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EFFECTS OF SWIMMING ON THE MORPHOFUNCTIONAL DEVELOPMENT OF YOUNG ADULTS AGED 20 TO 30 YEARS

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ABSTRACT. Swimming is considered one of the most complex physical activities due to the involvement of multiple muscle groups and the support it provides for cardiovascular health. Regular practice of swimming represents an effective means of improving the morpho functional capacity of young adults. Objective: The study aimed to investigate the effects of regular swimming on the development of morpho functional capacities in young adults aged between 20 and 30 years. It sought to determine the extent to which swimming contributes to the optimization of physical performance and health indicators. Materials and Methods: The study was conducted at the Swimming and Kinetotherapy Complex, where a group of participants within the specified age range was selected. They were monitored throughout a structured swimming program conducted over a period of twelve weeks. Initial and final assessments included measurements of body composition using the "Tanita" device, as well as functional capacity tests performed before and after the experimental program. Results: The results highlighted significant improvements in body composition, with a decrease in body fat percentage and an increase in lean muscle mass. Cardiovascular endurance also showed measurable progress. Discussion: The findings of this study are consistent with previous research emphasizing the beneficial effects of swimming on morpho functional development, confirming that regular practice generates both structural and functional adaptations. Conclusions: Swimming represents an effective strategy for improving morpho functional development in young adults aged between 20 and 30 years.

Keywords: effects, swimming, morpho functional development, young people

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INTRODUCTION

Swimming represents a complex form of physical activity that engages both the cardiovascular and muscular systems, exerting beneficial effects on the physical and psycho-emotional well-being of young adults. Studies show that regular swimming contributes to improved body composition, increased muscle mass, reduced body fat, posture correction, and the harmonious development of the body. Important parameters influencing these effects include the duration, frequency, and intensity of training, water temperature, and any dietary restrictions. Moreover, swimming promotes flexibility, muscle tone, and physical work capacity, while also having positive effects on mental health by reducing stress and anxiety. Few studies have analyzed the effects of swimming on the morpho functional development of young adults aged between 20 and 30 years. The study by (Răzvan et al., 2019) shows that sports contribute to the optimization of somatic parameters, such as blood circulation, heart rate, hormonal balance, and muscle tone, while also having positive effects on self-esteem and the perception of one's body image. Similarly, the study by (Grishko et al., 2021) demonstrates that students who engage in regular physical exercise maintain physical development indicators within normal limits and achieve a better psychological and motivational state for physical activity.

Another study (Mozolev et al., 2021) highlights the importance of maintaining adult women's health, especially during maturity, when motor activity decreases and stress increases, while (Vysotskaya et al., 2020) emphasize the importance of women's health for their social and productive functions. According to the authors (Dakal & Kachalov, 2024; Zhou et al., 2020), swimming represents a unique form of physical exercise, accessible to all ages and effective for overall health and physical development. Research conducted by (Zrnić et al., 2022) confirms that a sedentary lifestyle negatively affects health, while (Czajka & Sławińska, 2011) emphasize that somatic structure and physical condition undergo continuous changes throughout life, influenced by genetic and environmental factors. In this context, the (WHO, 2020) recommends limiting sedentary behavior and replacing it with physical activity of any intensity, including light activity, to prevent health problems. Research by (Cioroiu & Moldovan, 2009) shows that swimming not only maintains physical condition but also ensures harmonious development, relaxes muscle groups, and improves circulation and posture through the combination of static and dynamic exercises. Other research (Folsom et al., 1993) highlights that the waist-to-hip ratio is a better marker than body mass index for estimating the risk of mortality in older women, recommending its measurement in health monitoring. Additionally, studies by (Lampadari et al., 2015) emphasize that a sedentary lifestyle is part of the daily routine for most people, promoting the development of overweight and obesity, and that adults need regular physical activity to lose and maintain weight. Swimming or other water-based exercises are among the most popular forms of physical activity, providing benefits for both physical and mental health.

