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Effectiveness of Aquatic Exercise in Post-CABG Patients: A Systematic Review

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Abstract

Background and Aims: Coronary artery disease (CAD), characterized by the narrowing of coronary vessels, can lead to myocardial infarction. Treatment may involve medications or coronary artery bypass grafting (CABG). Exercise-based cardiac rehabilitation plays a key role in secondary prevention. While rehabilitation commonly emphasizes land-based exercises, water-based interventions are gaining attention for their potential benefits. This systematic review aimed to evaluate the effectiveness of aquatic exercises in CAD and post-CABG patients. Methods: A systematic search of PubMed was conducted to identify randomized controlled trials (RCTs) published between 2000 and 2024 assessing the effects of aquatic exercises in CAD or post-CABG patients enrolled in cardiac rehabilitation. Inclusion criteria were: RCTs involving patients aged >18 years, with full-text availability, both sexes, use of water-based interventions (aquatic exercises, hydrotherapy, or water gymnastics), and outcomes including aerobic capacity (. O_2peak) and quality of life. Studies without CABG, not involving cardiac rehabilitation, lacking a comparison group, or focusing on conventional interventions were excluded. Results: Water-based exercise showed significant benefits, including

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a 27.4% increase in . O_2peak, outperforming land-based exercise. BMI decreased by 1.3% and total body fat by 1.1 kg, though some gains diminished during detraining. Vascular function, measured via flow-mediated dilation (FMD), improved from 7.2% to 9.2%. Muscular strength increased significantly, with a 6.3 kg gain in leg strength and a 12.2% rise in total body strength. Adherence to water-based programs was high, reaching 89%, with few dropouts due to illness or personal circumstances. Conclusion: Water-based exercises are a safe, effective, and valuable component of cardiac rehabilitation for CAD and post-CABG patients, contributing to improved cardiovascular function, physical strength, and overall health outcomes

INTRODUCTION

Coronary artery disease (CAD) is the narrowing and obstruction of heart blood vessels, which can lead to death of the heart tissue. It remains the leading cause of death in both developed and developing nations Duggan et al. (2022). 10.9% of adults >45years of age and 17% > 65years of age are estimated to develop CAD. This is a major burden on the health system, with costs expected to balloon from 126.2 billion dollars in 2010 to more than 177 billion dollars by 2040 (Duggan et al., 2022). Based on a 2022 report, CHD is second on the top five killer disease list in the UK, with 68,000 people dying from it every year. Over 2.3 million people are living with CHD in the UK- 1.5 million men and 830,000 women (British, 2022). According to the American Heart Association guidelines, dietary management and lifestyle modification are fundamental to CAD risk control (Jia et al., 2020). Depending on the severity of CAD, surgical options such as Coronary Artery Bypass Grafting can also be employed (Jia et al., 2020).

Coronary Artery Bypass Grafting is a commonly performed surgical procedure, with nearly 400,000 operations annually (Bachar & Manna, 2018). In 2011, the United States performed 213,700 CABG procedures alone (Bachar & Manna, 2018). A 2021 meta-analysis concluded that CABG had short- and long-term improvements in quality of life (QoL) and a reduction in angina frequency. It enhanced long-term survival rate and lowered the incidence of major cardiac events (Creber et al., 2022). The 2018 guidelines from the European Society of Cardiology and the European Association for Cardio-Thoracic Surgery gave a class-I recommendation (strongly recommended) to CABG for enhancing outcomes in cases of left main coronary artery LMCA or multi-vessel coronary artery MVCA disease (Feng et al., 2023). Exercise-based cardiac rehabilitation (EBCR) is essential to comprehensive coronary heart disease (CHD) management. According to international guidelines, it has a class-I grade-A recommendation (Dibben et al., 2023). Findings from a Cochrane review demonstrate that EBCR is cost-effective and helps reduce cardiovascular mortality, myocardial infarction (MI), and hospitalizations (Dibben et al., 2023). Although cardiac rehabilitation is a mainstay of management and secondary prevention in patients with coronary artery disease (CAD), any recent myocardial infarction or coronary artery bypass grafting (CABG) can impair or hinder the patient's ability to participate in exercise (Danijela Vasić et al., 2019)

Cardiac rehabilitation typically focuses on land-based aerobic and strength training (Alana Lalucha Andrade Guimarães et al., 2023). However, less frequently prescribed water-based exercises are gaining popularity (Alana Lalucha Andrade Guimarães et al., 2023). Water-based exercises such as aqua aerobics are recognized as a safe and effective option for cardiac patients, demonstrating positive effects on . O2peak, exercise duration, and muscle strength in CAD patients (Ksela et al., 2024). Moreover, these exercises provide unique benefits, such as being low-risk, low impact and safe, thereby minimizing joint strain and musculoskeletal injuries (Ksela et al., 2024). The previous concern that water immersion could cause cardiovascular overload has largely been dismissed.

