BALNEO RESEARCH Balneo and PRM Research Journal
English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Prospective Clinical Studies

Impact of aquagym programs on body composition parameters assessed by bioelectrical impedance in women aged 40-60 years

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Citation: Elena V.L., Sînziana S.C., Ioan C.A. - Impact of aquagym programs on body composition parameters assessed by bioelectrical impedance in women aged 40-60 years
Balneo and PRM Research Journal ***2026****, 17(2): 1038*

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Received: 20.05.2026
Published: 10.07.2026

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Publisher's Note:
Balneo and PRM Research Journal stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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Abstract: The present study investigates the effects of a 12-week aquagym program on body composition and metabolic parameters assessed through bioelectrical impedance in women aged between 40 and 60 years. The research included 25 women who participated in an aquatic exercise program conducted twice per week within the Swimming and Kinesiotherapy Complex. Body composition assessment was performed before and after the intervention using the Tanita MC-780MA-N bioelectrical impedance analyzer. All participants successfully completed the intervention protocol, with attendance exceeding 90% of the scheduled sessions.The analyzed parameters included body mass index (BMI), fat mass, muscle mass, fat-free mass, visceral fat, ECW/TBW ratio, and metabolic age. The research methods included literature review, observation method, experimental method, testing method, and mathematical-statistical method. Statistical analysis was performed using the paired samples t-test, while effect size was calculated using Cohen's d for paired samples. The results demonstrated statistically significant improvements across all investigated parameters ($p = 0.001$). BMI decreased from 29.36 ± 5.99 kg/m² to 28.39 ± 5.66 kg/m², while fat mass and visceral fat values were reduced. At the same time, increases in muscle mass and fat-free mass were observed, indicating favorable physiological adaptations and optimization of body composition. Effect size analysis demonstrated large and very large effects for most variables, highlighting the substantial impact of aquatic exercise on body and metabolic status. Effect size analysis revealed large to very large effects, with Cohen's d values ranging from 1.14 to 5.45, confirming the substantial impact of the intervention program on the investigated parameters.The findings confirm that aquagym represents an effective, accessible, and adaptable exercise method for improving body composition and metabolic health in adult and middle-aged women.

Keywords: aquagym; body composition; bioelectrical impedance; women; aquatic exercise; metabolic health; physical activity; body mass index; aquatic therapy

1. Introduction

In recent decades, lifestyle changes have led to a significant increase in the prevalence of overweight and obesity, both of which are associated with numerous metabolic, cardiovascular, and functional disorders. According to the World Health Organization, the prevalence of overweight and obesity continues to rise globally. In Romania, excess body weight represents a significant public health concern, affecting a considerable proportion of the adult population, particularly middle-aged women,

thereby underscoring the need for the implementation of effective physical activity interventions. In adult and middle-aged women, excessive adipose tissue accumulation and reduced levels of physical activity negatively influence body composition, functional capacity, and overall health status. Body composition represents an important indicator of health status and metabolic risk [1]. Overweight and obesity are major public health concerns, while physical activity is considered essential for optimizing body composition [2,3]. Physical exercises performed in water have a low impact on the joints and are recommended for overweight and obese individuals [4]. Aquafitness contributes to improving physical fitness and increasing energy expenditure [5,6]. Moreover, Aqua Power aerobics may support body mass reduction and improve cardiopulmonary fitness in middle-aged women [7]. Recent studies have highlighted the beneficial effects of aquatic exercise on body composition and functional parameters. The study conducted by the authors in [8] reported improvements in physical fitness and body composition, while study [9] observed increases in muscular strength and optimization of body composition in overweight women. Study [10] demonstrated that aquatic exercises improve functional fitness in elderly women. Regular physical exercise has beneficial effects on body composition and functional capacity [11], while systematic physical activity may prevent unfavorable body changes [12]. Water-based exercises may also contribute to improving body composition in certain clinical conditions [13]. In postmenopausal women, visceral adipose tissue accumulation is associated with increased metabolic risks [14]. Fitness programs should be planned according to age, sex, body composition, and functional status [15]. Study [16] highlighted the effectiveness of differentiated aquafitness programs on women's body type, while study [17] emphasized the importance of individualized health programs for women. Physical exercise is recommended as a prophylactic and non-pharmacological method for maintaining health and improving functional parameters [18]. At the same time, nutritional factors may influence the body's metabolic and inflammatory responses [19]. Considering the limited evidence regarding the influence of aquagym programs on body composition assessed by bioelectrical impedance analysis (BIA), the aim of the present study was to investigate the effects of a 12-week aquagym intervention on body composition parameters and metabolic status among women aged 40 to 60 years.

