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# IMPACT OF ZUMBA TRAINING ON BODY COMPOSITION AND EATING BEHAVIOR IN OBESE WOMEN DURING COVID-19

# WPŁYW TRENINGU ZUMBY NA SKŁAD CIAŁA I ZACHOWANIA ŻYWIENIOWE U KOBIET Z OTYŁOŚCIĄ W OKRESIE PANDEMII COVID-19

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D. Data interpretation
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G. Funds collection
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**Summary**

**Background.** The aim of the study was to compare the effect of 8 weeks of online Zumba exercises and walking on body composition, eating attitude and body image perception in overweight and obese women during the pandemic.
**Material and methods.** A cohort of 150 obese women aged between 20 and 40 years old were classified as Control (n=50), Walking (n=50) and Zumba (n=50) groups. All groups received dietary counselling, while the Zumba and walking groups received 8 weeks of exercise intervention. Bioimpedance, Body Image Scale and Three-Factor Nutrition Questionnaire-Revised 18 Items Scale were used to assess body composition, body image satisfaction and eating behavior, respectively. Paired Sample T test and ANOVA analysis were used at the significance level of α=0.05.
**Results.** Walking and Zumba exercise groups had lower BMI, fat mass, fat percentage and waist-to-hip ratio. The body image increased significantly in both walking and Zumba groups, while a decline was determined in the control group at the end of the study. Uncontrolled eating, emotional eating and sensitivity to hunger decreased in walking and Zumba groups, while there was no significant difference in cognitive restrain for all three groups.
**Conclusions.** It can be concluded that 8-week home-based online Zumba exercise with self-monitoring via Smartphone apps was as effective as walking for improving body composition and eating attitudes of overweight and obese women.

**Keywords:** Zumba, body composition, body image, eating behavior, obesity, walking

**Streszczenie**

**Wprowadzenie.** Celem badania było porównanie wpływu 8-tygodniowych ćwiczeń Zumby online i spacerów na skład ciała, nastawienie do odżywiania i postrzeganie własnego ciała u kobiet z nadwagą i otyłością w czasie pandemii.
**Materiał i metody.** Kohortę 150 otyłych kobiet w wieku od 20 do 40 lat podzielono na grupę kontrolną (n=50), grupę odbywającą spacery (n=50) i ćwiczącą Zumbę (n=50). Wszystkie grupy otrzymały porady dietetyczne, podczas gdy grupy ćwiczące Zumbę i odbywające spacery otrzymały 8-tygodniową interwencję w postaci aktywności fizycznej. Do oceny odpowiednio składu ciała, zadowolenia z postrzegania własnego ciała i zachowań żywieniowych użyto bioimpedancji, skali postrzegania własnego ciała i zrewidowanej zawierającej 18 pozycji skali trójczynnikowego kwestionariusza żywieniowego TFEQ-R18. Test t-Studenta dla próbek sparowanych i analizę ANOVA zastosowano na poziomie istotności α=0,05.
**Wyniki.** Osoby w grupach spacerującej i ćwiczącej Zumbę miały niższy BMI, masę tkanki tłuszczowej, procent tłuszczu i stosunek obwodu talii do obwodu bioder. Postrzeganie własnego ciała istotnie się poprawiło zarówno w grupie odbywającej spacery, jak i trenującej Zumbę, podczas gdy w grupie kontrolnej stwierdzono pogorszenie tego wyniku pod koniec badania. Niekontrolowane jedzenie, jedzenie pod wpływem emocji i wrażliwość na głód zmniejszyły się w grupie odbywającej spacery, jak i ćwiczącej Zumbę, podczas gdy nie było istotnych różnic w ograniczaniu jedzenia dla wszystkich trzech grup.
**Wnioski.** Można stwierdzić, że 8-tygodniowe, prowadzone w domach, ćwiczenia Zumby online z samokontrolą za pomocą aplikacji na smartfony były równie skuteczne jak spacery w zakresie poprawy składu ciała i postaw żywieniowych kobiet z nadwagą i otyłością.

**Słowa kluczowe:** Zumba, skład ciała, obraz ciała, zachowania żywieniowe, otyłość, spacery

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**Introduction**

COVID-19 became an important macro stressor affecting mental and physical health, particularly in vulnerable groups suffering from obesity, due to the mandatory self-isolation, physical distancing measures and major restrictions on public and private life [1]. Statistics stated that 30.2% of hospitalizations during COVID-19 pandemic were attributed to obesity which clearly highlights the importance of obesity treatment and control of weight gain during the pandemic [2]. Overweight or obese individuals, compared to those with a healthy weight, are at increased risk for a variety of serious diseases such as type 2 diabetes, cardiovascular disease, cancer, chronic kidney failure, certain musculoskeletal disorders, and infections [3]. Not only the physiological, but also the psychological impact such as depression, emotional and behavioral disorders, low self-esteem, lack of motivation, poor quality of life, eating disorders and impaired body image has been observed among overweight and obese individuals [4]. Research performed during the pandemic showed that women are more prone to psychological effects such as difficulty in regulating eating and being preoccupied with food, which in turn might result in weight gain, higher BMI and dissatisfaction with body and appearance [5,6].

