

Effectiveness Of Chair Aerobics Vs Hydrotherapy on Functional Capacity in Middle-Aged Men

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ABSTRACT

Background: Functional capacity, which includes cardiovascular endurance, muscular strength, flexibility, and balance, is a crucial determinant of health and independence in aging populations. With increasing sedentary lifestyles and joint-related limitations, there is a growing need for accessible and joint-friendly exercise interventions.

AIM OF THE STUDY

To compare the effectiveness of chair aerobics and hydrotherapy in improving functional capacity—specifically cardiovascular endurance, muscular strength, flexibility, and balance—in middle-aged men over an eight-week intervention period.

NEED FOR THE STUDY

As the global population ages, maintaining functional independence is increasingly vital. Middle-aged men, particularly those leading sedentary lifestyles or dealing with musculoskeletal discomfort, are at risk of declining functional abilities. Conventional exercise routines may not be suitable for individuals with joint pain or reduced mobility. Hence, exploring alternative, low-impact exercise methods like chair aerobics and hydrotherapy is necessary to identify effective, scalable interventions. While both modalities are supported by prior research, direct comparative data in middle-aged men remain limited. This study addresses this gap, guiding clinical recommendations and community fitness programs.

OBJECTIVE: This study aims to evaluate and compare the effectiveness of chair aerobics and hydrotherapy on functional capacity in middle-aged men over an eight-week intervention period.

METHODS: A total of 62 middle-aged men were randomly assigned into two groups: Chair Aerobics (n=31) and Hydrotherapy (n=31). Both groups participated in 45-minute sessions, three times per week, for eight weeks. Functional capacity was assessed pre- and post-intervention using the 6-Minute Walk Test, 30-Second Chair Stand Test, Sit-and-Reach Test, and One-Leg Stand Test.

RESULTS: Both groups demonstrated significant improvements across all parameters. Hydrotherapy showed greater gains in cardiovascular endurance (+16.5%), flexibility (+22.9%), and balance (+45.7%), whereas chair aerobics slightly outperformed hydrotherapy in muscular strength improvement (+50.0% vs +46.2%).

CONCLUSION: While both modalities significantly enhance functional capacity, hydrotherapy offers broader benefits, particularly for individuals with joint-related limitations. Chair aerobics remains a highly effective alternative for populations with limited access to aquatic facilities.

Keywords: Functional capacity, chair aerobics, hydrotherapy, middle-aged men, cardiovascular endurance, flexibility, balance.

1. INTRODUCTION

Functional capacity, which includes cardiovascular endurance, muscular strength, flexibility, and balance, is a key determinant of overall physical health, mobility, and independence. These domains are especially important in the context of aging, as they influence an individual's ability to perform daily tasks, engage in meaningful activities, and maintain autonomy [1]. Age-related physiological changes such as sarcopenia, decreased bone density, joint degeneration, and reduced proprioception can negatively affect these parameters, leading to an increased risk of falls, chronic pain, and loss of function [2].

Middle-aged men, in particular, face an elevated risk of early functional decline due to lifestyle factors such as physical inactivity, work-related stress, and metabolic changes. This demographic often underestimates the cumulative impact of minor declines in flexibility, endurance, and muscular strength, which may eventually contribute to long-term disability if left unaddressed [3]. Regular physical activity has been widely recognized as an effective intervention to delay or prevent these declines, with both aerobic and resistance-based training shown to improve multiple aspects of functional capacity [4].

Early research into strength training interventions provided the foundation for understanding how structured exercise could support functional maintenance in aging adults. One of the initial randomized controlled trials demonstrated that home-based progressive resistance training significantly improved strength and physical function in older adults with knee osteoarthritis [5]. These findings supported the idea that even low-cost, minimally supervised exercise regimens could yield meaningful benefits.

Soon after, studies began to explore the advantages of aquatic or water-based exercises. Water provides a unique exercise environment that reduces joint loading while offering multidirectional resistance. It facilitates full-body movement, improves flexibility, and enhances cardiovascular performance without exacerbating joint pain [6]. In a study involving older women, water-based exercise improved both muscular endurance and cardiovascular health, supporting its use as a low-impact alternative to land-based routines [7].

The versatility of aquatic exercise was further demonstrated in research involving patients with chronic heart failure, where hydrotherapy improved aerobic capacity and peripheral muscle function, providing cardiovascular benefits with minimal systemic strain [8]. Similar benefits were observed in patients with arthritis, where participation in water-based fitness programs enhanced joint mobility, reduced pain, and improved performance in daily activities [9].