MATERIAL AND METHODS

Objective of the study: The study aimed to investigate the effects of regular swimming on the development of morpho functional capacities in young adults aged between 20 and 30 years, focusing on the extent to which this activity contributes to the optimization of physical performance and health indicators. Research methods: The methods used included analysis of the specialized literature, observation, experimental method, physical testing, mathematical-statistical analysis (mean, standard deviation, and coefficient of variation), and tabular-graphical representation of the data.

Participants

The study included 26 women aged between 20 and 30 years. Initial and final assessments were conducted using the Tanita device at the Swimming and Kinesiotherapy Complex. Prior to participation, all subjects provided informed consent and were clearly informed about the purpose of the study, the procedures applied, as well as potential risks and benefits. Participants were also assured that they could withdraw at any time without experiencing any negative consequences.

Procedure

Participants were selected according to the inclusion criteria: women aged between 20 and 30 years, without cardiovascular conditions or other health issues that could prevent participation in the swimming program, with consistent attendance at swimming lessons, and possessing basic swimming skills. The study, focused on the effects of swimming on morpho functional development, was conducted at the Swimming and Kinetotherapy Complex, where participants followed a structured swimming program over a period of 12 weeks. Before the start of the program, initial assessments were conducted, including body composition measurements (BMI, fat mass, muscle mass, bone mass, visceral fat, ECW, ICW, chronological age, and metabolic age) using the Tanita analyzer; Functional capacity tests (cardiovascular endurance, flexibility, and muscle strength). The swimming program was conducted three or four times per week, with sessions lasting 40–50 minutes, adapted to the stages and intensity of training. At the end of the 12 weeks, final assessments identical to the initial ones were performed to determine changes in body composition, functional capacity, and physical performance. All data were collected and analyzed in accordance with ethical principles and standard scientific methods.

Materials

The following materials and equipment were used for the study: Swimming pool located within the Swimming and Kinetotherapy Complex, measuring 25 m in length, with a depth of 1.35 m in the platform area (over approximately 8 m) and a maximum depth of 2.5 m in the rest of the pool. It provides optimal conditions for conducting swimming exercises and lessons aimed at developing physical endurance.

Tanita body composition analyzer, used to determine total body mass and body composition components.

The 12-week swimming program for the participants included in the study will be presented in tables 1-3.

Table 1. Stage 1 – Weeks 1–4: Adaptation and Technique

Day	Warm-up	Main Exercises	Breaks	Core Strength Exercises	Breaks	Relaxation and Stretching
Monday	100 m swimming in preferred style	4×50 m freestyle/breaststroke /backstroke	30 sec	2×12 push-ups, 2×12 knee raises in water	30 sec	100 m relaxation swim + 5 min stretching
Wednesday	100 m swimming in preferred style	4×25 m breathing exercises + 4×25 m freestyle/back kicks with kickboard	20–30 sec	2×12 pull-ups on pool edge	30 sec	100 m relaxation swim + 5 min stretching
Friday	100–150 m swimming in preferred style	6×25 m freestyle, low intensity, focus on correct technique	20 sec	2×12 jumps in water	30 sec	100 m relaxation swim + 5 min stretching

Table 2. Stage 2 – Weeks 5–8: Endurance and Toning

Day	Warm-up	Main Exercises	Breaks	Strength and Core Exercises	Breaks	Relaxation and Stretching
Monday	200 m swimming in preferred style	6×50 m freestyle, medium intensity	30 sec	3×15 push-ups, 3×15 knee raises	30 sec	100 m relaxation swim + 5–10 min stretching
Wednesday	200 m swimming in preferred style	4×50 m breaststroke/ backstroke, alternating speed	30 sec	3×15 pull-ups on the pool edge ("wave breaker")	30 sec	100 m relaxation swim + 5–10 min stretching
Friday	200 m swimming in preferred style	4×25 m sprint freestyle kicks, breaststroke with kickboard	20 sec	2×12–15 balance and core exercises	30 sec	100 m relaxation swim + 5–10 min stretching
Saturday	150 m swimming in preferred style	4×50 m freestyle + 4×25 m breaststroke	30 sec	3×12 jumps and push-ups in water	30 sec	100 m relaxation swim + 5–10 min stretching