Exercise training, whether voluntarily or on prescription, has multifaceted effects on both physiological and psychological health, improves well-being and body composition by reducing body weight, total body fat and visceral adipose tissue [7]. Participating regularly in activities such as walking, running, cycling, or swimming not only improves physical health, but also supports mental health [8] and is recognized as an integral part of the treatment of obesity in combination with dietary modification and behavioral support [9]. An overview of reviews provides evidence for the effectiveness of aerobic training compared to resistance training in weight, fat, and visceral fat loss at the same level of energy expenditure, while resistance training is the most effective exercise modality to preserve lean body mass during diet-induced weight loss [10]. On the other hand, high intensity interval training seems to be an alternative for moderate intensity continuous exercise for weight loss, but data on safety of interval training in adults with obesity is still unknown. Centuries ago, Hippocrates defined walking as the best medicine for humankind and it is still demonstrated as the gold standard in rehabilitation programs for non-communicable diseases [11].

Although walking has been accepted as the safest, cheapest and easiest exercise in rehabilitation programs, restrictions during COVID-19 curfews cast a shadow over walking, and most people were forced to stay at home or adopt isolation protocols to prevent transmission of the virus [1]. On the other hand, limited opportunity for walking during this period has impacted the way in which individuals engage in physical activity and replaced conventional exercise programs with online based exercise workouts such as bodyweight strength training, active play, and dance-based exercise [12]. Home-based videos of physical exercise, wearables, and smartphone apps represent new approaches to promoting physical activity and other changes in health behavior, such as dietary modification [13].

It can be hypothesized that online work-out videos and self-monitoring smartphone apps might serve as an alternative solution for supporting obese patients at home remotely and facilitate internal and external motivation not only for weight loss, but also for changing their eating attitudes and consequently their perception of body image [14,15]. A well-conducted systematic review published in 2022 provided evidence for promoting physical activity and weight loss via technology-based interventions, but also acknowledged a lack of evidence on the effectiveness of these technologies in clinical trials for successful weight loss and behavior changes [16]. Moreover, most investigations of technology-based interventions are often limited by complex, multi-modality study designs or involve concomitant dietary modification, which makes it challenging to assess the contribution of each intervention on body weight, while data for behavioral changes are limited or missing in these studies [16]. The popularity of emerging technology in promoting physical activity and health is increasing, but the effectiveness of home-based, patient-implemented rehabilitation as well as a comparison with traditional well accepted methods is still a question mark [17].

The aim of this study was to investigate the effect of home-based online Zumba exercises on body composition, eating attitude, and body image in overweight and obese patients who performed self-monitoring for exercise and dietary restriction via smart-phone applications for 8 weeks, and to compare the effectiveness of online Zumba exercise against the gold standard exercise of walking during the COVID-19 pandemic period.

## Material and methods

*Study design and participants*

Female patients (BMI's over 30 $kg/m^2$) aged between 20-40 years who sought but had not yet commenced dietary counselling and weight loss therapy at a dietary clinic were invited to the randomized controlled experimental study which was performed in accordance with the Declaration of Helsinki and the approval of the University Non-Invasive Clinical Research Ethics Committee (Acceptance Number: 2020-142). Sample size was calculated with G-power 3.9.1. and the total number required for the expectation of an effect size (f=0.60) to be statistically significant ($\alpha$=0.05;1-$\beta$=0.80) was found to be 30 for each group. Twice the number of patients, a total of 180 obese and overweight women, were invited to the study to handle the risk of possible dropouts during the study.

Patients having menopause, endocrine or metabolic disorders associated with weight loss, history of COVID-19 diagnosis, exercising regularly or taking any medication for the last six months were excluded (Figure 1).