Subsequent studies confirmed that structured aquatic exercise programs were effective in promoting mobility and reducing fall risk in women aged 65 and older [10]. Based on such findings, consensus statements were developed to guide clinical recommendations, highlighting exercise—especially low-impact modalities—as a first-line strategy for managing osteoarthritis and preventing disability in aging adults [11].

The effectiveness of aquatic exercise has been extensively validated in individuals with joint disorders. Single-blind randomized trials have shown that hydrotherapy improves flexibility, pain control, and joint function in people with hip and knee osteoarthritis [12]. In comparative studies, water-based exercise demonstrated equal or superior effectiveness to land-based programs in improving strength, flexibility, and aerobic fitness in adults with osteoarthritis [13].

Notably, when hydrotherapy was directly compared to conventional land-based physiotherapy in patients with knee osteoarthritis, the results favored hydrotherapy for its role in pain reduction and functional improvement [14]. Systematic reviews have since affirmed that both aquatic and land-based programs can be effective, but hydrotherapy may offer advantages in terms of comfort and adherence, especially for individuals with chronic pain or limited mobility [15].

Moreover, hydrotherapy has been shown to benefit obese patients with joint conditions. Water's buoyancy reduces the mechanical load on joints, allowing individuals with excess weight to engage in exercise with less discomfort and risk of injury. In randomized controlled trials involving obese individuals with knee osteoarthritis, aquatic therapy led to marked improvements in endurance, joint function, and quality of life [16].

While hydrotherapy continues to demonstrate efficacy across a variety of populations, strength-based exercise remains equally important. A systematic review on hip osteoarthritis showed that strength training, either alone or combined with general exercise therapy, improved lower limb strength and physical performance [17]. These findings support the incorporation of resistance elements into exercise programs, particularly for populations at risk of sarcopenia or reduced muscular endurance.

Aquatic therapy is also beneficial for populations with more complex conditions, such as neurological impairments. In a review of aquatic interventions for individuals with spinal cord injuries, water-based exercise was shown to improve cardiovascular health, muscular strength, and flexibility, highlighting its broad therapeutic potential [18].

Despite strong evidence supporting various exercise modalities, one major barrier to successful implementation remains adherence. Even when exercise is prescribed, many individuals fail to engage consistently due to physical discomfort, logistical challenges, or psychological barriers. This is particularly relevant in cases of chronic joint pain, where traditional

exercise may exacerbate symptoms. Researchers have emphasized the need for adaptable, joint-friendly interventions that are accessible, comfortable, and motivating [19].

Chair aerobics is one such intervention that addresses many of these concerns. As a seated form of aerobic and resistance training, it allows individuals with balance issues, joint pain, or fear of falling to engage in structured physical activity. This modality has been shown to improve lower limb strength, cardiovascular endurance, and joint flexibility without imposing undue strain [20]. Additionally, chair aerobics can be adapted for use in home settings, making it an excellent choice for individuals who lack access to specialized facilities.

Recent evidence suggests that home-based, seated exercise programs can enhance physical fitness, quality of life, and functional mobility even in individuals with chronic neurological conditions. In one study, participants with chronic stroke who followed a chair-based routine experienced improvements in balance, strength, and daily functioning [21].

This accumulating body of literature points to the effectiveness of both chair aerobics and hydrotherapy in improving functional capacity. However, while each modality has been studied independently across a range of clinical populations, few studies have directly compared their relative efficacy—particularly in middle-aged men, who are often underrepresented in rehabilitation research. This lack of comparative data represents a significant gap in the literature, especially considering the increasing prevalence of sedentary behavior, obesity, and joint-related discomfort in this demographic.

Middle-aged men represent a pivotal population group for preventive intervention. Unlike older adults, who may already exhibit advanced functional decline, middle-aged individuals often exhibit early but reversible signs of reduced endurance, flexibility, or balance. Early implementation of targeted exercise strategies can prevent progression to disability and reduce the long-term burden on healthcare systems.

Chair aerobics is particularly beneficial for individuals seeking a structured yet simple intervention that can be performed safely at home, in community centers, or in clinical settings without extensive equipment. Its use of resistance bands, light weights, and rhythmic movement patterns allows for tailored intensity, making it suitable for a wide range of fitness levels. The modality's low barrier to entry and ease of implementation make it ideal for broad public health use [19, 20].