2. Materials and Methods

The aim of the research is to highlight the influence of aquagym programs on body composition parameters assessed through bioelectrical impedance in women aged between 40 and 60 years, as well as to analyze the changes occurring in body weight and metabolic status following participation in a physical exercise program conducted in the aquatic environment.

Research hypothesis: It is assumed that the implementation of a 12-week aquagym program, with a frequency of two sessions per week, leads to improvements in body composition parameters in women aged between 40 and 60 years by reducing fat mass, visceral fat, and BMI values, while simultaneously increasing muscle mass and fat-free mass.

Research objectives: To evaluate body composition parameters in women participating in the aquagym program using the Tanita MC-780MA-N bioelectrical impedance analyzer; To determine changes in body mass index (BMI) following the implementation of the aquagym program; To analyze variations in fat mass and visceral fat after the aquatic intervention; To highlight changes in muscle mass and fat-free mass after the 12-week training period; To analyze changes in the ECW/TBW ratio and metabolic age following participation in the aquagym program; To statistically interpret

the obtained results using mathematical-statistical methods Data were processed using Microsoft Excel. Descriptive statistics included mean, standard deviation, median, quartiles, and coefficient of variation. Inferential analysis was performed using the paired samples t-test. Statistical significance was set at $p < 0.05$. Effect size was calculated using Cohen's d for paired samples; To highlight the effectiveness of physical exercise performed in the aquatic environment on optimizing body composition and metabolic status in adult and middle-aged women.

The aquagym program was conducted over a period of 12 weeks, with a frequency of two sessions per week and a duration of approximately 50-60 minutes per session. The activity was carried out within the Swimming and Kinesiotherapy Complex, and the program continues after the completion of the research period.

Body composition assessment was performed through bioelectrical impedance using the Tanita MC-780MA-N analyzer. Testing was conducted before and after the intervention period, monitoring parameters such as BMI, fat mass, fat-free mass, muscle mass, visceral fat, ECW/TBW ratio, and metabolic age. The study included 25 women aged between 40 and 60 years. Study Design and Participants: The study employed an experimental pretest–posttest design without a control group. Given the exploratory nature of the study and the availability of participants enrolled in the aquagym program, a convenience sample consisting of 25 women aged 40 to 60 years was recruited. No a priori sample size calculation was performed, and this limitation was taken into consideration when interpreting the study findings.

Inclusion criteria: The study included women aged between 40 and 60 years who participated in the aquagym program and completed both the initial and final assessments using the Tanita MC-780MA-N analyzer. All participants were informed about the purpose of the research and signed an informed consent form.

Exclusion Criteria: Participants were excluded from the study if they did not regularly attend the aquagym program, failed to complete both the baseline and post-intervention assessments, or did not provide informed consent for the use of their data for scientific purposes. Additionally, individuals with severe cardiovascular disease, uncontrolled hypertension, recent surgical interventions, acute musculoskeletal conditions, or other medical contraindications that could have limited their safe participation in aquatic exercise were excluded.

Research methods: The following research methods were used in the study: literature review, observation method, experimental method, testing method, and mathematical-statistical method. The experimental method consisted of implementing the aquagym program over a period of 12 weeks. The initial and final assessments were performed before the aquagym session. The testing method was used to assess body composition parameters through bioelectrical impedance, while the mathematical-statistical method allowed the processing and interpretation of the obtained data.

Program duration: Duration: 3 months, Frequency: 2 sessions/week, Total sessions: 24

Session duration: 50–60 minutes

Intensity: moderate (60–75% HRmax)

Perceived exertion: 5–7/10

Objectives of the aquagym program: Reduction of fat mass; Reduction of visceral fat; Increase in muscle mass; Improvement of body composition; Optimization of cardiometabolic capacity; Improvement of mobility and muscle tone.

Table 4 Structure of an aquagym session

Part	Duration	Content
Warm-up	10 min	walking in water, joint mobility exercises, breathing exercises
Main part	35–40 min	cardio exercises, toning exercises, water resistance exercises

Part	Duration	Content
Cool-down	5–10 min	stretching, relaxation, breathing exercises

Table 5 Weekly program

Day	Session Type	Main Objective
Tuesday	Cardio-metabolic aquagym	caloric expenditure and endurance
Thursday	Muscle toning aquagym	muscle tone and body composition

Example Session -Cardio-Metabolic Aquagym
Warm-up -10 minutes

Forward and backward walking through water, light jogging in water, arm rotations, hip and knee mobilization, breathing exercises.