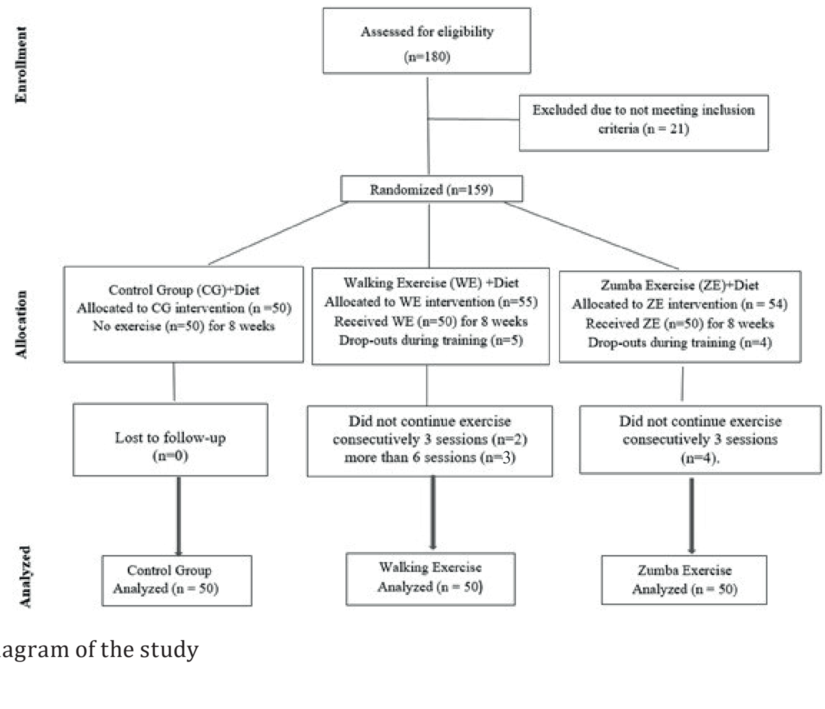


**Figure 1.** CONSORT diagram of the study

A cohort of 159 overweight and obese patients were included in the randomized experimental study with parallel group design after signing the written informed consent. Patients were categorized as control (n=50), walking (n=55) and Zumba (n=54) groups according to the participant's preference. The mean age of women was 30.29±5.23 years, while the mean age for the control group was 31.42±0.71 years (CI=30.0-32.83), for the walking group 29.84±0.80 years (CI=28.23-31.45), and for the Zumba group 29.62±0.69 years (CI=28.22-31.02). All groups received dietary counselling and caloric restriction which was stated as 2176±423.5 kcal for the control, 2053.7±342.7 kcal for the walking and 2193.2±742.6 kcal for the Zumba group, while only walking and Zumba groups received an additional exercise intervention. Baseline assessment was conducted face-to-face at the beginning of the study, whereas follow-up measurements were performed after the 8-week exercise interventions by the same clinician (Figure 1).

*Implementation*

All subjects were asked to maintain their current lifestyle before the pre-test baseline assessment. Following the pre-test baseline assessment, all participants received dietary counselling and caloric intake was calculated according to the basal metabolic rate for each patient. The basal metabolic rate of obese patients was calculated according to the Harris-Benedict Equation:

$$\text{Female BEE} = 65 + 9.6\,(\text{weight in kg}) + 1.8\,(\text{height in cm}) - 4.7\,(\text{age in years})$$

An additional 30% of the basal metabolic rate was added to calculate the daily necessary caloric intake to maintain body weight. This outcome was further reduced so that the daily caloric intake was adjusted to lose 0.5 kg per week for each participant in all groups. The caloric intake was advised according to the "Plate Model" including 5 food groups: 1) milk and dairy products group, 2) meat-chicken-fish-eggs-legumes-oil seeds-nuts group, 3) bread and cereals group, 4) vegetable group, 5) fruit group, respectively. The percentage of carbohydrates (45-60%), fats (20-35%) and proteins (10-20%) was arranged according to Australian Dietary Guidelines [18].

*Exercise intervention*

The intervention groups performed exercise at moderate intensity (70% of maximal heart rate) for 5 days per week for 8 weeks in both walking and Zumba groups. The exercise protocol started with 30 minutes per day at the beginning and increased gradually up to 60 minutes per day for the rest of the study. The target heart rate was measured with the smartphone application "Cardiograph", compatible with Windows Phone, iPhone OS and Android devices, by placing the participant's index finger on the device's integrated camera periodically every 10 minutes during the exercise. To reach the target heart rate, walking speed was increased gradually to match the increased level of physical activity in the walking group. For the Zumba group, online Zumba dancing videos were selected and grouped into beginner, intermediate and advanced level. Each participant in the Zumba group started with the beginner level Zumba videos in the first week and continued in the exercise intervention program with intermediate and/or advanced Zumba dancing videos to reach the target heart rate throughout the 8 weeks. The control group was allowed to continue their daily physical activity but were restricted for additional exercising.

*Assessment protocol*

Baseline and follow up evaluation were carried out in the medical center by face-to-face interview and assessments, two days before the beginning and two days after the completion of the 8-week exercise program within the time allotted to each participant. A total of 159 participants joined the baseline assessment, whereas only 150 patients were assessed at the end of the study due to the dropouts shown in Figure 1.