Research has demonstrated that water immersion decreases afterload and enhances cardiac function (Alana Lalucha Andrade Guimarães et al., 2023).

Moreover, a recent systematic review found that exercising patients with heart failure in a water environment improved exercise capacity and quality of life (Neto et al., 2015). A study by (Danijela Vasić et al., 2019) compared the effects of land-based training with water-based training. The study found that land-based training improved . O2 peak by 15.3% (from 16.7 ml/kg/min, 95% CI 16.0–17.4 ml/kg/min; $p < .001$) while water-based training led to a 27.4% increase (from 18.6 ml/kg/min, 95% CI 17.9–19.3 ml/kg/min; $p < .001$).

Aqua aerobics helps in improving the efficiency of the heart by shifting the blood from the limbs to the chest, thus increasing the plasma volume, which in turn increases the blood volume within the thoracic cavity, further leading to an increase in cardiac end-diastolic volume, stroke volume and cardiac output (Danijela Vasić et al., 2019). As the cardiac output increases, pulse pressure (difference between the systolic and diastolic blood pressure) increases, increasing urine output via excretion of excess salts and fluids, thus lowering the blood pressure (Pendergast et al., 2015).

Post-CABG patients are typically viewed as having undergone treatment rather than being classified as having a disease, unlike patients with CAD, which is why the effectiveness of cardiac rehabilitation is primarily studied in the CAD population. Most cardiac rehab programs focus on aerobic, strength, or combined exercises, with aquatic exercises often overlooked. Although a systematic review is available looking at the effect of aquatic exercises on various functional capacities in CAD (Guimarães et al., 2023), there is currently no systematic review documenting the specific effects of aquatic exercises on CABG patients. Thus, this systematic review aimed to synthesize existing evidence and provide a comprehensive understanding of aquatic exercises' impact on post-CABG patients.

RESEARCH QUESTION

In adults with coronary artery disease or those who have undergone coronary artery bypass grafting, how effective are water-based exercises compared to land-based exercises in improving aerobic capacity and quality of life as part of a cardiac rehabilitation program?

PROTOCOL AND REGISTRATION

The PRISMA protocol was followed for this systematic review and was not registered with PROSPERO

INCLUSION

To be included in this systematic review, studies had to be prospective controlled trials (RCTs) published as free full-text articles between January 1, 2000, and January 1, 2024. Eligible studies involved adult patients (aged 18 years or older) of both sexes diagnosed with coronary artery disease who had undergone coronary artery bypass grafting (CABG) and were enrolled in a cardiac rehabilitation program. The intervention of interest was water-based exercise, including aquatic exercises, hydrotherapy, or water gymnastics. Studies were required to include a comparison group and report outcomes related to both aerobic capacity and quality of life.

EXCLUSION

Studies were excluded if they involved patients who had not undergone coronary artery bypass grafting (CABG) or if they investigated interventions other than water-based exercise, such as weight training or calisthenics. Non-peer-reviewed manuscripts, studies without full text or complete methodological details, and those published in languages other than English were also excluded. Additionally, systematic reviews, dissertations, conference abstracts, posters, and studies that were not randomized controlled trials (RCTs) were not considered for inclusion

SEARCH STRATEGY

PubMed database was searched on (23rd December 2024): (Aquatic exercises) OR (water-based exercises) OR (hydrotherapy) OR (aquatic exercise therapy) OR (water gymnastics) OR (aqua aerobics) OR (aquatic aerobics) AND (coronary artery disease). Only randomized controlled trials (RCTs) from 2000 - 2024 were included.

CRITERIA FOR REVIEW (PICO)

Population: Patients with coronary artery diseases and patients who underwent coronary artery bypass grafting and were placed in the cardiovascular rehabilitation program. All studies included patients above the age of 18 years.