Table 3. Stage 3 – Weeks 9–12: Performance and Optimization

Day	Warm-up	Main Exercises	Breaks	Strength and Core Exercises	Breaks	Relaxation and Stretching
Monday	300 m swimming in preferred style	8×50 m freestyle, medium-high intensity	15–20 sec	3×15 push-ups, 3×15 pull-ups	20–30 sec	200 m relaxation swim + 10 min stretching
Wednesday	200 m swimming in preferred style	6×25 m sprint freestyle/ breaststroke/ backstroke, alternating strokes	20 sec	3×15 abs/back + swimming equipment (kickboards, tubes, etc.)	20–30 sec	200 m relaxation swim + 10 min stretching
Friday	300 m swimming in preferred style	4×50 m kicks with board + 4×50 m moderate freestyle	20–30 sec	3×15 core and balance exercises	20–30 sec	200 m relaxation swim + 10 min stretching
Saturday	200 m swimming in preferred style	8×25 m sprint + 4×50 m moderate freestyle	15–20 sec	3×15 push-ups + pull-ups	20–30 sec	200 m relaxation swim + 10 min stretch

RESULTS

The analysis of data obtained from the initial and final assessments allowed the identification of changes in body composition, metabolic age, and physical performance resulting from participation in the swimming program. The results are presented graphically, including mean values, standard deviations, and coefficients of variation for each analyzed indicator.

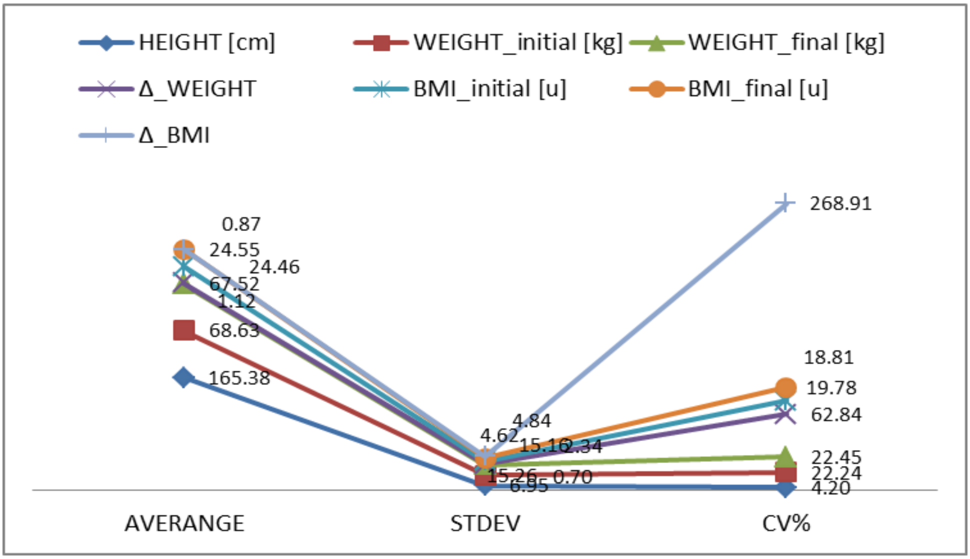

Fig. 1. Evolution of Participants' Weight and BMI

In (Figure 1), the average height of the participants can be observed, which is 165.38 cm, with a standard deviation of 6.95 cm, indicating a moderate variation among them. The coefficient of variation is 4.20%, suggesting that height is relatively homogeneous within the group. The initial weight shows a mean of 68.63 kg, while the final weight has a mean of 67.52 kg, indicating a decrease of 1.12 kg. The standard deviation for both initial and final weight is similar (approximately 15 kg), reflecting a high variability among participants. The coefficient of variation for weight is over 22%, suggesting that weight values are relatively dispersed within the group. Regarding the change in weight (Δ_Weight), it has a standard deviation of 0.70 kg and a CV% of 62.84%, indicating that weight loss or gain was very unevenly distributed among participants. For the Body Mass Index (BMI) test, the initial BMI has a mean of