*Anthropometric measurements*

All anthropometric measurements were performed twice by the same clinician in the medical center with a calibrated instrument (Seca, Germany) and standardized protocol [19]; average values were calculated and used for further analysis. Height and weight were measured in light clothing and bare feet using a stadiometer with 0.1 cm precision and a medical scale certified for medical use according to standard protocol. BMI was calculated as the weight (kg) divided by the square of the height ($m^2$). The participants were asked to breathe out for measurement of their waist circumference with an accuracy of 0.1 cm, measured with a non-elastic tape at the mid-point between the top of the iliac crest and the last palpable rib. Hip circumference was measured at the level of the maximum extension of the thigh by side view, and waist-hip ratio was calculated by dividing waist circumference to hip circumference.

*Bioelectrical impedance assessment*

Fat mass and fat percentage were determined with hand-held impedance measurements using BIA (Inbody 370S, South Korea) following the manufacturer's guidelines. Since BIA assessment is based on the electrical permeability difference of lean tissue mass and fat mass, patients were not allowed to wear any metal objects such as jewelry, zippers, etc. during the measurements. Participants were measured during daytime, after an overnight fast with empty bladder, wearing light clothing and bare feet. All patients belong to the same ethnic group, White Caucasian women, and were representative of the urban population. The single-gender and single ethnicity of the sample group did not need correction for gender and ethnicity which cause bias in bioelectrical impedance assessments [20].

*Body Image Scale (BIS)*

The BIS was adapted to Turkish by Hovardaoğlu [21]. The 40-items are rated on a 5-point Likert-type scale, ranging from never to always and the total score of the scale ranges from 40 to 200 with a cut-off point of 135. The higher the scores, the greater the feeling of body image satisfaction, whereas a total score below 135 indicates body image dissatisfaction.

*Three-Factor Eating Questionnaire-Revised 18 Items (TFEQ-R18)*

The TFEQ-R18 scale was revised for obese populations by Karlson [22] and his coworkers based on the original items and adapted by Kıraç [23] and his coworkers. Each item is scored from 1 to 4 in the original TFEQ-R18 scale which measures 3 sub-dimensions; cognitive restraint (6 items), emotional eating (3 items) and uncontrolled eating (9 items), while Kıraç [23] and his coworkers performed language adaption in 2015 based on the same items, but sub-scales were re-arranged as 4 sub-scales; cognitive restraint (6 items), emotional eating (3 items), uncontrolled eating (5 items) and sensitivity to hunger (4 items). Sensitivity to hunger arose as the 4$^{th}$ factor based on the sum of the TFEQ R18 scale items 4, 5, 8 and 9. The scores were summed to obtain scale scores for each sub-dimension which theoretically ranges from 6 to 24 for cognitive restraint, from 3 to 12 for emotional eating, from 5 to 20 for uncontrolled eating, and from 4 to 16 for sensitivity to hunger [23].

*Statistical analysis*

Statistical analysis was performed using SPSS 23.0 software. Normality of data distribution was checked using the Kolmogorov-Smirnov test and homogeneity of variances was tested with Levene's test. Pre-test and post-test scores of body composition, body image and eating behavior were compared using Paired Sample T test, whereas ANOVA and Tukey post hoc analysis was performed to identify differences among groups at the significance level of $\alpha$=0.05.

**Results**

All baseline scores for body composition, eating attitude and body image for three groups have been presented as mean±standard deviation (SD) in Table 1.

**Table 1.** Changes in body composition, body image and eating behavior of obese women in control, walking and Zumba groups

