

The effect of high-dose vitamin D supplementation and an exercise program to lose weight on some biochemical variables of overweight women

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Abstract

Background and Study Aim

In recent years, there has been a technological revolution and development in all fields, particularly the sports field. This has imposed on man a lifestyle characterized by comfort at the expense of a significant portion of his movement and activities. The problem of obesity has expanded beyond the inconsistency of the body to include its direct effect of increasing the proportion of fat and the negative impact on the work of vital organs. This disruption alters the body's internal environment and causes numerous diseases. The purpose of this study is to determine the effect of a sports program on taking vitamin D to lose weight and on some biochemical variables in young adults aged 30 to 35 years old.

Material and Methods

The study involved 10 overweight women aged 30-35 years, selected through intentional sampling. Inclusion criteria required consent, good health, and no ongoing vitamin D or exercise programs. The research employed a Randomized Controlled Trial (RCT) design. Primary outcome measures encompassed body weight, body composition, lipid profile, and vitamin D status. Anthropometric measurements included age, height, weight, and training age. Biochemical measurements involved blood tests for cholesterol, triglycerides, and vitamin D levels. The experimental group received vitamin D tablets and a proposed aerobic exercise program for 12 weeks.

Results

The proposed aerobic sports program with vitamin D intake improved biochemical variables, such as total fat, total cholesterol, triglyceride, high-density cholesterol, low-density cholesterol, OH, and Vitamin D-025 for the sample under investigation. The application of the aerobic program with vitamin D led to weight loss among the study's female participants. The aerobic program with vitamin D intake has a positive effect on the general health status of the sample.

Conclusions

Based on the study's findings, it is recommended to consider the positive effects of Vitamin D on the overall functional state of the body, making it essential to incorporate an aerobic sports program across various age groups. Regular medical tests are crucial for monitoring and maintaining overall health. Emphasizing the importance of regular exercise is vital in preventing weight gain and reducing the risk of certain chronic diseases. By implementing these recommendations, individuals can enhance their overall well-being and lead a healthier lifestyle. To further validate these outcomes, similar studies should be conducted on different age groups and diverse samples.

Keywords:

vitamin D, exercise, supplementation, lose weight, biochemical variables, overweight

Terms used in the search

Aerobic exercise: It is the type of physical activity in which the practitioner uses large muscle groups in the body through repeated and continuous rhythmic movements while the respiratory system supplies the muscles with the needed oxygen [1].

Obesity: It is an aberration of the natural composition of the human body as a result of the increase in the fat percentage level [2].

Vitamin D: It is a group of secosteroids that dissolve directly in fat. However, it is not primarily a nutritional vitamin because the body can compensate for its deficiency through exposure to sunlight [3].

Introduction

In recent years, there has been a technological revolution and development in all fields, particularly the sports field, which has imposed on man a lifestyle characterized by comfort at the expense of a significant portion of his movement and activities. Obesity is possibly the most prominent of these

diseases in terms of its impact on individuals and society [4].

Obesity is caused by technological advancement and lack of health education, lack of nutritional awareness, lack of exercise and physical activity, and poor eating habits. There are also factors associated with endocrine disorders or genetic and psychological factors and factors associated with poor metabolism. The issue of obesity has expanded beyond the inconsistency of the body to its direct effect of increasing the proportion of fat and the negative impact on the work of vital organs, thereby disrupting the body's internal environment and causing numerous diseases [4].

Obesity represents a deviation from the normal structure of the human body since an increase in the percentage of fat of 20% of body weight for individuals indicates the onset of obesity. The body has a natural tendency towards obesity due to the age factor until it reaches 50-70% of body weight [5]. Burt et al. [6] illustrated that the lack of physical activity leads to an increase in obesity in individuals more than an increase in the amount of food intake itself [6].