24.46, while the final BMI has a mean of 24.55, resulting in an average increase of 0.87. The standard deviation for both initial and final BMI is approximately 4.6–4.8, indicating moderate variability among participants. The coefficient of variation for BMI is lower than for weight (approximately 19%), but for BMI variation (Δ_BMI), the CV% is very high at 268.91%, showing that changes in BMI were extremely uneven among participants.

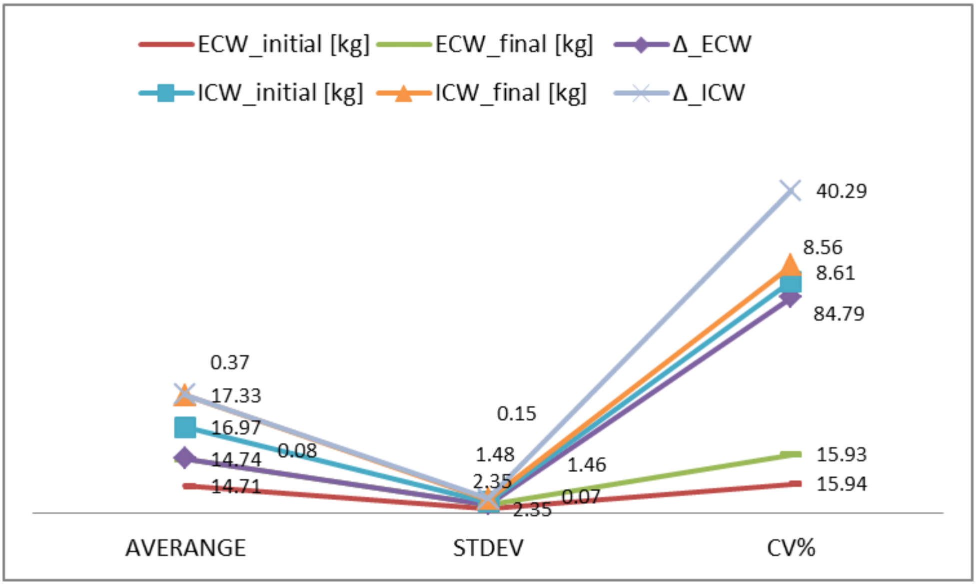

Fig. 2 Changes in Extracellular and Intracellular Body Water

In (Figure 2), the initial mean ECW is 14.71 kg, while the final mean ECW is 14.74 kg, indicating a very small average increase of 0.08 kg. The standard deviation is 2.35 kg for both initial and final ECW, reflecting moderate variability among participants. The coefficient of variation for ECW is approximately 16%, suggesting a moderate dispersion of values within the group. The ECW difference (D_ECW) has a very high CV% of 84.79%, indicating that individual changes were highly uneven: some participants experienced increases, others decreases, even though the mean change is nearly zero. Regarding ICW, the initial mean is 16.97 kg, and the final mean is 17.33 kg, resulting in an average increase of 0.37 kg.

The standard deviation for initial and final ICW is lower, at 1.46 kg-1.48 kg, showing less variability among participants compared to ECW. The CV% for initial and final ICW is approximately 8.6%, indicating greater uniformity of values. The ICW difference (D_ICW) has a CV% of 40.29%, showing that although the average increase is small, the variation between participants is quite significant.