| Variables | Control (no exercise) | | | | Walking (moderate intensity walking exercise) | | | | Zumba (moderate intensity online Zumba exercise) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pre test | Post test | t(50) | *p*-value | Pre test | Post test | t(50) | *p*-value | Pre test | Post test | t(50) | *p*-value |
| | Mean ± SD | Mean ± SD | | | Mean ± SD | Mean ± SD | | | Mean ± SD | Mean ± SD | | |
| **Body composition parameters** | | | | | | | | | | | | |
| **BMI (kg/m²)** | 33.39±5.76 | 33.24±5.63 | 0.58 | 0.56 | 32.89±5.34 | 30.93±4.67 | 13.68* | 0.001 | 34.50±5.46 | 31.45±4.95 | 17.44* | 0.001 |
| **Waist/ hip ratio (cm)** | 0.98±0.06 | 0.98±0.06 | 0.34 | 0.73 | 0.98±0.07 | 0.95±0.07 | 5.55* | 0.001 | 1.01±0.05 | 0.97±0.06 | 9.22* | 0.001 |
| **Fat mass (kg)** | 38.28±11.21 | 37.70±10.81 | 1.13 | 0.27 | 36.22±10.35 | 31.79±9.21 | 12.94* | 0.001 | 40.32±10.23 | 33.63±9.46 | 17.78* | 0.001 |
| **Fat percentage (%)** | 43.33±5.37 | 42.88±5.48 | 1.43 | 0.16 | 42.63±6.39 | 39.78±6.47 | 9.10* | 0.001 | 43.51±5.03 | 39.68±5.77 | 14.00* | 0.001 |
| **TFEQ18 subscale** | | | | | | | | | | | | |
| **Uncontrolled eating** | 14.18±2.63 | 14.70±2.70 | -1.77 | 0.084 | 14.22±2.44 | 7.96±1.71 | 14.95* | 0.001 | 13.96±2.63 | 7.82±1.66 | 13.35* | 0.001 |
| **Emotional eating** | 7.18±2.99 | 8.28±2.68 | -2.43* | 0.019 | 6.96±3.06 | 4.32±1.50 | 5.30* | 0.001 | 7.72±2.89 | 4.08±1.45 | 8.09* | 0.001 |
| **Cognitive restraint** | 13.76±2.22 | 14.22±2.84 | -0.97 | 0.337 | 14.06±2.33 | 13.90±1.59 | 0.37 | 0.712 | 14.14±2.31 | 14.32±1.83 | - 0.41 | 0.688 |
| **Sensitivity to hunger** | 11.48±2.02 | 12.90±2.90 | -2.88* | 0.006 | 11.96±1.80 | 6.08±2.46 | 14.75* | 0.001 | 12.16±1.86 | 9.92±2.02 | 5.73* | 0.001 |
| **Body image** | 131.70±16.03 | 122.28±11.54 | 8.57* | 0.001 | 134.08±15.74 | 146.2±10.09 | -10.89* | 0.001 | 129.34±15.43 | 148.48±9.95 | -17.37* | 0.001 |

Notes: BMI: Body Mass Index, SD: Standard Deviation, * Significance level is at α<0.05.

Paired Sample T test was used to compare baseline and follow up scores of BMI, fat mass and percentage, body image and the sub-scales of eating behavior in each group and were presented in Table 1. BMI, fat mass, fat percentage, and waist to hip ratio decreased significantly in both walking and Zumba groups ($p$=0.001) but remained the same for the control group (Table 1). Body image was below the cut-off point of 135 points for all three groups at the beginning of the study and increased significantly in walking and Zumba groups ($p$=0.001), whereas a decline was observed in the control group after 8 weeks ($p$=0.001). Eating behavior of participants in all groups showed significant differences for all sub-scales, except cognitive restraint ($p$>0.05). Uncontrolled eating sub-scale scores for walking and Zumba were significantly lower in the follow-up assessment, while the control group did not show any significant difference between the baseline and follow up assessment. Emotional eating scores decreased in the walking ($p$=0.001) and Zumba ($p$=0.001) groups, while emotional eating ($p$=0.019) and sensitivity to hunger ($p$=0.006) increased in the control group at the end of the study (Table 1).

According to the follow-up assessment, fat mass and fat percentage showed statistically significant differences among groups, whereas BMI and waist-to-hip ratio were not statistically different among groups (Table 2). Tukey post hoc analysis showed that the control group was significantly different compared to walking and Zumba groups in terms of fat mass and fat percentage, while the body image mean score of the control group was lower compared to walking ($p$=0.001) and Zumba ($p$=0.001) groups (Table 2).

**Table 2.** Comparison of control, walking and Zumba groups according to body composition parameters and body image for pre-test and post-test assessment