Intervention: Aquatic or Water-based exercises, hydrotherapy or water gymnastics are employed in the rehabilitation procedure.

Comparison: Studies comparing traditional or land-based exercise as part of the rehabilitation Program.

Outcomes: Aerobic capacity was the primary outcome and quality of life was the secondary outcome used to check intervention effectiveness

DATA EXTRACTION

The data from articles was extracted by identifying the articles that met the inclusion criteria. Subsequently, further data was extracted based on the outcomes. Any discrepancies were resolved. Data was extracted via a standardized table including author, sample size, participants (containing gender and age) intervention specific to each included study, study design, outcome measures, results and conclusion

RESULTS

SELECTION OF THE STUDIES

A total, 34 articles were identified during the PubMed database search from 2000 to 2024. Of these, 18 were excluded because they were not related to

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the topic being studied. Of the 16 studies left, 13 were excluded. One was excluded because of discrepancy in title, one had a different intervention, two studies discussed different population, five had a different study design, one was an editorial and three evaluated different outcomes. The final three studies which examined aquatic exercises and their effects on heart health by evaluating aerobic capacity, BMI, anthropometric measurements, body fat%, flow mediated dilatation FMD and muscle strength in both upper and lower limbs were selected for review. Study selection is summarized in Figure 1.

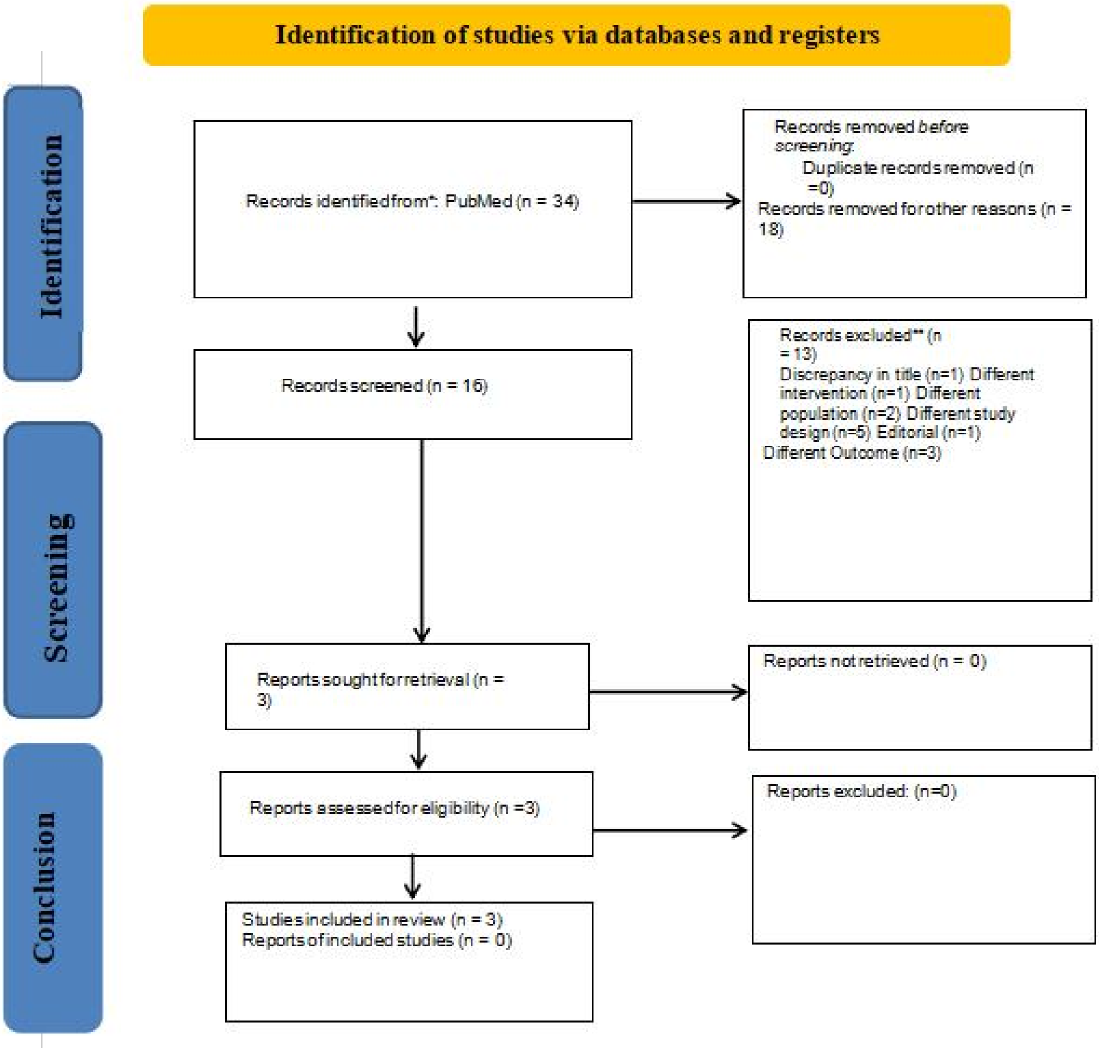

FIGURE 1 PRISMA FLOW CHART

STUDY CHARACTERISTICS

Table 1 summarizes key findings of the reviewed studies, including author, sample size, intervention, study design, outcome measures, results and conclusion. The studies were performed between 2008 and 2021. The prevalent conditions treated were cardiac issues such as coronary artery diseases and people undergoing coronary artery bypass surgery for it. This systematic review included thoroughly reviewed studies, encompassing a total of 162 patients with an average age of 59 years. The studies comprised of 142 males and 20 females. Sixty participants received water-based exercises, thirty received land-based training, twenty received gym-based exercises and fifty-two combined were in the control groups. All the studies reported the primary outcome of interest-aerobic exercise capacity or exercise capacity or aerobic capacity and not the secondary outcome of choice which was quality of life.