Obesity is considered a problem for a large number of individuals from a psychological perspective. Additionally, it contributes to the development of numerous chronic diseases and modern diseases, such as diabetes and various cardiovascular and circulatory diseases [5]. Carrillo [7, 8] demonstrated numerous risks of obesity, such as high cholesterol in the blood and thus the occurrence of clots, along with infertility in women, high blood pressure, diabetes, and stress due to less effort and osteoporosis.

Aerobic exercise is one of the world's most well-known healthy physical activities, particularly for obese patients. In addition, it is considered the most effective treatment for obesity because it burns calories and reduces blood cholesterol. Therefore, the practice of regulated sports activities, as mentioned by Foroozanfard et al. [9], particularly aerobic sports activities with intensity ranging between average and less than the maximum. It leads to a decrease in the percentage of blood fats of different types, especially triglycerides, whose percentage in the blood decreases temporarily after training and for 48 hours of training, thereby the continuation of the practice activities. Performing aerobic exercise (3-4) times per week can permanently maintain normal blood triglyceride levels [9].

Low-Density Lipoprotein (LDL) in the blood is known for transporting fats and depositing them on the inner walls of the arteries, causing them to narrow and causing atherosclerosis [10]. Jabbour et al. [11] reported that the practice of regulated aerobic activities according to an organized program reduces the cholesterol level in the blood, as a 1% reduction in blood cholesterol is associated with

a 2% reduction in the incidence of heart disease [12]. Physical activity a crucial role in altering the body's energy balance equation by expelling and consuming excess calories during physical activity and enhancing metabolism, thus eliminating the greatest amount of fat and preventing its storage. Physical activity also has positive effects on a number of biological factors associated with obesity and excess fat, including blood pressure, heart rate, cholesterol levels, body components, and functions of various body systems [13].

The main motive behind conducting this research is the researcher's work in the field of sports. It was noticed that many women suffer from obesity of one degree and increased cholesterol in the body and the consequent increase in weight. Moreover, the majority of women suffer from a lack of physical fitness and an increase in body fat, as well as infection with a variety of organic diseases, including diabetes, high blood pressure, atherosclerosis, and others. This prompted the researcher to develop a program of aerobic exercises, day or night, and determine the impact of this program on obesity and the levels of blood fat in women [14].

The researcher reviewed the results of the Million Health Campaign, among the results of the first phase in which the percentage of Egyptians with obesity increased [15]. Obesity is regarded as one of the primary causes and gateways to numerous diseases, such as cardiovascular disease, high blood pressure, diabetes, diseases of the musculoskeletal system and joints, as well as improper body shape, which is one of the primary reasons that obese people want to lose weight. Using a reference survey, a review of previous studies, and an international information network, the researcher determined that studies in the field of obesity did not adequately address the use of a sports diet program proposing aerobic exercises at night for obese women [1, 16].

Using a reference survey, a review of previous studies, and an international information network, the researcher found that studies in the field of obesity did not adequately address the use of a sports diet program proposing aerobic exercises at night for obese women. Consequently, the researcher conducted the current study.

Importance of Research:

- This research is among the applied research that may benefit the sports nutrition specialist.
- The inadequacy of previous studies dealing with weight loss using aerobic exercises day and night for obese women.
- This research is among the studies addressing the problems of obesity in women.

Aim of Study. This study aims to determine the effect of a sports program on vitamin D supplementation for weight loss and certain biochemical variables in young adults aged 30 to 35.

Materials and Methods

Participants

The research community represents a group of obese women. The research sample was chosen based on the intentional method and included 10 overweight women aged 30-35 years.

Selection criteria for the research sample:

1. Consent from the research subjects to participate in the study and aerial program.
2. The research subjects are not permitted to participate in other research.
3. The study participants have no medical conditions that prevent them from exercising, such as high blood pressure, diabetes, and liver or kidney disease.
4. Prepare for regular implementation of the proposed program and the doses of vitamin D specified before the onset of the study.

In accordance with the nature of the research, the researcher utilized the experimental method, employing the experimental design for one experimental group and implementing pre- and post-measurement.