In (Figure 3), the initial mean fat mass is 21.17 kg, while the final mean is 19.65 kg, indicating an average decrease of 1.52 kg. The standard deviation is relatively high, 9.78 kg initially and 9.27 kg finally, showing substantial variability among participants. The coefficient of variation for initial and final fat mass is high, 46–47%, confirming that fat mass values are widely dispersed among participants. The fat mass difference (Δ _Fat Mass) has a CV% of 60.75%, indicating that fat reduction was highly uneven among participants: some lost more fat, others less. Regarding muscle mass, the initial mean is 45.06 kg, and the final mean is 45.60 kg, resulting in an average increase of 0.54 kg. The standard deviation is lower, 5.76–5.81 kg compared to fat mass, indicating moderate variability among participants. The CV% for initial and final muscle mass is approximately 12–13%, suggesting greater uniformity of muscle mass among participants. The muscle mass change (Δ _Muscle Mass) has a high CV% of 71.89%, showing that although the average muscle gain is small, individual responses varied greatly among participants.

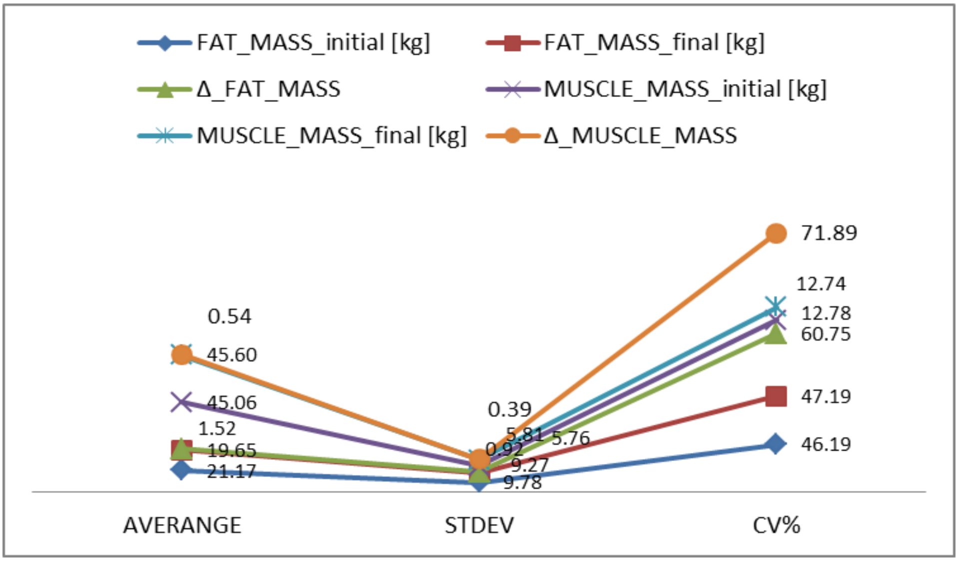

Fig. 3 Changes in Fat Mass and Muscle Mass

In (Figure 4), the mean initial and final bone mass is 2.41 kg, indicating an average change of 0 kg. The standard deviation is 0.29 kg, and the coefficient of variation is 12.07%, suggesting that bone mass values are relatively uniform among participants. Practically, bone mass did not undergo significant changes within the group, which is expected over a short period. Regarding visceral fat, the initial mean is 2.88, and the final mean is 2.08, resulting in an average decrease of 0.81 levels. The standard deviation for initial and final values is 2.10 and 1.44, respectively, and the CV% is very high at 72.67% and 69.25%, indicating a highly variable distribution among participants. The visceral fat change (Δ _Visceral Fat) has a CV% of 106.66%, showing that the reduction in visceral fat was extremely uneven among participants: some experienced large decreases, while others had smaller decreases or no change at all.