Main Part - 35 minutes
Circuit 1 - Cardio activation
3 sets × 45 seconds / 15 seconds rest: water jumping jacks, high-knee running, ski jumps, alternating front kicks, lateral leg swings
Circuit 2 - Lower limb toning
3 sets: squats in water, lunges, calf raises, hip extensions, lower limb abductions
Circuit 3 - Core and trunk
3 sets: water twisting, alternating knee raises, noodle exercises, pool-edge push-ups, postural stabilization exercises
Cool-down - 5-10 minutes
Slow walking, lower limb stretching, breathing exercises, active relaxation.
Example Session - Muscle Toning
Materials Used: sticks, aquatic dumbbells, swimming floats.
Lower limbs: front kicks, lateral kicks, squats, dynamic lunges.
Upper limbs: water pushing exercises, resistance pulling exercises, arm flexion and extension exercises.
Core area: water crunches, trunk rotations, balance exercises.

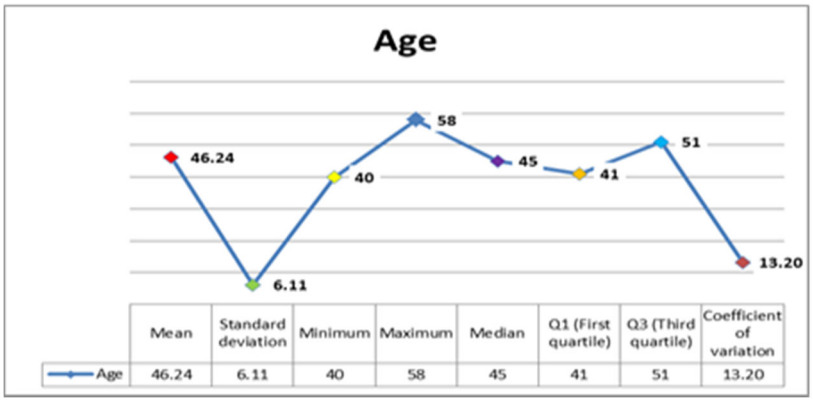
Table 6 Program Progression

Period	Characteristics
Weeks 1–4	adaptation and low intensity
Weeks 5–8	increased duration and complexity
Weeks 9–12	moderate-to-high intensity and functional circuits

3. Results

Descriptive Statistical Analysis of Body Composition Parameters

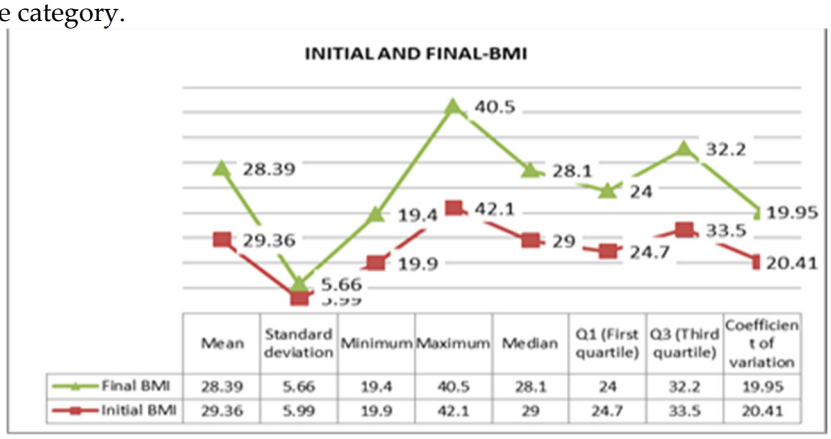
Descriptive statistical indicators of anthropometric and body composition parameters assessed through bioelectrical impedance will be presented before and after the implementation of the aquagym program conducted over a period of 3 months, with a frequency of two sessions per week. The results will also be illustrated through graphical diagrams in order to highlight the changes observed following participation in the aquagym program.



	Mean	Standard deviation	Minimum	Maximum	Median	Q1 (First quartile)	Q3 (Third quartile)	Coefficient of variation
Age	46.24	6.11	40	58	45	41	51	13.20