Study Design

Study Type: Randomized controlled trial (RCT)

Inclusion Criteria:

- Overweight women aged 18-50 years.
- Body Mass Index (BMI) between 25 and 29.9 kg/m².
- Generally healthy, with no known chronic diseases affecting metabolism or vitamin D absorption.
- Not currently taking vitamin D supplements or participating in a regular exercise program.

Exclusion Criteria:

- Pregnant or lactating women.
- Women with a history of cardiovascular disease, renal impairment, or liver disease.
- Individuals with a known allergy or intolerance to vitamin D supplements.
- Women on medications affecting vitamin D metabolism or lipid profile.

Outcome Measures:

Primary Outcome Measures:

- Body weight and body composition (e.g., BMI, waist circumference, percentage body fat)
- Body Composition:
- Total fat: Measured using techniques such as dual-energy X-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA). Reported as a percentage of total body weight or absolute fat mass.
- Lipid Profile.
- Total cholesterol: Measured using enzymatic methods. Reported in milligrams per deciliter

(mg/dL) or millimoles per liter (mmol/L).

- Triglycerides: Measured using enzymatic methods. Reported in mg/dL or mmol/L.
- High-density lipoprotein (HDL) cholesterol: Measured using enzymatic methods after precipitation of other lipoproteins. Reported in mg/dL or mmol/L.
- Low-density lipoprotein (LDL) cholesterol: Calculated using the Friedewald equation or measured directly if triglyceride levels are high. Reported in mg/dL or mmol/L.
- Vitamin D Status.
- D25 - OH - Vitamin D (25-hydroxyvitamin D): Measured using a blood sample through immunoassay methods (e.g., enzyme-linked immunosorbent assay, radioimmunoassay). Reported in nanograms per millilitre (ng/mL) or nanomoles per liter (nmol/L).

Research sample

- Research community.

Study variables:

- Anthropometric variables.
- Biochemical variables.

Methods of measuring research variables:

1- Anthropometric measurements:

- Age measurement (to the nearest month);
- Measuring the total length of the body (to the nearest 1 cm);
- Weight measurement (the closest to 100 grams);
- The training age (to the nearest month).

2- Biochemical measurements:

- Cholesterol level in the blood.
- Total fat.
- High-density lipoprotein and low-density lipoprotein levels in the blood.
- The level of triglycerides in the blood.
- D25 - OH - Vitamin D.

The measurement was carried out:

- A specialized medical team drew blood samples of 5 cm² from a vein in the upper arm after placing the compressive ligament on the ulna region. The subjects were in a sitting position on a chair with the hand extended forward in relaxation with the fist firmly clenched. After injecting the vein and drawing blood, the compressive ligament was opened.
- In the ulna area, with an open fist and draw blood.
- Each sample was transferred from the syringe to a glass tube containing heparin (an anti-coagulant) by pouring blood on the walls of the tube after removing the needle.
- The special tubes were numbered after writing the name of each player on them and placed in a special refrigerated medical bag. The samples were transferred to the laboratory to measure the biochemical variables under investigation

(cholesterol, high-density proteins, low-density triglycerides, vitamin D).

Instruments and measurement tools:

The researcher prepared the devices and tools necessary to carry out the measurements under study and to implement the proposed training program, which included the following:

- Plastic syringe sizes 5 cm.
- Numbered test tubes and the stand for the tubes.
- Antiseptic solution and sticky strips.
- Icebox to store blood samples.
- Digital Stopwatch to the nearest 1/100 from the second.
- Tape inserted in centimeters to measure length.
- Medical scale to measure weight.
- Pedestrian box, height 50 cm.
- Tape measure (barrel).

The exploratory study

The researcher conducted the exploratory study during the period from 4/1/2022 to 10/1/2022 on a sample of 10 overweight women similar to the research community and outside of the sample.

Basic Experiment:

Premeasurement: has been applied to the biochemical variables under study from 12/1/2022 to 15/1/2022 for all sample members under the same conditions and in the same way.