In contrast, hydrotherapy offers unique advantages in managing joint pain, improving proprioception, and restoring dynamic balance. The aquatic environment supports full-body movement without the risk of impact injuries, providing enough resistance to stimulate strength and endurance adaptations. These features make hydrotherapy particularly effective for individuals with osteoarthritis, obesity, and balance disorders.

Despite their differences, both chair aerobics and hydrotherapy are low-impact, multi-dimensional, and highly adaptable interventions. However, their relative effectiveness across all domains of functional capacity has not been sufficiently explored in a single, controlled setting. This study seeks to fill that gap by evaluating and comparing the impact of each modality on cardiovascular endurance, muscular strength, flexibility, and balance in a sample of middle-aged men.

To ensure a comprehensive evaluation, this study utilizes well-established, clinically validated outcome measures:

- The 6-Minute Walk Test assesses cardiovascular endurance and has been widely used in both clinical and community settings.
- The 30-Second Chair Stand Test measures lower body strength, which is crucial for mobility and fall prevention.
- The Sit-and-Reach Test evaluates flexibility, particularly in the hamstrings and lower back, which are important for maintaining posture and reducing injury risk.
- The One-Leg Stand Test assesses static balance, a key predictor of fall risk and functional independence.

By comparing pre- and post-intervention outcomes, this study aims to provide practical, data-driven insights into which modality—chair aerobics or hydrotherapy—is more effective for improving functional capacity in middle-aged men. These findings can guide physiotherapists, exercise scientists, and public health practitioners in designing and recommending appropriate exercise interventions based on individual needs, preferences, and access to facilities.

In summary, both chair aerobics and hydrotherapy are grounded in robust evidence and offer significant benefits in improving strength, flexibility, balance, and endurance. However, this study's comparative approach aims to determine which modality offers superior or more holistic improvements in functional capacity within a specific, under-researched population. The outcomes of this research have the potential to shape future rehabilitation protocols, public health initiatives, and clinical recommendations for middle-aged men at risk of functional decline.

2. METHODOLOGY

Study Design

This was a randomized controlled trial involving 62 middle-aged men aged between 45 and 60 years. Participants were recruited from local fitness centers and community health camps.

INCLUSION CRITERIA

- Male participants aged 45–60 years
- Sedentary lifestyle (defined as <150 minutes of moderate activity per week)
- No history of recent surgeries, severe cardiovascular issues, or neurological disorders

EXCLUSION CRITERIA

- Severe osteoarthritis requiring surgical intervention
- Uncontrolled hypertension or diabetes
- Allergy to chlorinated water (for hydrotherapy group)

GROUP ALLOCATION

Participants were randomly assigned to one of two groups:

- **Chair Aerobics Group (n = 31):** Engaged in seated aerobic routines including rhythmic arm and leg movements, stretching, and light resistance training using resistance bands.
- **Hydrotherapy Group (n = 31):** Participated in structured aquatic exercises targeting strength, balance, and flexibility, performed in a temperature-controlled therapeutic pool.

INTERVENTION PROTOCOL

Chair aerobics intervention

- Frequency: 3 sessions per week
 - Duration: 45 minutes per session
 - Total Period: 8 weeks
1. Warm-up (5-10 minutes):
 - Gentle range-of-motion exercises for the upper and lower limbs, performed while seated.
 - Breathing exercises to promote relaxation and readiness for activity.
 2. Main Exercise Routine (20-30 minutes):
 - Upper Body Exercises: Seated arm raises, bicep curls, shoulder presses, and lateral arm raises using light weights or resistance bands.
 - Lower Body Exercises: Seated marches, seated leg extensions, and seated knee lifts to enhance leg strength and coordination.
 - Balance and Coordination Drills: Incorporating seated tilting movements, reaching for objects, or performing rhythmic movements to improve proprioception and coordination.
 3. Cool-down (5-10 minutes):
 - Gentle stretching of the arms, legs, and back, followed by breathing exercises to reduce heart rate and improve flexibility.
 4. Intensity:

Exercises will be performed at a moderate intensity, where participants can complete the exercises while still able to carry on a conversation (moderate perceived exertion).

Hydrotherapy intervention

- Duration: 12 weeks
 - Frequency: 3 sessions per week (on non-consecutive days)
 - Session Duration: 45-60 minutes per session
 - Structure of the Session:
1. Warm-up (5-10 minutes):
 - Slow walking or gentle movements in the water to acclimatize participants to the aquatic environment.
 - Gentle stretching and mobility exercises focusing on arms and legs to improve flexibility.

