021) examined the effect of aerobic exercise combined with pomegranate juice consumption on serum levels of oxidative and antioxidant enzymes in breast cancer survivors. Their results indicated that 8 weeks of aerobic exercise combined with pomegranate juice consumption significantly reduced malondialdehyde (MDA) levels and increased superoxide dismutase (SOD) and glutathione peroxidase (GPX) levels in women with breast cancer. In contrast, aerobic exercise alone only resulted in a significant reduction in MDA levels (27). Nagizadeh and Heidari (2021) examined the effect of 12 weeks of high-intensity interval training (HIIT) combined with curcumin consumption on oxidative markers in obese men with type 2 diabetes. Their findings showed that the interactive effect of exercise and curcumin significantly increased paraoxonase-1, SOD, and GPX, while significantly reducing MDA (28).

Additionally, Moradpourian and Shakerami (2017) investigated the effect of 8 weeks of resistance training on oxidative and antioxidant markers in middle-aged women with type 2 diabetes. Their results showed a significant increase in SOD and GPX levels in the experimental group, with no significant change in the control group. Furthermore, MDA levels significantly decreased post-intervention in the experimental group, although no significant changes were observed in the control group (29).

Sani et al. (2016) examined the effect of aerobic exercise combined with peanut supplementation on total antioxidant capacity and serum MDA levels in overweight girls. Their results indicated that aerobic exercise combined with peanut consumption significantly impacted total antioxidant capacity and serum MDA levels (30). Ribeiro et al. (2017) investigated the effect of traditional and pyramid resistance training systems on oxidative stress in elderly women. Their results demonstrated that 8 weeks of resistance training improved oxidative stress, regardless of the type of training system (31). Soares et al. (2015) examined the effects of combined exercise on DNA damage, antioxidant capacity, and oxidative stress changes. Their results showed an increase in antioxidant capacity and a reduction in oxidative stress (32).

Bouzid et al. (2015) investigated the effect of low-intensity aerobic exercise on oxidative stress markers in elderly individuals. Their findings indicated an increase in MDA levels in both groups, while no changes were observed in SOD, GPX, Gred, and vitamin E and C levels in the exercise group, suggesting the positive effect of aerobic exercise on reducing antioxidant capacity in the aging process (33). Johnson et al. (2014) examined the effect of 8 weeks of endurance training on the antioxidant system in healthy, untrained young and elderly subjects. Their results showed no changes in the gene expression of SOD1, SOD2, and CAT in the elderly experimental group, while SOD2 increased in the young experimental group, with no changes observed in the other two enzymes (34). Mitranun et al. (2014) evaluated the effect of continuous and interval aerobic exercise (treadmill) on antioxidant capacity in diabetic patients. Their results showed an increase in GPX in the interval training group and no change in SOD1, while no changes in either antioxidant enzyme were observed in the continuous training group (35).

Ruzbahan et al. (2021) found that 8 weeks of aerobic exercise combined with pomegranate juice consumption led to a significant reduction in MDA levels and an increase in SOD and GPX levels in women with breast cancer. Aerobic exercise alone only resulted in a significant reduction in MDA levels, and no significant changes were observed in the three variables with pomegranate juice consumption alone (27). Nagizadeh and Heidari (2021) reported that the interactive effect of exercise and curcumin significantly increased paraoxonase-1, SOD, and GPX levels and significantly reduced MDA levels. Exercise alone also significantly increased paraoxonase-1, SOD, and GPX levels and reduced MDA levels (28).

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In explaining the results of these hypotheses, it can be stated that continuous and interval aerobic exercises combined with loquat leaf consumption are recognized as effective methods for improving oxidative and antioxidant capacity in overweight women. Numerous studies have observed an increase in antioxidant capacity and a reduction in oxidative stress as the primary outcomes of these exercises. Oxidative capacity refers to the body's ability to counteract oxidants and free radicals. In overweight women, reduced oxidative capacity typically results from increased free radical production and the body's inability to counteract them. Continuous and interval aerobic exercises combined with loquat leaf consumption can improve this capacity, thereby reducing oxidative stress and preventing oxidative damage. Antioxidants, including enzymes and vitamins present in the body, play a crucial role in counteracting oxidants and free radicals. Increased levels of enzymes such as SOD, catalase, and GPX, as well as higher levels of antioxidant vitamins like vitamin C and E, indicate an improvement in the body's antioxidant capacity. These increases are typically achieved through regular physical activity and the consumption of antioxidant-rich foods.

Overall, continuous and interval aerobic exercises combined with loquat leaf consumption can significantly improve the oxidative and antioxidant capacity of overweight women, which can enhance overall health and reduce the risk of oxidation-related diseases.

In conclusion, based on various studies and the results of the present study, it can be concluded that continuous and interval aerobic exercises combined with loquat leaf consumption are effective methods for improving oxidative and antioxidant capacity in overweight women. These exercises not only enhance oxidative and antioxidant capacity but also improve overall body function and reduce the risk of oxidation-related diseases. Additionally, the combination of aerobic exercise and loquat leaf consumption may serve as an effective approach to improving liver function and general health in overweight women. This approach may have significant effects on liver parameters and oxidative and antioxidant capacities, ultimately contributing to the improvement of overall body health.

Based on the findings of this study, it can be concluded that the results provide a scientific basis for developing therapeutic and preventive strategies for liver diseases in overweight individuals. This research may be considered an important study in the field of liver health improvement and reducing the risk of liver-related diseases in this group. The results can assist healthcare centers in developing appropriate prevention and treatment programs to reduce the risk of liver diseases in overweight individuals. Limitations of the study include the lack of access to all overweight women in Qom and the exclusion of other effective weight-loss exercises, which may affect the generalizability of the results and indicate the need for further research to confirm and expand the findings.

Authors' Contributions

M. P., M. N. N., and S. A. B. contributed equally to this study on the elite sports policy framework in Iran. M. P. led the research design and coordinated data collection through interviews and document analysis. M. N. N. contributed to the systematic analysis approach, assisting with coding and conceptual framework development. S. A. B. provided expertise in sports policy and facilitated access to relevant participants and documents. All authors participated in the interpretation of results, discussion, and drafting of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study placed a high emphasis on ethical considerations. Informed consent obtained from all participants, ensuring they are fully aware of the nature of the study and their role in it. Confidentiality strictly maintained, with data anonymized to protect individual privacy. The study adhered to the ethical guidelines for research with human subjects as outlined in the Declaration of Helsinki. This study is extracted from Afshari's Ph.D. dissertation with the ethics code IR.IAU.NAJAFABAD.REC.1402.089.

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