The experimental group took vitamin D tablets along with the proposed aerobic exercise program from 16/1/2022 to 17/4/2022 for 12 weeks. The training is three training times a week, orally and 3 hours before exercise, at a dose of 2 grams per day of vitamin D, equivalent to 2 tablets per day, for three months.

Post-measurement: The researcher conducted a dimensional measurement between 18/4/2022 and 19/4/2022, in accordance with what was done prior to applying for the proposed program, taking the following into account during the application:

- Measurements should be made for all members of the sample uniformly.
- The same measurement tools should be used for the entire sample.
- Measurements should be performed in the same order in which the premeasurements were taken.

Statistical analysis

Data analyzed using the IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). The Kolmogorov-Smirnov was used to verify the normality of the distribution of variables. Paired t-test was used to compare two periods for normally distributed quantitative variables. ANOVA with repeated measures was used for comparing the different studied periods for normally distributed quantitative variables, followed by the post hoc test (Bonferroni adjusted) for pairwise comparison.

Pearson coefficient to correlate between two normally distributed quantitative variables. The significance of the obtained results was judged at the 5% level.

Results

All research subjects are homogeneous in terms of age, height, weight, and physiological and biochemical tests to ensure that they fall under the moderation curve.

Table 1. Distribution of demographic data and level of skewness (n = 10)

Variables	Mean	SD	Skewness
1 Age (year)	34.5	1.22	-0.128
2 Weight (kg).	93.54	4.82	0.458
3 Length (cm)	169.8	3.85	-1.002

According to Table 1, all the skewness coefficients for the research sample ranged between (-0.128 - 0.458). These values are limited to (3±), confirming the moderation of the distribution of the subjects of the research sample in the main variables of the study.

Table 2. Distribution of the biochemical variables of the research sample (n = 10)

Variables	Mean	SD	Skewness
Total fat (g)	372	2.99	0.299
Cholesterol (mg)	212.3	1.82	0.158
Triglycerides (mg/dL)	161.1	2.58	0.172
High-density lipoprotein cholesterol (mg/dL)	35.2	1.51	0.558
Low-density cholesterol (mg/dL)	144.4	1.35	0.438
D25 - OH - Vitamin D (nmol/L)	14.6	1.14	0.854

Table 2 shows that all the skewness coefficients for the research sample ranged between (0.158-0.854). These values are limited to (3±), confirming the moderation of the distribution of the members of the research sample in biochemical variables before conducting the study.

The study results revealed statistically significant differences in the biochemical variables between the tribal and remote measurements of the research sample in favor of the post-measurement.

Table 3 shows a statistically significant with an f-value of over 1.96 and a p-value of less than 0.05, indicating an improvement in post-measurement data.

According to Figure 1, the percentage of improvement between the pre and post-measurements in the biochemical variables in the research sample. The highest percentage of variable improvement was for D25 - OH - Vitamin D (34.66%),

Table 3. The Relations of the pre-and post-measurements in the biochemical variables n = 10

Variables	Pre-test		Post-test		F Value	P-Value
	Mean	SD	Mean	SD		
Total fat (g)	372	2.99	319	7.96	2.852*	0.005
Cholesterol (mg)	212.3	1.82	191	7.77	2.803*	0.005
Triglycerides (mg/dL)	161.1	2.58	125	4.04	2.803*	0.005
High-density lipoprotein cholesterol (mg/dL)	35.2	1.51	38.5	0.189	2.820*	0.005
Low-density cholesterol (mg/dL)	144.4	1.35	130	4.39	2.825*	0.005
D25 - OH - Vitamin D (nmol/L)	14.6	1.14	19.66	1.63	2.844*	0.004

Table 4. The percentage of change between the pre-and post-measurements for the research sample in the biochemical variables n = 10