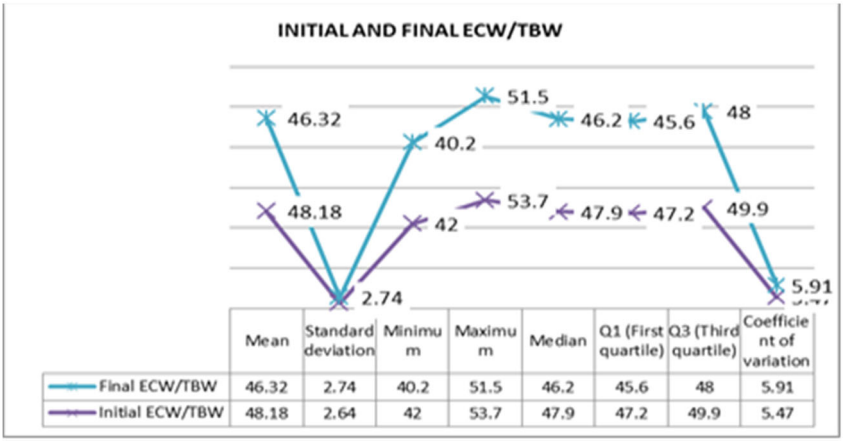
Figure 1. Descriptive statistical indicators of participants' age

The participants' mean age was 46.24 ± 6.11 years, with values ranging between 40 and 58 years, indicating a relatively homogeneous group in terms of the investigated age category.



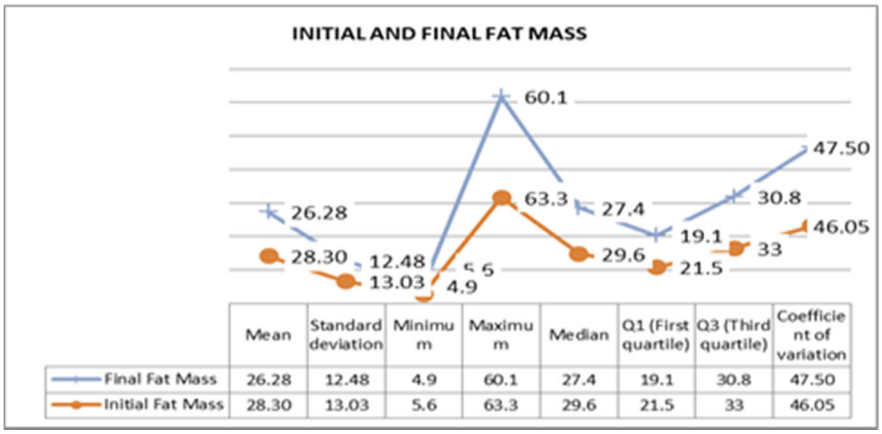
	Mean	Standard deviation	Minimum	Maximum	Median	Q1 (First quartile)	Q3 (Third quartile)	Coefficient of variation
Final BMI	28.39	5.66	19.4	40.5	28.1	24	32.2	19.95
Initial BMI	29.36	5.99	19.9	42.1	29	24.7	33.5	20.41

Figure 2. Descriptive statistical indicators of initial and final BMISignificant differences were identified between the initial and final evaluations ($p < 0.05$). Regarding body mass index (BMI), a reduction in the mean value was observed from 29.36 ± 5.99 kg/m² to 28.39 ± 5.66 kg/m² following the intervention program. Median values decreased from 29 to 28.1, while the interquartile range indicated a shift in the distribution toward lower BMI values. The coefficient of variation showed a slight decrease (20.41%–19.95%), suggesting a moderate homogenization of the group after the aquagym program.



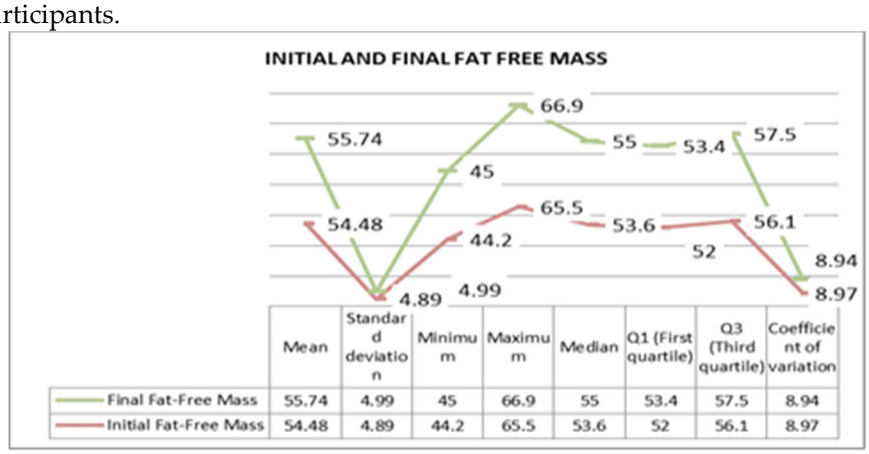
	Mean	Standard deviation	Minimum	Maximum	Median	Q1 (First quartile)	Q3 (Third quartile)	Coefficient of variation
Final ECW/TBW	46.32	2.74	40.2	51.5	46.2	45.6	48	5.91
Initial ECW/TBW	48.18	2.64	42	53.7	47.9	47.2	49.9	5.47

Figure 3. Descriptive statistical indicators of initial and final ECW/TBW. Significant differences were identified between the initial and final evaluations ($p < 0.05$). The ECW/TBW ratio showed a decrease in the mean value from 48.18 ± 2.64 to 46.32 ± 2.74, indicating an improvement in fluid balance and body fluid distribution. The low variability of these values (CV < 6%) demonstrates a relatively uniform response of the participants to the intervention.