| Variables | | Pre test | | | | Post test | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | F(2,149) | *p*-value | Post hoc$_{Tukey}$ | | F(2,149) | *p*-value | Post hoc$_{Tukey}$ | |
| | | | | condition | $p_{Tukey}$ | | | condition | $p_{Tukey}$ |
| BMI (kg/m$^2$) | Control(1) | 1.11 | 0.331 | 1-2 | 0.896 | 2.83 | 0.062 | 1-2 | 0.064 |
| | Walking(2) | | | 1-3 | 0.572 | | | 1-3 | 0.187 |
| | Zumba(3) | | | 2-3 | 0.315 | | | 2-3 | 0.869 |
| Waist/ Hip ratio (cm) | Control(1) | 2.99 | 0.053 | 1-2 | 0.986 | 2.75 | 0.067 | 1-2 | 0.053 |
| | Walking(2) | | | 1-3 | 0.108 | | | 1-3 | 0.404 |
| | Zumba(3) | | | 2-3 | 0.076 | | | 2-3 | 0.545 |
| Fat mass (kg) | Control(1) | 1.87 | 0.157 | 1-2 | 0.808 | 4.71* | 0.010 | 1-2* | 0.026 |
| | Walking(2) | | | 1-3 | 0.986 | | | 1-3* | 0.021 |
| | Zumba(3) | | | 2-3 | 0.715 | | | 2-3 | 0.997 |
| Fat percentage (%) | Control(1) | 0.342 | 0.711 | 1-2 | 0.690 | 4.72* | 0.010 | 1-2* | 0.016 |
| | Walking(2) | | | 1-3 | 0.990 | | | 1-3* | 0.001 |
| | Zumba(3) | | | 2-3 | 0.990 | | | 2-3 | 0.693 |
| Body image | Control(1) | 1.13 | 0.325 | 1-2 | 0.730 | 94.45** | 0.001 | 1-2* | 0.001 |
| | Walking(2) | | | 1-3 | 0.734 | | | 1-3* | 0.001 |
| | Zumba(3) | | | 2-3 | 0.291 | | | 2-3 | 0.534 |

Notes: One-way ANOVA Test, * Significance level is at $\alpha$<0.05.

All TFEQ R18 sub-scales were statistically different among groups ($p$=0.001), except cognitive restraint sub-scale ($p$=0.59). Tukey post hoc analysis showed that both uncontrolled eating and emotional eating were significantly lower in walking ($p$=0.001) and Zumba groups ($p$=0.001) compared to the control group, while the mean scores of sensitivity to hunger showed statistically significant differences between the control group and both walking ($p$=0.001) and Zumba ($p$=0.001) groups, and also between walking and Zumba exercise groups ($p$=0.001) (Figure 2).

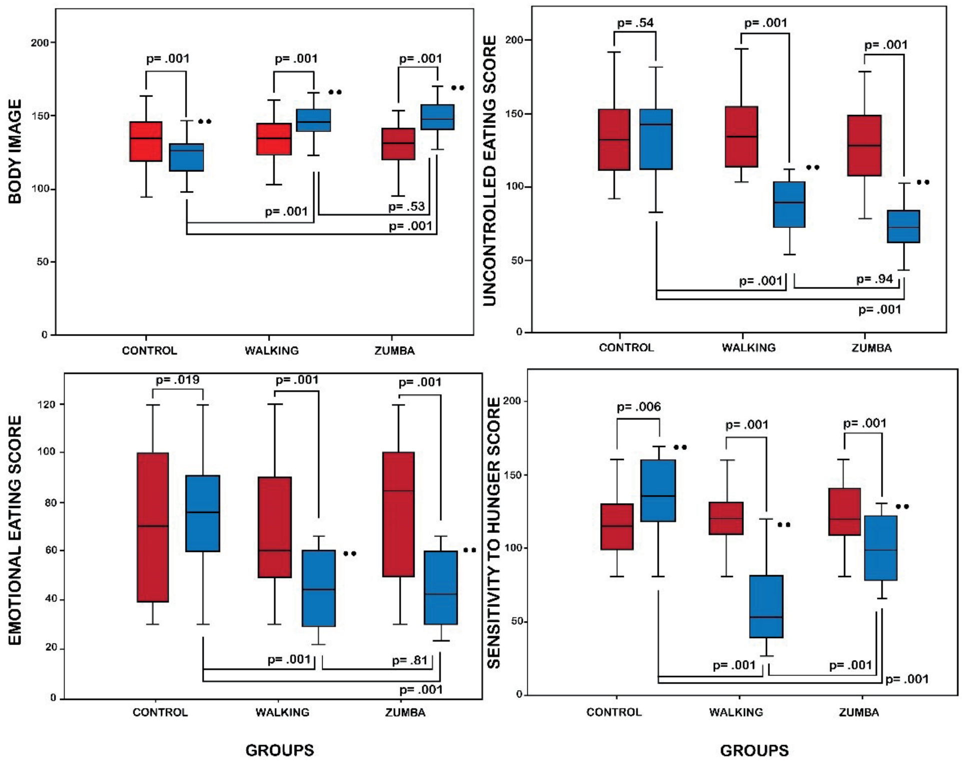


**Figure 2.** Differences in eating behavior between pre-test (red boxes) and post-test (blue boxes) among groups

## Discussion

The findings of this study showed that Zumba exercise performed with online videos at home by using self-monitoring smartphone apps might be an alternative for obese women to maintain and improve body composition and alter eating attitudes positively. Moreover, online Zumba exercise together with remote dietary counselling increased the body image of overweight and obese women during the restrictions of the COVID-19 period. Walking has been demonstrated as a gold standard low impact physical activity for obese individuals and patients with weak physical strength, while both exercise groups in our study, independent of exercise type, experienced a decline in fat mass and fat percentage, and their waist-to-hip ratio decreased significantly. These outcomes are in accordance with literature which shows that moderate aerobic exercise alone or combined with diet restriction intervention causes clinically significant weight loss and improves body composition in overweight and obese postmenopausal women [24].