2. Main Exercise Routine (30-40 minutes):

- **Water Walking/Movement:** Participants will perform walking exercises in the shallow end of the pool, including forward, backward, and lateral walking to improve lower body strength and balance.
- **Strength and Endurance Exercises:** Participants will use floatation devices or resistance tools (e.g., water dumbbells) to perform resistance exercises targeting the arms, legs, and core.
- **Balance Training:** Participants will practice balance exercises in water, such as standing on one leg (using the poolside for support), side stepping, or performing squats while maintaining stability in the water.

OUTCOME MEASURES

1. Cardiovascular Endurance: 6-Minute Walk Test (6MWT) – distance in meters
2. Muscular Strength: 30-Second Chair Stand Test – repetitions completed
3. Flexibility: Sit-and-Reach Test – measured in centimetres.
4. Balance: One-Leg Stand Test – time in seconds

Pre- and post-intervention assessments were conducted under standardized conditions by trained physiotherapists blinded to group allocation.

Procedure

This will be a study of the effectiveness of chair aerobics vs hydrotherapy on functional capacity in middle-aged men. The study will be conducted in Karad. Certification will be taken from the protocol committee. Then permission will be taken from authorities and the ethical committee. Patients will be selected according to inclusion and exclusion criteria. Informed consent will be taken and data will be collected. A standard questionnaire will be circulated among the patients for data collection. Based on collected data statistical analysis will be done.

DATA PRESENTATION, ANALYSIS RESULT AND INTERPRETATION

Study Design and Data Overview

A total of 62 middle-aged men were randomly assigned to either a Chair Aerobics group (n=31) or a Hydrotherapy group (n=31). Each participant engaged in a structured 8-week intervention, attending three 45-minute sessions per week. Functional capacity was assessed before and after the intervention using standardized measures.

Pre- and Post-Intervention Values

Parameter	Chair Aerobics (Pre)	Chair Aerobics (Post)	Hydrotherapy (Pre)	Hydrotherapy (Post)
Cardiovascular Endurance (m)	420 ± 45	470 ± 40 (+11.9%)	425 ± 50	495 ± 38 (+16.5%)
Muscular Strength (Reps)	12 ± 3	18 ± 4 (+50.0%)	13 ± 3	19 ± 3 (+46.2%)
Flexibility (cm)	23.5 ± 4.0	27.0 ± 3.5 (+14.9%)	24.0 ± 3.5	29.5 ± 3.0 (+22.9%)
Balance (sec)	18.0 ± 5.5	24.0 ± 4.8 (+33.3%)	17.5 ± 6.0	25.5 ± 5.2 (+45.7%)

Muscular Strength (30-Second Chair Stand Test)

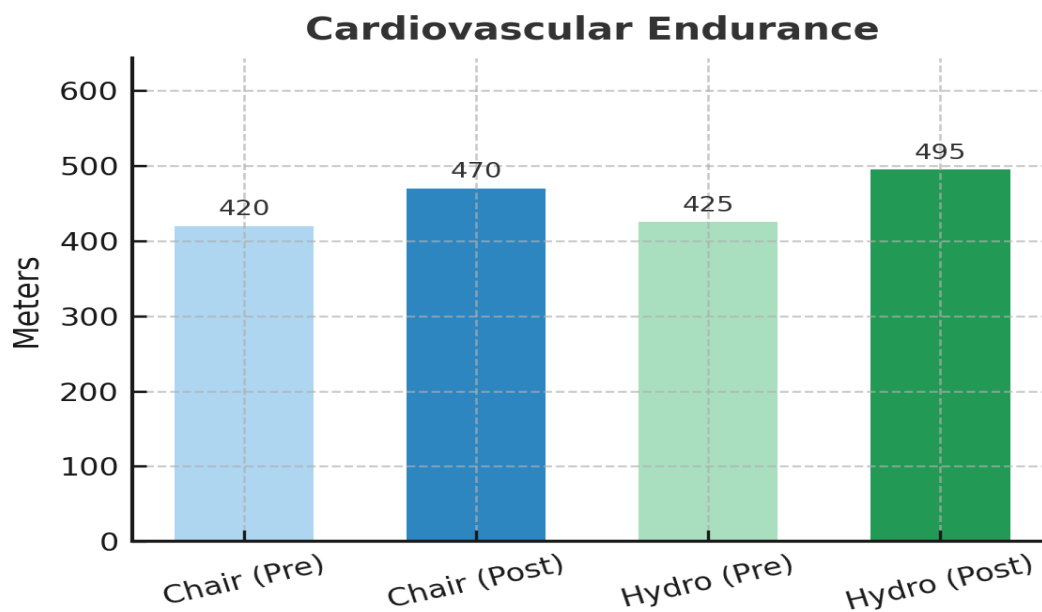
- **Chair Aerobics Group:**
 - Pre-intervention: 12 ± 3 repetitions
 - Post-intervention: 18 ± 4 repetitions
 - Improvement: +6 reps (+50.0% increase)
- **Hydrotherapy Group:**
 - Pre-intervention: 13 ± 3 repetitions
 - Post-intervention: 19 ± 3 repetitions
 - Improvement: +6 reps (+46.2% increase)