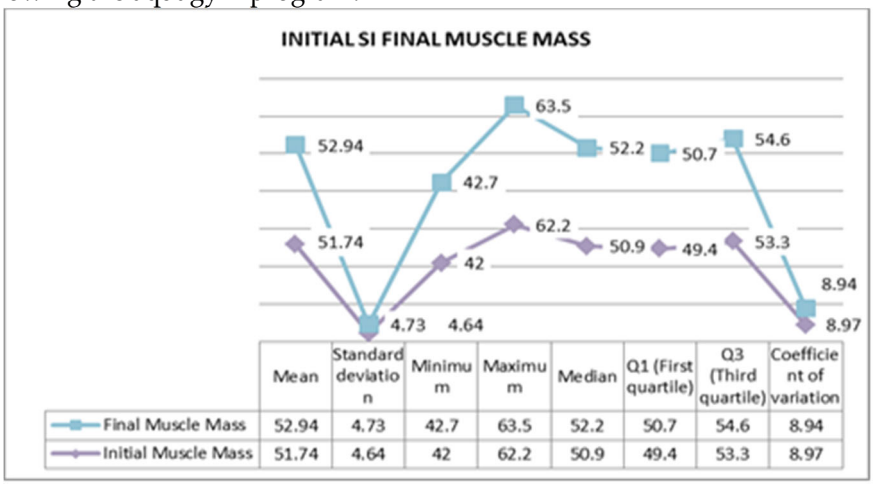
	Mean	Standard deviation	Minimum	Maximum	Median	Q1 (First quartile)	Q3 (Third quartile)	Coefficient of variation
Final Fat Mass	26.28	12.48	4.9	60.1	27.4	19.1	30.8	47.50
Initial Fat Mass	28.30	13.03	5.6	63.3	29.6	21.5	33	46.05

Figure 4. Descriptive statistical indicators of initial and final fat mass. Significant differences were identified between the initial and final evaluations ($p < 0.05$). Fat mass showed one of the most evident changes, with the mean value decreasing from 28.30 ± 13.03 kg to 26.28 ± 12.48 kg. In addition, median values decreased from 29.6 kg to 27.4 kg, suggesting a favorable effect of aquatic exercise on adipose tissue reduction. However, the high coefficient of variation (>45%) reflects important individual differences among the participants.



	Mean	Standard deviation	Minimum	Maximum	Median	Q1 (First quartile)	Q3 (Third quartile)	Coefficient of variation
Final Fat-Free Mass	55.74	4.99	45	66.9	55	53.4	57.5	8.94
Initial Fat-Free Mass	54.48	4.89	44.2	65.5	53.6	52	56.1	8.97

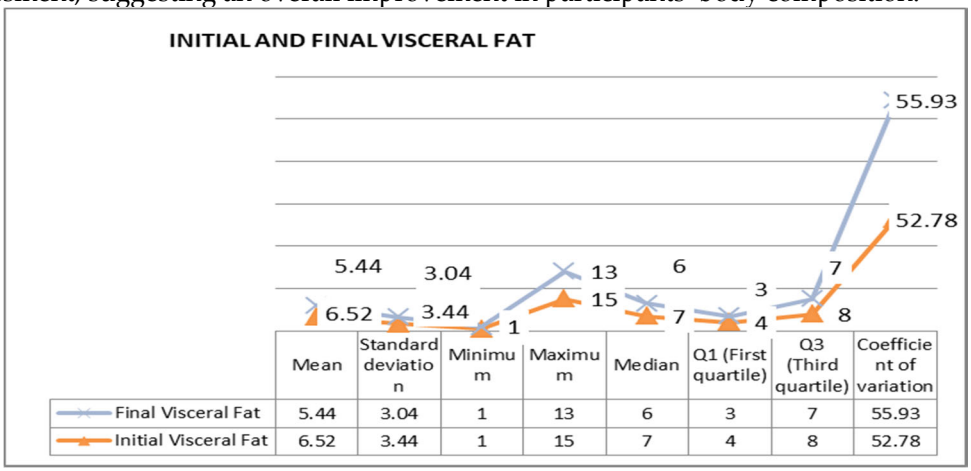
Figure 5. Descriptive statistical indicators of initial and final fat-free mass. Significant differences were identified between the initial and final evaluations ($p < 0.05$). At the same time, fat-free mass increased from 54.48 ± 4.89 kg to 55.74 ± 4.99 kg, while muscle mass increased from 51.74 ± 4.64 kg to 52.94 ± 4.73 kg. These changes indicate positive physiological adaptations and a possible improvement in muscle tone and body composition following the aquagym program.