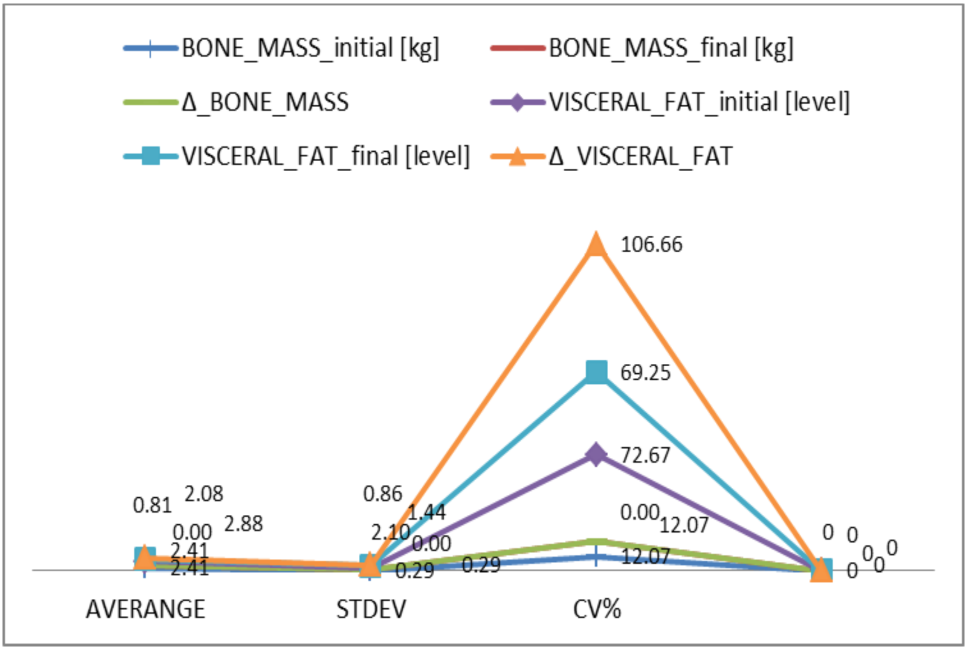

Fig. 4 Changes in Bone Mass and Visceral Fat

In Figure 5, the mean chronological age is 23.15 years, while the mean initial metabolic age is 25.27 years. This suggests that, at the beginning, the participants metabolism corresponded to that of a person approximately 2 years older than their actual age. This difference indicates a slightly slower metabolic rate or a suboptimal body composition, possibly due to higher fat mass or lower muscle mass. After the intervention, the mean metabolic age is 22.08 years, nearly 1 year younger than the chronological age. This indicates an improvement in metabolism, suggesting that the intervention (physical activity, nutrition, body composition) had a positive effect on overall health and metabolic efficiency. The average difference between initial and final metabolic age is 3.19 years, representing a significant reduction. Practically, the participants "rejuvenated" metabolically by more than 3 years on average, bringing their metabolism closer to or even below the level corresponding to their chronological age, even though some participants already had a metabolic age significantly lower than their chronological age.