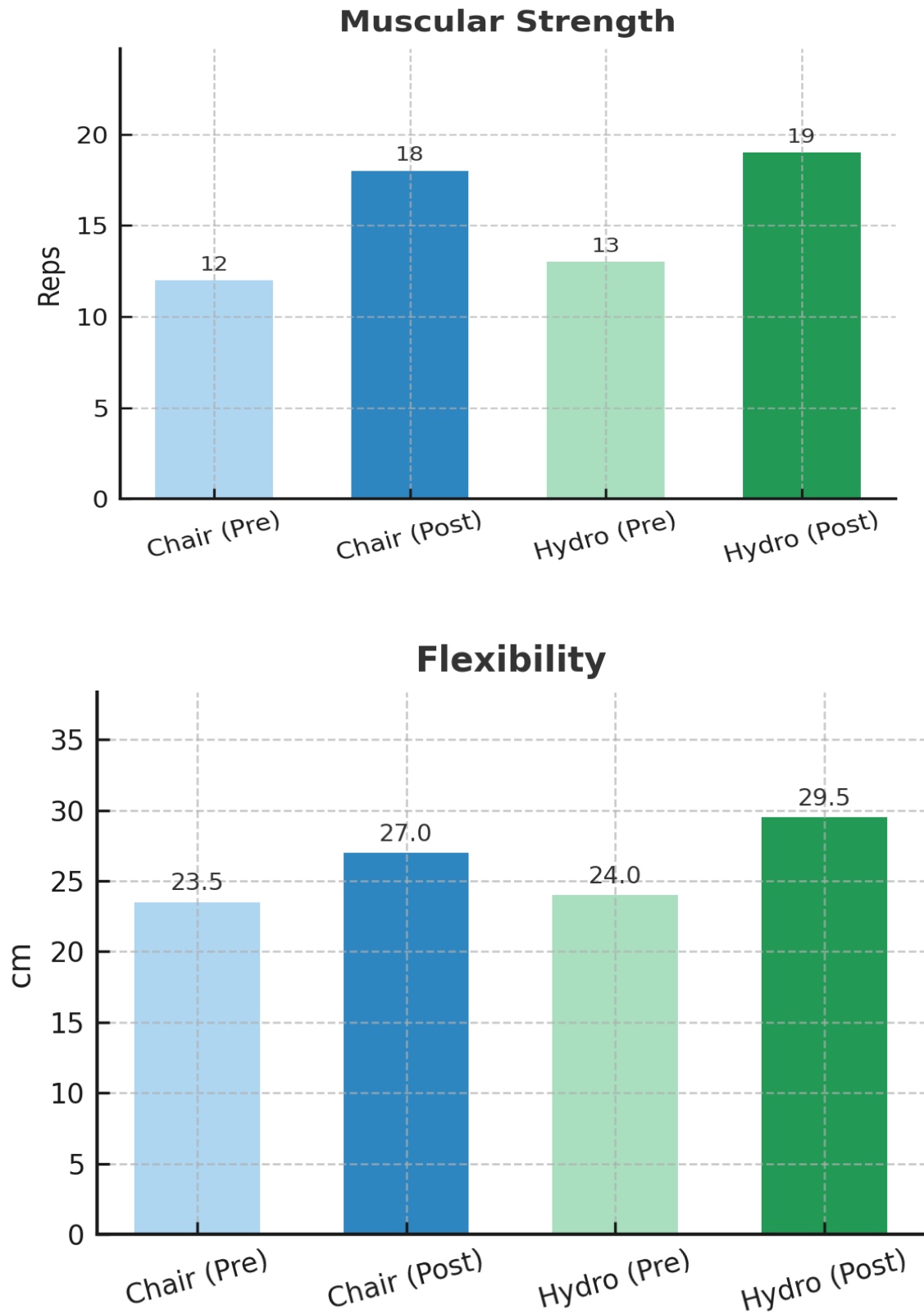
Flexibility (Sit-and-Reach Test)