	Mean	Standard deviation	Minimum	Maximum	Median	Q1 (First quartile)	Q3 (Third quartile)	Coefficient of variation
Final Muscle Mass	52.94	4.73	42.7	63.5	52.2	50.7	54.6	8.94
Initial Muscle Mass	51.74	4.64	42	62.2	50.9	49.4	53.3	8.97

Figure 6. Descriptive statistical indicators of initial and final muscle mass. Significant differences were identified between the initial and final evaluations ($p < 0.05$). Muscle mass in-

creased from a mean value of 51.74 ± 4.64 kg to 52.94 ± 4.73 kg, highlighting the favorable effects of the aquagym program on the development and maintenance of muscle mass. In addition, median and quartile values showed slight increases at the final assessment, suggesting an overall improvement in participants' body composition.



	Mean	Standard deviation	Minimum	Maximum	Median	Q1 (First quartile)	Q3 (Third quartile)	Coefficient of variation
Final Visceral Fat	5.44	3.04	1	13	6	3	7	55.93
Initial Visceral Fat	6.52	3.44	1	15	7	4	8	52.78

Figure 7. Descriptive statistical indicators of initial and final visceral fat. Significant differences were identified between the initial and final evaluations (p < 0.05). Visceral fat decreased from a mean value of 6.52 ± 3.44 to 5.44 ± 3.04, suggesting a reduction in the metabolic risk associated with excess abdominal adiposity. At the same time, metabolic age decreased from 44.60 ± 12.13 years to 41.60 ± 11.55 years, indicating an improvement in the participants' overall metabolic status.

The analysis of medians and quartiles (Q1 and Q3) confirms the general trend toward improvement in body composition parameters following the aquagym program. The reduction in BMI, fat mass, visceral fat, and metabolic age values, together with the increase in muscle mass and fat-free mass, highlights the beneficial effects of physical exercise performed in the aquatic environment on the body and metabolic health of women aged between 40 and 60 years.

For the inferential statistical analysis, in order to evaluate the effectiveness of the aquagym program on body composition parameters, the paired samples t-test was used, comparing the participants' initial and final values. The level of statistical significance was set at $p < 0.05$. The results revealed statistically significant differences for all analyzed parameters, confirming the effectiveness of the intervention conducted over the 3-month aquatic training period.

Body mass index (BMI) showed a statistically significant reduction ($t = 14.13$; $p < 0.05$), indicating a favorable effect of the program on the participants' weight status. The decrease in BMI values suggests a reduction in excess body weight and an improvement in overall body profile.

Fat mass also showed statistically significant differences between the initial and final assessments ($t = 15.88$; $p < 0.05$). These findings demonstrate the effectiveness of aquatic exercise in reducing adipose tissue, an important aspect for metabolic and cardiovascular health.

Regarding muscle mass, statistical analysis revealed a statistically significant increase ($t = -23.53$; $p < 0.05$). The high t-test values indicate a pronounced effect of the program on the development and maintenance of muscle mass, suggesting favorable physiological adaptations induced by physical exercise performed in the aquatic environment. The ECW/TBW ratio showed statistically significant differences ($t = 6.33$; $p < 0.05$), indicating an improvement in body water distribution and fluid balance following participation in the aquagym program. Fat-free mass recorded one of the highest statistical test values ($t = -23.26$; $p < 0.05$), highlighting a significant increase in metabolically and functionally active body components.

In the case of visceral fat, the observed reduction was statistically significant ($t = 10.94$; $p < 0.05$), suggesting a decrease in cardio-metabolic risk associated with abdominal adipose tissue accumulation. Metabolic age also showed statistically significant changes ($t = 23.23$; $p < 0.05$), with the results indicating a substantial improvement in the participants' metabolic status following the aquatic exercise intervention.

The inferential analysis confirms that the aquagym program produced significant beneficial effects on body composition, metabolic parameters, and the functional profile of the participating women, demonstrating the usefulness of aquatic physical exercise for optimizing body health in the 40–60 years age category.