According to our findings, an 8-week online Zumba exercise was as effective as walking in reducing BMI, fat mass and fat percentage in obese patients, while only caloric restriction was not sufficient for any weight loss or improvement in body composition (Table 1). Interestingly, the BMI was lower at the follow-up assessment in both walking and Zumba groups, but the decline was very limited and could not be distinguished from the control group, whereas the reduction in fat mass and fat percentage could be clearly seen in both walking and Zumba groups. Findings are in accordance with literature stating that 12-weeks of aerobic exercise decreased fat mass and fat percentage by partially compensating for increased hunger and energy intake in obese women, whereas the low energy expenditure in the control group performing only non-exercise physical activity or having sedentary behavior could not compensate energy intake for significant loss in fat mass and fat percentage

[25]. Moreover, it has been shown that a 12-week high intensity of aerobic exercise results in a decrease in BMI, body fat, and waist to hip ratio, while low intensity of exercise reduces fat mass and percentage in obese women, even when the diet was not controlled [26]. However, prescribing a high aerobic exercise training program for individuals with obesity is mostly not convenient due to individual's low exercise capacity which is not enough to complete a high intensity exercise program. Although several studies stated the positive effect of exercise interventions, the actual observed degree of weight loss is usually less than the theoretically expected weight loss based on the amount of energy expended which depends on several factors, including the complex effects of exercise on physiology [24]. Despite evidence demonstrating that approximately 10,000 steps per day can provide significant health benefits for overall physical and mental health [9], epidemiological studies confirm that the percentage of physically inactive adults is quite high in the world [27], while overweight and obese individuals are characterized by a lower physical activity level compared to normal weight peers [28]. It can be argued that a regular physical activity level of obese women in the control group was inadequate and very low to create a negative energy balance, while Zumba performed at moderate intensity was as effective as walking for burning fat as supported by literature stating that cardiovascular exercises trigger fat burning and might increase basal metabolism by increasing muscle mass during the treatment of obesity [29]; however, the 8-week period of exercise in our study might be not enough to significantly decrease BMI. On the other hand, the period of exercise was enough to cause a positive effect on eating attitude and improved the body image perception in overweight and obese women in walking and Zumba groups.

The body image perception of all participants was low at the beginning of the study, as stated in literature that obese individuals complain more and are dissatisfied with their bodies compared to non-obese individuals [30]. Body image of patients in the exercise intervention groups increased significantly, whereas a decline in body image was observed in the non-exercising control group (Table 1, Figure 1). It has been shown that walking for 80 minutes per day in the forest improves body image for obese individuals [31]. Although completion of weight loss intervention programs alone might cause improvements in the body image of obese adult women [14], findings of our study showed that body image perception decreased with caloric restriction in the control group (Table 1). The contrary results might be explained by the adverse effect of the COVID-19 pandemic period, since women ate more and thought more about food during the 3-month quarantine due to social media [32]. Literature argues that women go on a diet because of pressure to diet and lose weight due to shared content by social media but were unsuccessful in losing weight and even gained more weight during the pandemic period. Thus, social media has been shown to be a major contributing factor to deteriorating body image during the pandemic [32]. Increased body image concerns and eating disorders during COVID-19 restrictions was found to be associated with an increased level of psychological stress because of increased exposure to content related to eating and appearance [33] due to increased use of social media [34] and limitations in face-to-face interactions [35,36]. Although the effect of social media has not been determined in this study, it can be argued that dissatisfaction with body image in the control group might have been increased because of adverse effects of COVID-19 restrictions, whereas exercise was able to lower psychological stress in obese women in both walking and Zumba groups (Figure 2, Table 2).

Several studies conducted during the COVID-19 pandemic reported several negative consequences not only for body image but also for eating behavior for the general population. A systematic meta-analysis study reported an increase in disordered eating behavior such as emotional eating, binge eating and vomiting, and compulsive eating disorders associated with lower body image and increased weight during the COVID-19 pandemic period [37]. The COVID-19 pandemic period reduced psychological well-being [38], disturbed the emotional balance, and changed specific and general psychopathology of eating disorders [39]. Findings of this study are in accordance with literature and found that eating behavior was altered in obese women at the beginning of the study in all three groups. While diet restriction alone was not effective in improving eating behavior, both online Zumba and walking exercise decreased emotional eating, uncontrolled eating, and sensitivity to hunger and thereby improved disturbed eating behavior (Table 1). The findings are in accordance with a study showing that physical activity is associated with body image and eating disorders in adolescent girls during the COVID-19 pandemic [40], while adapted physical activity appears to be a solution to reducing undesirable psycho-physical conditions, especially during the COVID-19 pandemic [41].