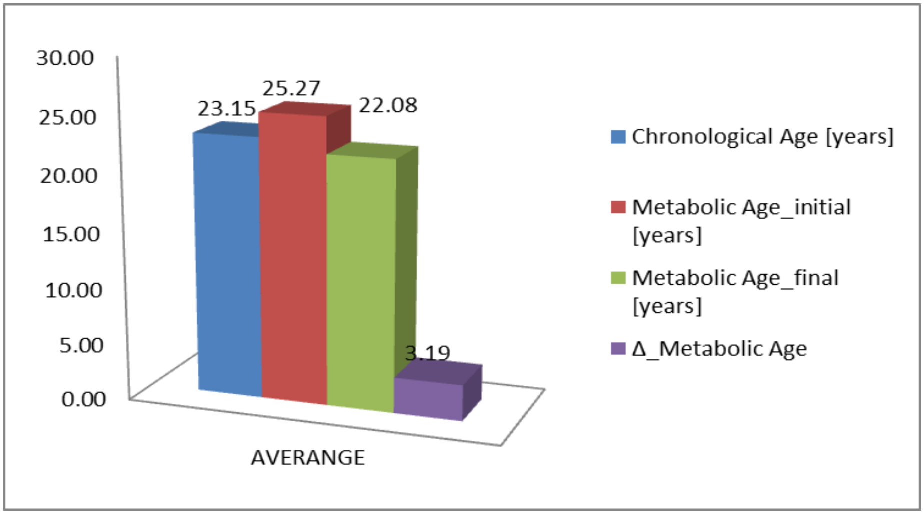

Fig. 5 Improvement of Metabolic Age in Relation to Chronological Age

In (Figure 6), the mean initial endurance is 154.23 m, while the final mean is 194.42 m, indicating an average increase of 40.19 m. The standard deviation for initial and final endurance is relatively small 9.78 m and 11.57 m, with a CV% of approximately 6%, showing that initial and final performances were relatively homogeneous among participants. The significant average increase indicates a clear improvement in swimming endurance. Regarding flexibility, the initial mean is 12.19 cm, and the final mean is 17.31 cm, resulting in an average increase of 5.12 cm. The standard deviation is small (approximately 1.5 cm) and CV% ranges between 8–13%, suggesting moderate variability among participants. The increase in flexibility demonstrates that the intervention had a positive effect on mobility and muscle stretching.

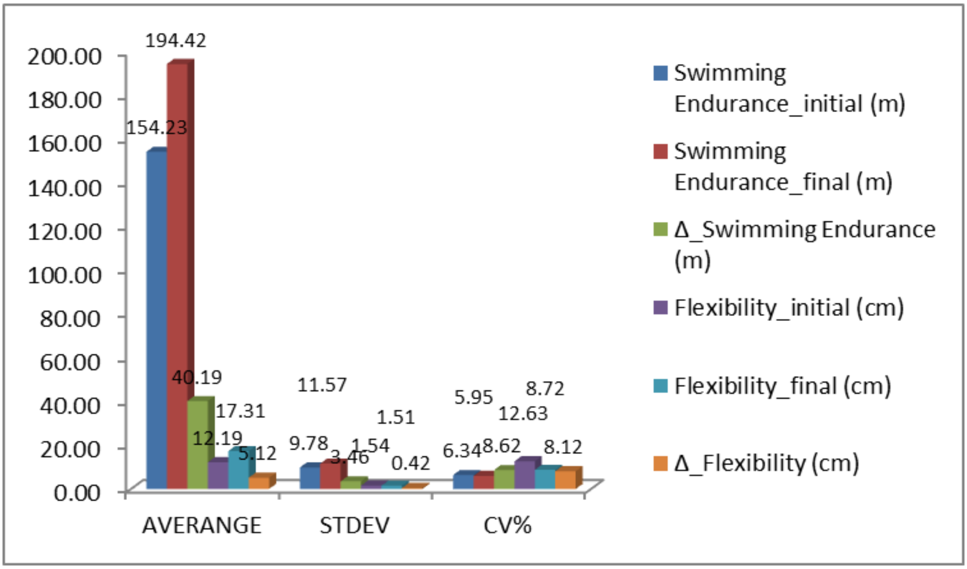

Fig. 6 Evolution of Physical Performance in Swimming and Flexibility

In (Figure 7), the mean initial strength is 18.31 repetitions, while the final mean is 24.81 repetitions, resulting in an average increase of 6.5 repetitions in 30 seconds. The standard deviation and CV% are relatively small, indicating that most participants experienced similar improvements in muscle strength.