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Table 1. Characteristics Of The Studies Included For Review

S. No.	Study	Sample size (n)	Participant s	Intervention	Study design	Outcome measures	Results	Conclusion
1	(Tokmakidis et al., 2008)	21	Male patients with CAD, with evidence of 70% occlusion in major vessels. MI and having undergone	Experimental Group (exercise group (n=11) (supervised exercise-for 4 months, followed by no exercise for 4 months, resuming exercise after another 4	Prospective 2 group RCT (n=11 in the experimental group and n=10 in the control group)	BMI was calculated from body weight and height. Skin fold thicknesses were measured by spring-loaded calipers. Maximum Muscle	Significant changes occurred during training, with detraining returning to baseline levels (r = -0.62, p < .05). Retraining resulted in improvements	Water-based exercise is highly effective for low-risk cardiac patients, incorporating aerobic activities. It enhances

	CABG or PTCA Experimental Group (age 52.4 ±11.8) Control Group (age 50.8 ±9.4)	months (dropout 1ortho injury). Four sessions/wks. Two sessions of aqua aerobics (50-85% max HR) Two sessions water-based circuit weight training at 60-80% of RPE, 11-14 on Borg RPE. Months 1–2: Work-to- rest ratio is 1:1.5. Months 3–4:		strength was measured using the 1-RM method. 6 min Water Walking Test Peak Oxygen Uptake (. O2peak)	(body mass: -1.3%, skinfold thickness: -9.7%, $p < .05$). Muscle strength during training= increase in total strength ($M = 285.5$, $SD = 29.4$ to $M = 320.2$, $SD = 35.8$ kg, $p < .001$) During detraining= significant reduction in	cardiac rehabilitation, improves physiological parameters, and promotes long-term health. Cessation leads to reduction in health. Lifelong participation needed to improve cardiovascular protection and

	Work-to-rest ratio is 1.5:1) Control group (n=10) no supervised exercise just regular exercise		muscle strength ($p<0.05$) Retraining= Significant increase in total body strength (M = 314.3, SD= 35.2 to M=336.2 to SD= 32 kg, $p<.001$) . O_2peak increased by 8.4% (p < .001), and exercise time improved by	better overall prognosis.