Variables	Pre-test		Post-test		The difference between averages	Percentage of change %
	Mean	SD	Mean	SD		
Total fat (g)	372	2.99	319	7.96	53	14.25%
Cholesterol (mg)	212.3	1.82	191	7.77	21.3	10.03%
Triglycerides (mg/dL)	161.1	2.58	125	4.04	36.1	22.41%
High-density lipoprotein cholesterol (mg/dL)	35.2	1.51	38.5	0.189	3.3	9.37%
Low-density cholesterol (mg/dL)	144.4	1.35	130	4.39	14.4	9.97%
D25 - OH - Vitamin D (nmol/L)	14.6	1.14	19.66	1.63	5.06	34.66%

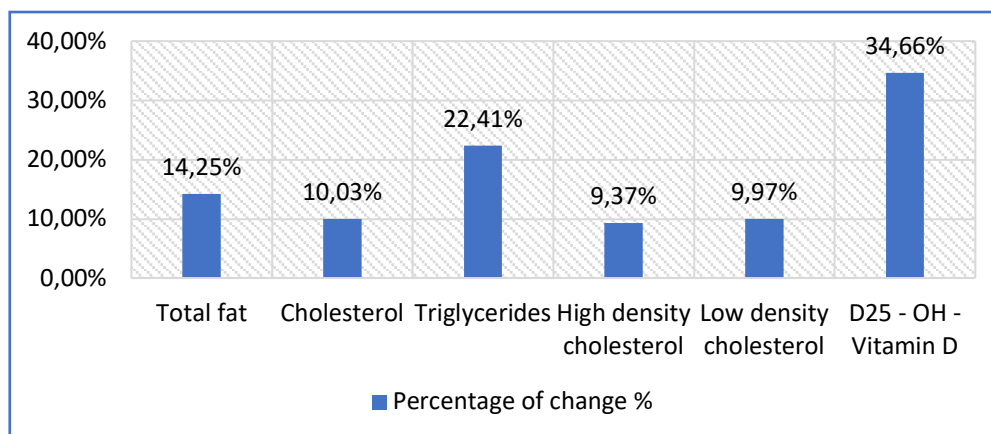


Figure 1. The percentage of change between the pre and post measurements

while the lowest percentage of improvement was for the High-density cholesterol variable (9.37%).

Discussion

The results of Table 3 and Figure 1 revealed statistically significant differences between the pre-and post-measurements at the significance level of 0.05. The percentage of improvement for all biochemical variables under study ranged from 9.37% to 34.6% in favor of the dimensional measurement. This improvement in biochemical variables can be attributed to the vitamin D intake sports program due to the diversity of the exercises used for 12 weeks and the regularity of all sample members. This had a significant impact on improving biochemical variables, and metered

doses of vitamin D contributed to raising vitamin D levels. Some evidence suggests that getting enough of this vitamin can promote weight loss and reduce body fat, thereby aiding in weight loss.

Sepehrmanesh [17] illustrated that the practice of aerobic physical activity increases the metabolic rate in the body. This activity aids in burning fats and dissolving fats accumulated in fat cells, thus encouraging the body to use fats as energy and increasing the level of good cholesterol [17]. Studies revealed that vitamin D could reduce the formation of new fat cells in the body and prevent the storage of fat cells, effectively reducing fat accumulation. Vitamin D can increase serotonin levels, affecting mood and sleep regulation [2].

Serotonin may play a role in appetite

control, increased satiety, weight loss, and decreased calories burned. Increased vitamin A levels may also be associated with increased testosterone levels, promoting weight loss [18]. At a significance level of 0.05, the results of Table 3 indicate that the concentration of triglycerides decreased significantly between the pre-and post-measurements. The percent of improvement in triglyceride concentration was 22.41. This result can be attributable to the effect of aerobic training and vitamin D supplementation, which reduces the level of triglyceride concentration until it reaches a plateau that can be maintained with physical exercise.