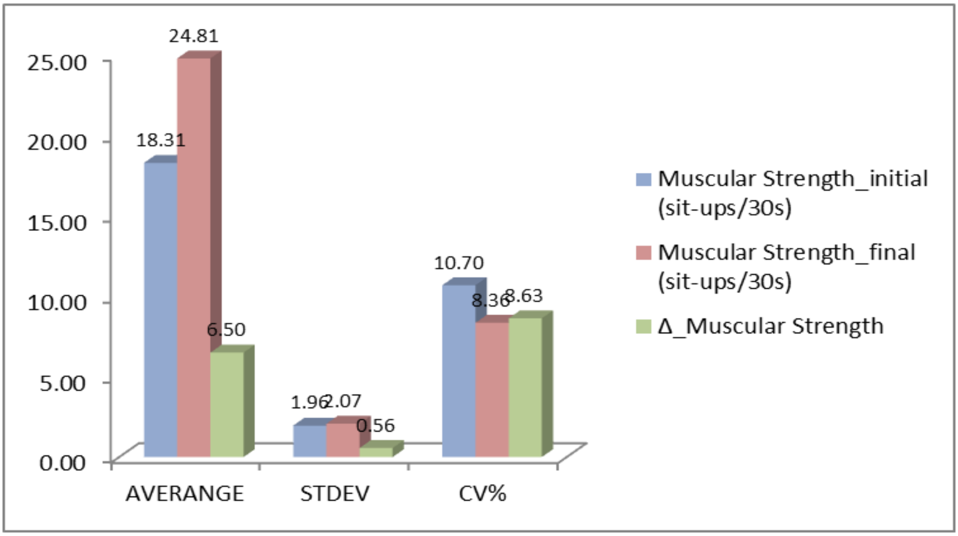

Fig. 7 Evolution of Participants' Abdominal Strength

DISCUSSION

The analyzed studies confirm the effectiveness of aquatic training on the physical and psycho-emotional condition of young adults. (Bondar et al., 2025) demonstrated that systematic swimming sessions improved work capacity (+4.9 units) and reduced stress levels (-3.4 points) in female students, without significantly affecting cardiovascular adaptive potential or body mass index. (Boltabayev et al., 2025) showed that swimming activities aimed at health promotion were more effective than running in improving physical fitness and work capacity in students (+2.9% vs. +2.4%). Another study by (Pirohova et al., 2021) highlighted the effectiveness of a differentiated approach in aqua fitness on women's body types, reducing class I and II obesity and increasing the proportion of those with normal weight (+13.37%). The authors (Rocha et al. 2007) confirmed that the Water Force program is effective in increasing the dynamics of maximal strength of the upper and lower limbs, showing significant differences between sexes ($p = 0.0360$). These results emphasize the benefits of aquatic training not only for improving physical performance but also for correcting body proportions and reducing stress, suggesting its applicability in various aquatic programs. The authors (Tuuri et al., 2002) found that swimming distance correlated with body fat (23%), waist circumference (26%), abdominal sagittal diameter (20%), and skinfolds (20–24%). Abdominal sagittal diameter was more strongly related to age ($R^2 = 0.29$) than swimming distance ($R^2 = 0.20$). Bone mineral content was negatively associated with age ($R^2 = 0.18$) and positively with swimming distance ($R^2 = 0.12$), while bone mineral density decreased with age ($R^2 = 0.12$).

CONCLUSIONS

The group showed small but positive changes in weight, BMI, ECW, and ICW, with significant individual variability, indicating that training responses differed among participants. Average reductions in fat mass and visceral fat were observed, along with slight increases in muscle mass, maintenance of bone mass, and a significant decrease in metabolic age, reflecting improvements in metabolic health and body composition. All assessed physical components swimming endurance, flexibility, and muscle strength improved significantly, with balanced progress, highlighting that swimming contributes to optimizing physical performance and functional capacity in young adults. Regular swimming proves to be a comprehensive activity that enhances both metabolic health and overall physical performance, supporting the balanced development of morpho functional capacities.

AUTHOR CONTRIBUTIONS

Slusar Adriana and Vizitiu Lakhdari Elena contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

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