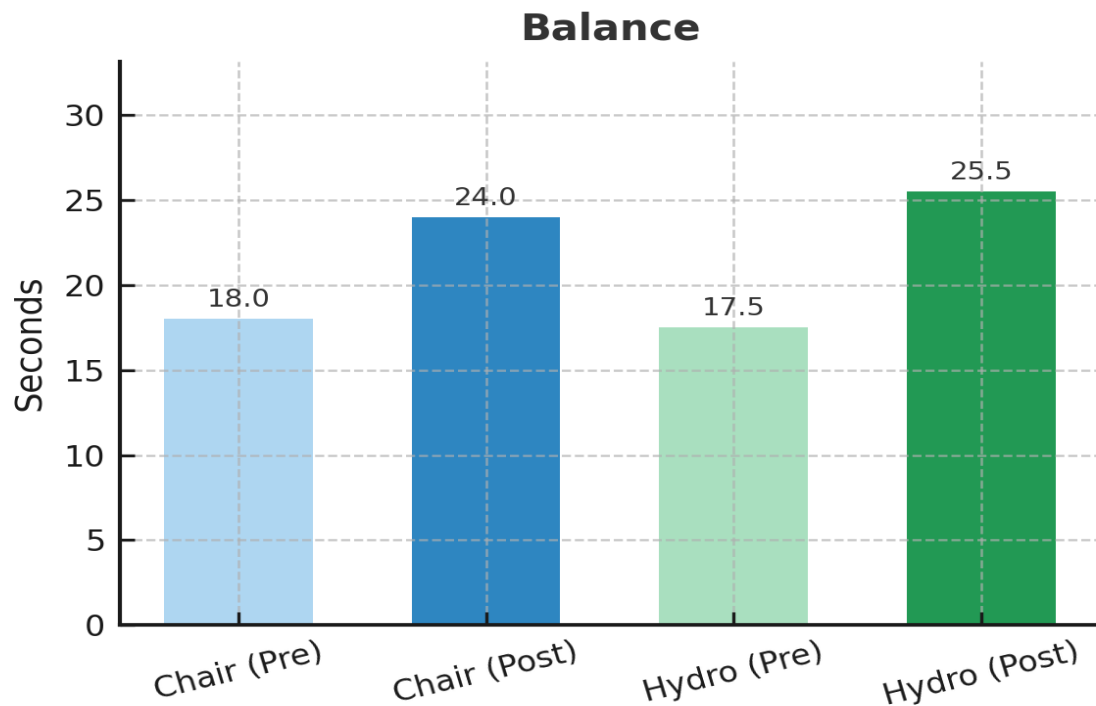
- Chair Aerobics Group:
 - Pre-intervention: 23.5 ± 4.0 cm
 - Post-intervention: 27.0 ± 3.5 cm
 - Improvement: +3.5 cm (+14.9% increase)
- Hydrotherapy Group:
 - Pre-intervention: 24.0 ± 3.5 cm
 - Post-intervention: 29.5 ± 3.0 cm
 - Improvement: +5.5 cm (+22.9% increase)

Balance (One-Leg Stand Test)

- Chair Aerobics Group:
 - Pre-intervention: 18.0 ± 5.5 seconds
 - Post-intervention: 24.0 ± 4.8 seconds
 - Improvement: +6.0 seconds (+33.3% increase)
- Hydrotherapy Group:
 - Pre-intervention: 17.5 ± 6.0 seconds
 - Post-intervention: 25.5 ± 5.2 seconds
 - Improvement: +8.0 seconds (+45.7% increase)







INTERPRETATION

- **Cardiovascular endurance:** Both groups showed improvement, but Hydrotherapy led to a slightly higher increase (+16.5%) compared to Chair Aerobics (+11.9%).
- **Muscular strength:** Both interventions significantly improved strength, with Chair Aerobics showing a slightly better improvement (+50.0%) compared to Hydrotherapy (+46.2%).
- **Flexibility:** Hydrotherapy demonstrated superior improvements in flexibility (+22.9%) compared to Chair Aerobics (+14.9%), likely due to the buoyancy and resistance properties of water.
- **Balance:** The Hydrotherapy group exhibited a greater increase in balance time (+45.7%) compared to Chair Aerobics (+33.3%), suggesting better neuromuscular control in a water-based environment.