		11.8% ($p < .001$). Detraining reduced training effects non-significantly. Retraining further enhanced results, with exercise time increasing by 4.5% ($p < .001$) and 6-min walk test distance improving by

							7.6% (p < .01).	
2	(D. Vasić et al., 2019)	89	Patients after a recent CAD event (2-4 weeks after MI, PCI and/or CABG, with LVEF >40% between May to October 2016. Age M = 59.9,	Water-based exercise training group (n=29) (one dropout, URTI). Two 30min session daily. Aerobic endurance (5 min warm up, 20 min conditioning (water walking, side stepping, cycling with arms) at 60-80% HR max followed by 5 min of cool	Prospective randomized, open- label clinical trial with three parallel groups (two experimental/ intervention and one control group)	Exercise capacity assessment (. O2peak) Vascular Function (FMD) Blood markers	With land-based training, . O2peak increased by 15.3% (16.7 ml/kg/min, 95% CI [16.0, 17.4], p < .001) from baseline. With Water-based training by 27.4% (18.6 ml/kg/min, 95% CI [17.9, 19.3], p < .001)	Aquatic exercises is a safe and effective option for patients participating in cardiac rehabilitation after a recent CAD event. Compared to land- based exercises, calisthenics and endurance

	SD = 8.2 Male= 69 Female=20	down). Calisthenics (5 min of war up, 20 min of conditioning (muscles of upper and lower limbs such as triceps dips, extension, leg press, push-ups at 60-80% of max HR), 5 min cool down. Land-based exercise training group (n=30)		from baseline but no significant increase in controls 0.6% (14.9 ml/kg/min, 95% CI [14.2, 15.6], p = .775) from baseline. Land-based training group FMD increased from 5.5 to 8.8% (p < .001). Water-based training group	exercises performed in water had similar benefits in improving exercise capacity and vascular function in CAD patients.

	two 30min sessions daily, bicycle ergometer training (5min warm up, 20 min at 60-80% max HR and 5 min cool down). Calisthenics (5min warm up, 20 min exercises targeting the upper and lower limbs at 60-80% max HR, increasing the		increase from 7.2 to 9.2% (p <.001). Control group no significant change (p = .629). Biomarkers showed no significant change except NT- proBNP and D-dimer which decreased in water training group (p<.01)

		speed and number of reps progressively) Control group (n=30) lifestyle advice. Awareness of benefits of exercise. Engage in regular physical activity (ADLs) but refrain from supervised exercise				
	Male patients	WEX group (n=20)1-hour	Three arm, parallel	Aerobic exercise	Water based exercise	The study concluded that

3	(A. Scheer et al., 2021)	52	with diagnosis of CHD based on diagnosis of MI, PCI ⩾ 50% occlusion of ⩾ 1 coronary artery or CABG. Stable medication ⩾ 1 month; ⩾ 6 months	sessions, 3/wk. for 12 weeks. Dropouts (5). GEX group (n=20) 60mins sessions. 3/week for 12 weeks. (dropouts 2). Control Group (n=12) Continue usual exercise for 12 weeks	group, RCT, with concealed allocation and ITT analysis. Recruitment of participants from December 2016 to March 2019.	capacity (. O2peak) Muscular strength (1-RM) for bicep curls, Latissimus pull down, leg press and hamstring curls. Anthropometric measures (body weight, BMI, waist circumference and hip circumference.	improved Aerobic exercise capacity (VO2peak) by M= 2.5 ml/kg/min (95% CI [0.6, 4.4]). It also improved leg strength (1RM hamstring curl of M= 6.3 kg, 95% CI [1.2, 11.3]). It also reduced. Water-based exercise also reduced total	water based exercise training improved exercise capacity, lower limb strength and decreased fat mass similar to gym based exercises in stable CAD/CHD patients. This highlights the potential of water- based

	after surgery (Age M=66, SD=8)		DXA for body mass, body fat and bone mineral density.	body fat M = 1.1kg (95% CI, [0.0, 2.3]). No clear changes in anthropometric measures. Both modes (WEX and GEX) had almost similar results with VO2peak increasing in GEX also. Leg strength was improved with both but Latissimus dorsi	exercise as a low joint-impact option that also enhances exercise engagement.

		showed significant improvement in strength with GEX (M= 4.2 95%CI, [0.3, 8.1]). Body fat decreased with both types of exercise training, with a negligible difference between the effects of the exercise.

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RCT= Randomized Controlled Trials, CAD= Coronary Artery Disease, RPE= rate of perceived exertion, 1RM= 1 Rep. maximum, MI= myocardial Infarction, BMI= body mass index, ADLs= activity of daily livings, CABG= coronary artery bypass graft, PTCA= percutaneous transluminal coronary angiography, LVEF= left ventricular ejection fraction, FMD= flow mediated vasodilation, URTI= upper respiratory tract infection, . O2peak= aerobic exercise capacity, WEX= water-based exercise and GEX= gym-based exercise.