Apart from the effect of COVID-19, a study focused on a community-based cognitive-behavioral weight-management program for 6 months showed that increased exercise did not have a direct effect on improved eating; however, exercise might benefit behavioral eating changes through a transfer of self-regulatory skill improvements [42]. Low levels of physical activity can lead to erratic appetite and a mismatch between energy intake and expenditure, while also increasing hedonistic states and behavioral traits that indirectly support overconsumption through increased body fat [43]. Regular exercise can provide more precise appetite control due to the acute effect of exercise on gastric emptying [44], decreased ghrelin secretion, and increased peptide tyrosine-tyrosine (PYY) and glucagon-like peptide (GLP-1), and pancreatic polypeptide secretion [45]. Moreover, exercise-based physiological adaptation such as improved sensitivity to insulin and leptin [46], might play an important role in food intake and eating behavior [47]. Thus, overweight and obese individuals in the control group with lower levels of physical activity have non-regulated appetite and greater non-homeostatic influences favoring overconsumption and a weaker satiety response to food, while increased physical activity levels in the Zumba and walking group cause regulated appetite and an increased drive to eat and enhanced satiety response to food [43].

In contrast to uncontrolled and emotional eating, cognitive restraint was not altered for all three groups throughout the study, showing that the cognitive dimension of eating behavior relies on different mechanisms which are not affected by exercise. Cognitive restraint, mostly observed in obese individuals, describes restricting food intake to lose weight or avoid regain [10]. Although the cognitive restriction scores are the same for normal weight and obese groups, obese individuals have higher emotional eating scores which is the tendency to eat too much during a negative mood state compared to normal weight participants. Thus, obese individuals might consume excess food to overcome anxiety and any other negative emotions they may be prone to [48]. Self-isolation gave rise to increased anxiety and depression in the population, whereas physical activity was found to counteract mental and psychological negative effects during the COVID-19 pandemic [49,50]. Studies stated that physical activity might be a good moderator of anxiety, depression, and anger [51], and has been associated with psychological well-being during closure [52]. It can be argued that walking and Zumba exercises might have decreased emotional eating due to the benefits of exercise on mental health and psychological well-being during the COVID-19 pandemic [53], since symptoms of anxiety and depression were found to be higher for individuals who were inactive for 10 hours a day compared to individuals exercising for 30 minutes a day during the pandemic [50]. This positive effect of regular exercise on mental health has been linked to changes in the hypothalamic-pituitary-adrenal (HPA) axis and mediation of the endogenous opioid system involved in stress responsiveness, anxiety, mood, and emotional responses [53].

Taking all these together, findings of the study showed that online Zumba exercise at home might be a solution for obese women to reduce the effect of COVID-19 infections. Obese patients were determined as a vulnerable group during the pandemic, since the risk of hospitalization of morbidly obese individuals was 6.2 times higher as stated in the study focused on the need for hospitalization of obese individuals after being diagnosed with COVID-19 during the pandemic process [54].

*Limitations*

The present study was carried out among obese patients who applied to a diet clinic; however, quality of life and physiological wellbeing, emotional wellbeing, depression, and sexual health was not questioned during the study due to the extra-ordinary pandemic conditions. Thus, the effect of the COVID-19 pandemic restriction on an individual's social functioning and life habits are unknown. Participants were asked for self-evaluation, without clinical assessment by a psychologist, for eating disorders such as bingeing, skipping meals and the consumption of unhealthy foods, which might have an influence on both body image and eating behavior. Moreover, several dimensions such as social media, family support and cultural environment might have a negative effect on body image. There is not enough evidence to establish a cause-and-effect relationship between eating behaviors and body image without further research based on clinical evaluation.

**Conclusions**

It can be concluded that 8-week home-based online Zumba exercise with self-monitoring via Smartphone apps was as effective as walking for improving body composition and eating attitudes of overweight and obese women. Video-based online Zumba might be an alternative solution for weight loss for obese women and improved body image during the restriction period of COVID-19. Exercise, both Zumba and walking, might alter disturbed eating behavior such as uncontrolled and emotional eating in obese women, and the positive effect of exercise might help to reduce the negative psychological effect of the COVID-19 pandemic.

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