Table 1. Cohen's d for the calculated differences

Parameter	Mean Difference	SD of Differences	Cohen's d
BMI	0.97	0.34	2.85
Fat mass	2.02	0.64	3.16
Muscle mass	1.20	0.22	5.45
ECW/TBW	1.80	1.58	1.14
Fat-free mass	1.26	0.25	5.04
Visceral fat	1.08	0.57	1.89
Metabolic age	2.96	0.68	4.35

Table 1 presents the analysis of effect size using Cohen's d coefficient highlights the impact of the aquagym program on body composition and metabolic parameters in the participants included in the study. The obtained values indicate large and very large effects for all analyzed variables, suggesting the effectiveness of the intervention carried out over the 12-week period.

In the case of body mass index (BMI), the Cohen's d value of 2.85 indicates a very large effect associated with the reduction in BMI values following participation in the aquagym program. This result suggests an improvement in weight status and a reduction in excess body weight.

Fat mass also showed a very large effect ($d = 3.16$), highlighting the effectiveness of physical exercise performed in the aquatic environment in reducing adipose tissue and optimizing body composition.

Regarding muscle mass, the Cohen's d value of 5.45 indicated the largest effect among the analyzed parameters, suggesting important physiological adaptations and improvements in muscle mass following participation in the aquagym program.

The ECW/TBW ratio recorded a large effect ($d = 1.14$), reflecting improvements in fluid balance and body water distribution after the aquatic intervention.

Fat-free mass showed a very large effect ($d = 5.04$), confirming the development of metabolically active body components and the improvement of the participants' functional profile.

In terms of visceral fat, the value of $d = 1.89$ indicates a very large effect associated with the reduction of cardio-metabolic risk and the decrease in abdominal adipose tissue accumulation.

Metabolic age also recorded a very large effect ($d = 4.35$), suggesting improvements in overall metabolic status and increased functional efficiency of the body following participation in the program.

Overall, the effect size analysis confirms that the aquagym program had a significant impact on body composition and metabolic parameters, with the most evident changes observed in muscle mass, fat-free mass, and metabolic age.

Table 2 Analysis of the distribution of participants by BMI categories

Category	Number of Participants
Normal	7
Overweight	7

Category	Number of Participants
Obesity Grade I	8
Obesity Grade II	1
Obesity Grade III	2

The classification of participants according to body mass index (BMI) was performed based on the World Health Organization criteria. The distribution analysis revealed that most participants were classified within categories associated with excess body weight and obesity. Of the total number of participants, 7 women were classified as normal weight, 7 as overweight, 8 as obesity grade I, 1 participant as obesity grade II, and 2 participants as obesity grade III.

These results highlight the predominance of excess body weight within the analyzed group, justifying the need for implementing physical exercise programs aimed at optimizing body composition and reducing metabolic risk.

Table 3 Mean BMI reduction according to BMI categories

Category	Mean BMI Reduction
Normal	0.54
Overweight	0.91
Obesity Grade I	1.19
Obesity Grade II	1.3
Obesity Grade III	1.6

The analysis of the response to the aquagym program revealed differences between categories regarding the mean reduction in BMI values. Normal-weight participants showed the smallest BMI change (ΔBMI = 0.54), suggesting the maintenance of a relatively stable body weight status within normal physiological limits. In the overweight category, the mean BMI reduction was 0.91 units, indicating a favorable response to the aquatic exercise intervention.

Participants classified as having Class I obesity exhibited a more pronounced reduction in body mass index (ΔBMI = 1.19 kg/m^2). The participant classified as having Class II obesity demonstrated a BMI reduction of 1.3 kg/m^2, whereas participants with Class III obesity showed a mean reduction of 1.6 kg/m^2. These findings suggest a trend toward greater BMI reduction among participants with higher baseline BMI values. However, the small number of participants included in the Class II and Class III obesity categories should be taken into consideration when interpreting these results. The obtained results suggest the existence of a direct relationship between the initial BMI value and the magnitude of the response to the aquagym program. The higher the level of excess body weight at the initial assessment, the more pronounced the changes induced by the aquatic intervention.

From a physiological perspective, these results may be explained by the increased energy expenditure associated with physical exercise performed in the aquatic environment, the reduction of joint impact, and the possibility of performing exercises with greater duration and intensity in overweight and obese individuals. In addition, water resistance promotes increased caloric expenditure and muscle mass stimulation, contributing to adipose tissue reduction and body composition optimization.