OUTCOMES

Aerobic capacity (. O_2peak) was measured in all three studies, while quality of life was not consistently assessed. Tokmakidis et al. (2008) used a symptom-limited Bruce protocol treadmill test with open-circuit spirometry and 12-lead ECG monitoring. Vasić et al. (2019) conducted CPET on a cycle ergometer using a Ganshorn Power Cube gas analyzer. Scheer et al. (2021) used indirect calorimetry with a graded treadmill protocol, ECG monitoring, and standard metabolic cart calibration. All tests were conducted until symptom limitation or physician termination.

VO_2PEAK

In Tokmakidis et al. (2008), no baseline difference in . O_2peak was found between groups. After 4 months of water-based training, . O_2peak increased by 8.4% ($p < .001$), declined slightly after detraining (−3.57%), and rose again during retraining (+6.57%, $p < .05$). No significant changes were observed in the control group. Vasić et al. (2019) reported a significant increase in . O_2peak in both land-based (+15.3%) and water-based (+27.4%) groups (both $p < .001$), with no change in the control group. Scheer et al. (2021) found similar improvements in . O_2peak for both water-based (M = 2.5 ml/kg/min, 95% CI

[0.6, 4.4]) and gym-based (M = 2.3 ml/kg/min, 95% CI [0.6, 4.0]) exercise group

ANTHROPOMETRIC MEASURES (WEIGHT, BMI, BODY COMPOSITION)

Tokmakidis et al. (2008) reported a significant reduction in BMI after 4 months of water training (from M=29.0 to M=28.3, $p<.05$), followed by a slight increase during detraining (M=28.9). A negative correlation between body mass and walking hours was noted during this period ($r = -.62$, $p<.05$). BMI decreased again during retraining (M=28.6, $p<.05$), with additional improvements in body composition (body mass −1.3%, skinfolds −9.7%, $p<.05$). In Scheer et al. (2021), water-based exercise reduced total body fat by 1.1 kg (95% CI [0.0, 2.3]), with no significant changes in BMI, weight, or circumferences. Similar fat reduction was observed in the gym-based group (1.2 kg, 95% CI [0.1, 2.3]).

VASCULAR FUNCTION

In the study by D. Vasić et al. (2019), there was a significant increase in vascular function calculated through FMD via ultrasound in both land-based and water-based exercises, with an increase from 5.5 to 8.8% ($p<.001$) in the former and from 7.2 to 9.2% ($p<.001$). No significant change was observed in vascular functions in the control group ($p=.629$). There was also a significant increase in Nitroglycerin mediated dilatation (NMD) in both intervention groups (Water based exercise group M=11.4 95% CI [7.6, 13.4], $p<0.042$) and land-based exercise group (M= 11.1, 95% CI [9.0, 14.3], $p<.001$) with a rather larger increase observed in the land-based exercise group.

BIOMARKERS

Vasić et al. (2019) found no significant changes in low-grade inflammation markers. However, the water-based training group showed significant reductions in NT-proBNP (M = 308 ng/L, 95% CI [187, 394], $p < .001$) and D-dimer levels (M = 370 μg/L, 95% CI [260, 590], $p < .001$).

ONE REPETITION MAXIMUM (1RM)

Tokmakidis et al. (2008) reported significant increases in total body strength after 4 months of training (+12.2%, $p<.001$), a slight decline during detraining (−1.8%, $p<.05$), and a further significant gain after retraining (+17.8%, $p<.001$). In Scheer et al. (2021), water-based exercise (WEX) improved leg strength (M = 6.3 kg, 95% CI [1.2, 11.3]) with no notable changes in upper limb strength. Gym-based exercise (GEX) showed similar leg strength gains (M = 7.2 kg, 95% CI [2.9, 12.2]) along with a significant increase in upper limb strength (lat pull-down: M = 4.2 kg, 95% CI [0.3, 8.1]).