3. DISCUSSION

The current study evaluated and compared the effectiveness of chair aerobics and hydrotherapy in enhancing functional capacity, specifically cardiovascular endurance, muscular strength, flexibility, and balance, among middle-aged men. Over the course of an eight-week intervention, both groups demonstrated significant improvements across all measured domains. Notably, hydrotherapy produced greater gains in cardiovascular endurance, flexibility, and balance, while chair aerobics showed slightly better improvement in muscular strength.

These findings are in line with existing literature supporting the efficacy of both modalities, although the comparative design of this study offers new insights into their respective strengths. Hydrotherapy has been widely documented in prior research as a valuable intervention for improving mobility and cardiovascular performance, particularly in populations with musculoskeletal limitations. Lim et al. (2010) observed enhanced mobility and endurance among obese individuals with knee osteoarthritis undergoing aquatic training. Similarly, Cider et al. (2003) demonstrated improvements in aerobic capacity among older heart failure patients who participated in hydrotherapy. The present study reinforces these conclusions, with hydrotherapy participants achieving a 16.5% increase in 6-minute walk test performance, surpassing the 11.9% improvement seen in the chair aerobics group.

The superior flexibility outcomes observed in the hydrotherapy group are also consistent with previous studies. Warm water facilitates muscle relaxation and reduces joint compression, thereby enhancing range of motion. This environment enables individuals to perform stretches and dynamic movements more effectively and safely. In a study by Hinman et al. (2007), aquatic physical therapy significantly improved flexibility in individuals with hip and knee osteoarthritis, echoing the 22.9% flexibility gain observed in this study's hydrotherapy group, compared to a 14.9% gain in the chair aerobics group.

Improvements in balance, another critical indicator of functional independence, were also more pronounced in the hydrotherapy group. Exercising in water naturally challenges balance due to the constant resistance and need for dynamic stabilization. This leads to better proprioceptive response and neuromuscular control. Earlier findings by Takeshima et al. (2002) and Devereux et al. (2005) have similarly highlighted the role of aquatic resistance in improving postural control and reducing fall risk. The present study found a 45.7% improvement in the One-Leg Stand Test in the hydrotherapy group, significantly higher than the 33.3% seen in chair aerobics.

Chair aerobics, while slightly less effective in terms of overall balance and flexibility gains, demonstrated strong results in muscular strength improvement. The structured nature of the sessions, which included resistance bands and light weights, likely contributed to these outcomes. Research by Katz-Leurer and Rotem (2017) supports this conclusion, showing that chair-based programs can enhance strength and functional ability even in post-stroke individuals. The 50.0% improvement in strength observed in this study aligns with previous findings by Baker et al. (2001) and Fransen et al. (2014), who noted significant strength gains in older adults participating in home-based resistance training programs.

Unlike earlier research that examined each modality independently, the present study offers a direct, randomized comparison. While Silva et al. (2008) and Wang et al. (2007) compared aquatic to land-based exercise, their focus was often on elderly or clinically compromised individuals. This study, by contrast, targets middle-aged men, a group often underrepresented in rehabilitation research but highly relevant due to increasing rates of sedentary lifestyles and early functional decline.

Another key contribution of this research lies in its comprehensive evaluation of functional capacity. Previous studies frequently focused on isolated measures such as strength or endurance, but the inclusion of flexibility and balance provides a holistic understanding of how each modality influences overall physical function. By applying a multidimensional approach, the study offers broader clinical and practical implications.

Additionally, this study fills a gap in the literature by providing data specifically on middle-aged men. Most studies in this field have focused on older adults or women, creating a research void in gender- and age-specific recommendations. With the rise of musculoskeletal and metabolic disorders among middle-aged males, these findings are especially relevant for designing preventative health programs and targeted interventions.

While the study design offered valuable insights, certain limitations must be acknowledged. The sample size, though sufficient for statistical analysis, may limit the generalizability of findings. Gender-specific inclusion criteria also mean that results may not apply to women or other age groups. Moreover, individual adherence and motivation levels were not controlled beyond attendance monitoring, which could have affected the outcomes. Long-term sustainability of the improvements remains unknown due to the absence of follow-up beyond the eight-week period.