The BMI category analysis confirms that the aquagym program had a more pronounced impact on participants with higher grades of obesity, highlighting the usefulness of aquatic exercise as an effective intervention method for managing excess body weight and improving metabolic parameters in adult and middle-aged women.

4. Discussion

The findings of the present study confirm the effectiveness of aquatic exercise on body composition parameters and metabolic status in adult and middle-aged women.

Similar results have been reported following land-based aerobic exercise programs and resistance training interventions. However, aquatic exercise offers additional advantages, including reduced joint loading, enhanced comfort during physical activity, and improved adherence to exercise programs, particularly among overweight and obese individuals.

The results obtained are consistent with those reported by Kantyka et al. [20], who demonstrated improvements in body weight, fat-free mass, and muscle mass following an aqua aerobics program in sedentary women. Similarly, Tsourlou et al. [21] showed that aquatic training contributes to increases in muscle strength and lean body mass in older women, findings that were also observed in the present study. Furthermore, Pirohova et al. [16] reported reductions in fat mass and favorable effects on body composition among obese women participating in water-based exercise programs.

Collectively, these findings indicate that aquagym programs represent an effective, accessible, and adaptable intervention for optimizing body composition and improving functional and metabolic status in adult and middle-aged women.

With regard to metabolic age, the results demonstrated a statistically significant reduction following the implementation of the aquagym program. However, this parameter is estimated using proprietary algorithms incorporated into the Tanita bioelectrical impedance analyzer and does not constitute a direct physiological measurement. Consequently, the observed changes are more likely to reflect improvements in overall metabolic status and body composition rather than an actual reduction in biological age.

These findings further support the beneficial effects of aquatic exercise on the metabolic and functional profile of women aged 40 to 60 years.

5. Conclusions

The research findings highlight that the aquagym program conducted over a period of 12 weeks, with a frequency of two sessions per week, produced favorable changes in body composition and metabolic parameters in women aged between 40 and 60 years. Descriptive statistical analysis revealed trends toward reductions in body mass index, fat mass, and visceral fat, together with improvements in parameters associated with muscle mass and fat-free mass. These changes suggest the optimization of body composition and the improvement of the participants' functional status. Inferential analysis demonstrated the existence of statistically significant differences between the initial and final assessments for the investigated parameters, confirming the effectiveness of the physical exercise program performed in the aquatic environment. The evaluation of effect size using Cohen's d coefficient highlighted large and very large effects for most of the analyzed variables, indicating the substantial magnitude of the changes produced following the intervention. The classification of participants according to BMI categories showed that the most evident improvements were observed in individuals classified as overweight and obese, suggesting that the effects of the aquagym program are more pronounced in participants with higher levels of excess body weight. The reduction in visceral fat and the improvement in metabolic parameters confirm the positive impact of aquatic exercise on cardio-metabolic health and quality of life. The obtained results confirm the research hypothesis and highlight that aquagym represents an effective, accessible, and adaptable method for optimizing body composition and improving metabolic status in adult and middle-aged women. From a practical perspective, aquagym programs may be recommended as a safe, accessible, and effective strategy for optimizing body composition and reducing cardiometabolic risk among women aged 40 to 60 years. Furthermore, the aquatic environ-

ment facilitates physical exercise by reducing joint loading, enhancing movement comfort, and promoting consistent participation in physical activity, all of which are important for maintaining an active and healthy lifestyle over the long term.

One limitation of the present study is the absence of a control group, which restricts the ability to attribute all observed changes exclusively to the aquagym intervention. In addition, the relatively small sample size and the limited duration of the intervention represent further limitations that should be considered when interpreting the findings. Future research should include larger sample sizes, control groups, and longer intervention periods, as well as comparisons between aquatic exercise and other forms of physical activity.

Overall, the findings of the present study support the role of aquagym as a beneficial exercise modality for improving body composition and metabolic health in adult and middle-aged women, while highlighting the need for further research to confirm and extend these results.

Author Contributions: The following statements should be used "Conceptualization, V.L.E. and S.C.S; methodology, C.A.I.; software, C.A.I.; validation, V.L.E., S.C.S. and C.A.I.; formal analysis, V.L.E.; investigation, V.L.E.; resources, C.A.I.; data curation, S.C.S.; writing—original draft preparation, V.L.E.; writing—review and editing, V.L.E.; visualization, S.C.S and C.A.I.; supervision, V.L.E.; project administration, V.L.E.; funding acquisition, C.A.I. All authors have read and agreed to the published version of the manuscript."

Funding: This research received no external funding

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Commission of "Ștefan cel Mare" University of Suceava (No. 177/05.11.2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest.

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