6-MINUTE WATER WALKING TEST

Tokmakidis et al. (2008) reported a significant improvement in 6-minute water walking distance after 4 months of training (M = 282.7 m, SD = 21.3, $p < .05$). A non-significant decline was observed during detraining (M = 275.5 m, SD = 32.7), followed by a significant 7.6% increase during retraining (M = 296.4 m, SD = 30.0, $p < .01$)

DISCUSSION

This systematic review aimed to evaluate the effectiveness of water-based (aquatic) exercises in patients with coronary artery disease (CAD), particularly those who underwent coronary artery bypass grafting (CABG). Only three randomized controlled trials (RCTs) met the inclusion criteria, highlighting the scarcity of high-quality studies in this area. Collectively, the studies support the effectiveness of aquatic exercise in improving aerobic capacity (. O_2peak), muscular strength (especially in the lower limbs), and body composition, while also reducing cardiac biomarkers, BMI, and total body fat.

Aerobic capacity, measured through . O_2peak, significantly improved across all included studies. Notably, Tokmakidis et al. (2008) observed that improvements were retained even during detraining and further enhanced after retraining. Water-based exercise showed superior percentage increases in . O_2peak compared to land- and gym-based interventions. This finding aligns with prior meta-analyses (e.g., Guimarães et al., 2023), which suggest that aquatic exercise is more effective in enhancing aerobic capacity than no exercise or land-based alternatives.

Muscle strength also improved with water-based training, particularly in lower limbs. Gains were lost during detraining but regained during retraining (Tokmakidis et al., 2008). Scheer et al. (2021) and other systematic reviews (e.g., Prado et al., 2022) support these findings, though some studies found no major differences between water- and land-based strength gains.

The 6-minute water walking test (6MWT), used as a measure of endurance, improved significantly after aquatic training and retraining (Tokmakidis et al., 2008), confirming its utility in tracking functional improvements in CAD patients. Biomarkers such as NT-proBNP and D-dimer significantly decreased in the water-exercise group (Vasić et al., 2019), suggesting positive physiological adaptations.

Anthropometric outcomes showed mixed results. Tokmakidis et al. (2008) reported significant reductions in BMI, body mass, and skinfolds. Scheer et al. (2021) found reductions only in total body fat, while other parameters such as BMI and circumference measures remained unchanged. These findings are consistent with Cugusi et al. (2020), who noted significant changes in skinfold thickness but not in overall body weight or BMI.

A notable strength of this review is the exclusive inclusion of RCTs. However, a key limitation is the gender imbalance: only 12% of participants were female, which restricts generalizability. Similar trends were observed in prior reviews (Cugusi & Mercuro, 2019), underscoring the need for more gender-inclusive cardiovascular research.

Another important finding is the high adherence to aquatic programs, with Tokmakidis et al. (2008) reporting over 85% attendance, contributing to favorable outcomes. Water-based environments offer additional benefits such as reduced joint stress, greater safety, and improved exercise enjoyment, potentially enhancing adherence and long-term outcomes.

While this review supports aquatic exercise as an effective cardiac rehabilitation strategy, further large-scale, long-term RCTs are needed. These should include diverse patient populations, explore different aquatic protocols, and consider additional outcomes like quality of life, which was not assessed in any of the included studies.

CONCLUSION

Water-based exercises offer significant benefits for patients with coronary artery disease, including improvements in aerobic capacity, muscular strength, vascular function, and body composition. These findings support the incorporation of aquatic exercise as an effective component of cardiac rehabilitation. High adherence rates further emphasize its feasibility and long-term potential. However, the underrepresentation of female participants across studies highlights the need for more inclusive research. Overall, water-based exercise should be recognized as a safe, effective, and valuable strategy in the rehabilitation of CAD patients.

LIMITATIONS

The primary limitation of this review was the small number of included studies (only three studies with a total of 162 participants), which limits the generalizability and robustness of the findings. Additionally, the studies had a significant gender imbalance, with only 12% of participants being female. The variation in study designs such as three arm and two arm RCTs, exercise protocols, and patient populations may also have influenced the results, making it difficult to draw definitive conclusions regarding the most effective type of water-based exercise. Furthermore, quality of life was not assessed in any of the reviewed studies, making it difficult to answer definitively whether water-based exercises lead to patient well-being. Future research with larger, more diverse populations and standardized outcome measures is needed to provide more conclusive evidence on the efficacy of aquatic exercise as part of the cardiac rehabilitation.

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