According to Wagner et al. [19], the aerobic energy system depends on glycogen and fats as indirect sources of energy production, with aerobic training helping to balance the representation of fat in the body via muscle cells, allowing it to be deposited in fat cells or eliminated by the liver [19]. The results also indicated statistically significant differences in total cholesterol concentration, HDL, and LDL. As the level of total cholesterol concentration decreased and the percentage of improvement reached 10.03 %, the level of HDL increased, and the percentage of improvement reached 9.37 %. Moreover, the level of LDL cholesterol concentration decreased, and the percentage of improvement reached 9.97%. This result is due to the effect of the proposed training program with its aerobic exercises and the regularity of the sample members during its application.

According to Wamberg et al. [20], regular physical activity has a significant impact on the ratio of total cholesterol, high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol (LDL) [20]. The significance of a low LDL cholesterol concentration suggests that it is the leading cause of coronary artery disease and that there is a direct correlation between the level of LDL cholesterol and physical fitness; the higher the concentration of LDL cholesterol, the lower the level of physical efficiency [21].

Therefore, the first hypothesis, which states that “there are statistically significant differences between the pre and post-measurements between the research sample in the biochemical variables in favor of the post-measurement,” has been confirmed.

Superiority of Research

Novel Intervention Approach: Our study stands out by examining the synergistic effects of high-dose vitamin D supplementation and an exercise program in overweight women. While previous studies have separately investigated these interventions, the combined effects remain relatively unexplored. By integrating both interventions, we expect to observe additive or potentially synergistic effects on biochemical variables, leading to improved weight

loss and metabolic outcomes.

Rigorous Study Design: Our research utilizes a randomized controlled trial (RCT) design, the gold standard for studying intervention effects. This design allows for robust comparison and minimizes bias, enhancing the validity and reliability of our findings. Furthermore, blinding researchers and participants to intervention assignments reduces potential biases, ensuring a high-quality study.

Comprehensive Outcome Measures: Our study focuses on multiple biochemical variables, including body composition (total fat), lipid profile (total cholesterol, triglycerides, HDL cholesterol, LDL cholesterol), and vitamin D status (D25 - OH - Vitamin D). By assessing a wide range of relevant variables, we can provide a comprehensive understanding of the impacts of the intervention on metabolic health markers in overweight women.

Novelty of Research

Targeted Population: Our study specifically targets overweight women, a population at increased risk of developing metabolic disorders. By focusing on this demographic, we address a critical research gap and provide insights into tailored interventions for weight management and metabolic health in this vulnerable group.

High-dose Vitamin D Supplementation: While the effects of standard or low-dose vitamin D supplementation have been investigated to some extent, our study explores the impact of high-dose vitamin D supplementation on biochemical variables. This higher dosage may elicit more substantial effects on weight loss and metabolic parameters, potentially uncovering novel findings and contributing to the existing literature on vitamin D supplementation.

Integration of Exercise Program: Our research combines high-dose vitamin D supplementation with an exercise program, acknowledging the interplay between nutrition, supplementation, and physical activity in weight management. This integration is novel in overweight women, allowing us to explore the potential synergistic effects of these interventions on biochemical variables.

Conclusion

Considering the objectives of the research and presenting the results within the limits of the research sample, the following can be concluded:

1. The proposed aerobic sports program with vitamin D intake led to an improvement in biochemical variables, including total fat, total cholesterol, triglyceride, high-density cholesterol, low-density cholesterol, OH, and vitamin D - 025) for the sample under investigation.
2. The application of the aerobic program with vitamin D resulted in weight loss among the

study's female participants.

3. The aerobic program with vitamin D intake has a positive effect on the general health status of a sample.

Recommendations

Within the limits of the research community and according to the findings, the researcher recommends the following.

1. Vitamin D has a positive effect on the general

functional state of the body, necessitating the implementation of an aerobic sports program at various ages.

2. Similar studies should be performed on different age groups and samples.
3. Medical tests should be conducted periodically to follow up on the health status of the body.
4. There should be a focus on regular exercise to prevent weight gain and certain chronic diseases.

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