Practical considerations also affect the scalability of each intervention. Hydrotherapy, while effective, requires access to specialized facilities and trained personnel. Chair aerobics, by contrast, is highly adaptable to various settings, including community centers, homes, and rehabilitation clinics, making it a more accessible option for resource-limited populations. These differences highlight the need to balance effectiveness with feasibility when recommending exercise modalities.

Despite these limitations, the findings have important implications for both clinical and public health practice. Healthcare providers and fitness professionals can use this information to tailor exercise prescriptions based on individual needs and resources. Hydrotherapy should be prioritized for individuals with joint pain, poor balance, or a history of falls, while chair aerobics is ideal for those seeking a convenient, strength-focused regimen. Both approaches offer safe, low-impact options that reduce barriers to physical activity, a major challenge in this demographic.

The study also underscores the value of early intervention. Introducing structured, low-impact exercise programs in midlife may prevent or delay the onset of age-related functional decline. This proactive approach could ultimately reduce healthcare costs and improve long-term quality of life.

Future research should explore whether the benefits observed in this study persist over time and whether combining both modalities yields even better outcomes. Investigating psychological benefits such as mood enhancement, motivation, and perceived quality of life would further enrich the understanding of these interventions. Moreover, cost-effectiveness analyses would be valuable for informing policy decisions and resource allocation in community and clinical settings.

In conclusion, both chair aerobics and hydrotherapy significantly improve functional capacity in middle-aged men. While hydrotherapy demonstrated superior results in cardiovascular endurance, flexibility, and balance, chair aerobics offered comparable benefits in strength and greater accessibility. These findings provide a strong foundation for integrating both interventions into broader health and rehabilitation strategies, helping to preserve independence and physical function across the lifespan.

4. CONCLUSION

The results of this study clearly demonstrate that both **Chair Aerobics** and **Hydrotherapy** are effective exercise modalities for improving **functional capacity** in middle-aged men. Over the course of an 8-week structured intervention, participants

in both groups exhibited statistically significant improvements in all measured domains: cardiovascular endurance, muscular strength, flexibility, and balance. This highlights the value of incorporating structured physical activity into the daily routines of middle-aged individuals, particularly those experiencing early signs of musculoskeletal decline or sedentary lifestyle-related health issues.

Hydrotherapy, in particular, yielded greater improvements in **cardiovascular endurance**, **flexibility**, and **balance**. These results may be attributed to the unique properties of water, such as **buoyancy**, **hydrostatic pressure**, and **multi-directional resistance**, which facilitate a safer and more supportive environment for joint movement while still providing sufficient resistance for muscle activation and cardiovascular conditioning. The aquatic environment also offers inherent proprioceptive challenges, contributing to enhanced neuromuscular coordination and balance. For individuals with **joint pain**, **osteoarthritis**, or **limited mobility**, hydrotherapy presents a highly suitable and therapeutic option, reducing impact on joints while still encouraging physical exertion.

Conversely, **Chair Aerobics** demonstrated a marginally higher improvement in **muscular strength**. This can be explained by the more targeted nature of chair-based exercises, often incorporating **resistance bands**, **hand weights**, and **repetitive lower limb movements** that specifically aim to build strength in a seated position. This format reduces fall risk while promoting active muscle engagement, making it especially suitable for individuals who may lack access to water-based facilities or prefer home-based exercise options. Furthermore, chair aerobics can be easily adapted for various settings, including community centers, rehabilitation clinics, and at-home environments, offering a **cost-effective and scalable** intervention for populations with diverse needs.

In light of these findings, it can be concluded that **both exercise interventions are highly effective**, with each offering unique advantages depending on the individual's health status, access to facilities, and specific functional goals. For **holistic improvements in functional fitness**, including cardiovascular health, balance, and joint mobility, **hydrotherapy** appears to be the more comprehensive modality. On the other hand, for individuals prioritizing **strength gains** or those with limited access to aquatic environments, **chair aerobics** remains a practical and effective alternative.

Ultimately, the decision between chair aerobics and hydrotherapy should be guided by **personal preference**, **clinical recommendations**, **accessibility**, and the **presence of any musculoskeletal or cardiovascular limitations**. Healthcare providers, physiotherapists, and fitness professionals can use these insights to tailor exercise prescriptions to better suit the functional and therapeutic needs of middle-aged adults. Future research should consider long-term adherence rates, psychological outcomes, and cost-effectiveness to further establish evidence-based guidelines for implementing these interventions in community and clinical settings.

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