

Effects of Aquatic Calisthenic High Intensity Interval Training on Functional Capacity in Overweight- An Experimental Study

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DOI: <https://doi.org/10.52403/ijhsr.20241004>

ABSTRACT

Background: Overweight is excessive fat accumulation that may impair health. It is a major health concern related with high health care cost and important co-morbidities. It is known to increase one's risk of cardiovascular diseases. It raises risk of several illnesses and complications. Due to overweight and obesity there is reduced functional capacity and there is decreased quality of life.

Objective: To evaluate the effect of Aquatic Calisthenic High Intensity Interval Training on Functional Capacity in Overweight subjects.

Material and Methods: The study was conducted with 10 Overweight subjects who met the inclusion criteria. After approval of ethical clearance, informed consent from participation was obtained after explaining the purpose of the study. Demographic data and baseline measures were recorded before starting the exercise. Aquatic Calisthenic exercises were performed. The collected data were measured using the open Epi Instat version for Windows statistical software.

Result: In the present study of 10 overweight subjects, the mean age group was 24.4±1.64, and Male/Female 03/07. Before intervention we found Vo₂max was 11.83±1.11 mL/kg per minute and post intervention it was 12.73±1.44 mL/kg per minute. P Value was 0.0047 and was found very significant result.

Conclusion: Aquatic Calisthenic High Intensity Interval Training exercise program for five weeks have proven effective in increasing functional capacity in overweight subjects.

Keywords: Overweight, Functional Capacity, Aquatic Calisthenic High Intensity Interval Training.

INTRODUCTION

In 2024, the WHO described overweight as an excessive fat buildup that may be harmful to one's health. Overweight individuals are identified by the excess fat they carry. ^[1] This primary public health concern is linked

to significant accompanying illnesses and costly medical expenses. ^[2]

BMI does not distinguish lean mass and fat mass. As age increases at a constant BMI, body fat percentage also rises due to a consistent increase in fat mass and a slight

decrease in lean mass. Excessive body fat independently contributes to various obesity-related ailments, including coronary heart disease, diabetes mellitus, and certain cancers, which stem from insulin resistance, endothelial dysfunction, and altered lipid metabolism. Weight in kilograms divided by square meters of height yielded the BMI and then classified into four categories (Underweight, Normal, Overweight, and Obese) according to WHO guidelines. [3]

BMI is commonly used to measure adiposity because it is easy and inexpensive to calculate. More than 1 billion people globally, including 39 million children, 340 million teenagers, and 650 million adults, are affected by overweight and obesity. The World Health Organization (WHO) predicts that 167 million people and children worldwide will be overweight or obese by 2025, leading to a decline in overall health. [4]

More than 88 million individuals in India are affected by excess weight. Various factors, such as age, gender, residence, socioeconomic status, and others, impact the likelihood of obesity in India. [5] The National Family Health Survey (NFHS-3) conducted in 2005–2006, along with a few small-scale studies, indicates a significant rise in obesity in India, particularly among women, highlighting the need for authorities to address this issue. [6]

This negatively impacts the metabolic health of young individuals and can lead to impaired glucose tolerance, T2D, and early-onset metabolic syndrome. [7]

Various factors, including the social environment, education, personal health practices, and culture, can influence the level of health. [8]

Functional capacity generally relates to a person's ability to engage in physical activities like walking, climbing, and other everyday tasks without excessive tiredness or physical strain. Worldwide, hypertension, type 2 diabetes, and cardiovascular disease are the primary noncommunicable diseases that impact daily activities to different extents and are also complications of being

overweight and obese. Maximal/peak oxygen uptake (VO₂ max) objectively measures functional capacity. VO₂max represents the maximum oxygen consumption during exercise. The six-minute walk test (6MWT) is a straightforward, cost-effective, safe, and consistent method for evaluating aerobic fitness. Enhancing functional capacity is closely associated with regular exercise and is deemed significant. [9]

Physical activity is crucial in treating overweight and obesity as it helps decrease body fat, boost lean mass, and alleviate associated health conditions. [10]

The evidence is clear that engaging in exercise leads to a more favorable body composition, reducing body fat and increasing fat-free mass, particularly in people with higher body fat levels. [11]

The physical properties of water, including buoyancy, hydrostatic pressure, viscosity, and density, make it an excellent environment for exercise throughout the year. Water's buoyancy helps to reduce joint loading, improve flexibility, and support body weight. The resistant forces of viscous drag and turbulence in water provide resistance for movements, aiding in muscle strengthening. Engaging in water exercises can enhance agility and balance and promote heart health while lowering the chance of falling compared to exercising on land. [12]

The primary purpose of this study was to examine the impact of high-intensity interval training using aquatic calisthenics on the functional capacity of overweight individuals.

MATERIALS & METHODS

We conducted an experimental study in the Sports Complex Swimming Pool at Tertiary Care Medical College & Hospital Campus. The duration of the study was from 2023-24. Ethical clearance was obtained from the institutional ethics committee, and written informed consent from the participants was acquired. Our study included a convenient sample size of 10 overweight subjects aged 18-50 years, and no regular physical activity

for 3 months before the exercise program was included. Subjects with respiratory and cardiovascular disorders, musculoskeletal disorders, neuromuscular disorders, cutaneous wounds, and skin infections were excluded. The outcome measure included assessing the functional capacity by a 6-minute walk test (6MWT).

The procedure of Aquatic Calisthenic Exercises

- **Familiarization sessions:**

The familiarization sessions were given to the subjects.

The familiarization session consisted of practicing the aquatic calisthenics exercises for the exercise sessions.

This session began with a warm-up period, followed by practice of each aquatic exercise, and ended with a cool-down period.

- **Training sessions:**

Subjects completed 15 exercise sessions that included 3 weekly sessions for 5 weeks. The average time for treatment ranged between 30-40 mins.

The training sessions began with a 5-minute warm-up period that included pool walking, jogging, and pool wall stretches. Each training session included a variety of upper body (UB), lower body (LB), and full body (UB/LB) calisthenic exercises.

Table 1: Protocol of Aquatic Calisthenic Exercises given in training session

Upper body exercises	Lower body exercises	Full body exercises
Sweeping arms	High knee jog	Cross country ski
Arm curls	Back kicks	Cross country ski with Knee tucks
Rolling arms	Straight back extensions	Jumping jacks
Triceps push backs	Flutter kicks	Jumping jacks with knee tucks
Punches	Bicycles	Squat jumps
Triceps dips	Scissors	Hackey sack
Push ups	Hopscotch	Russian twist
Breast stroke arms		

Each week, there were controlled increases in exercise duration and reduced recovery time.

Week 1: 10-second exercise intervals and 50-second active recovery intervals using 8 exercises.

Week 2: 15-second exercise intervals and 45-second active recovery intervals using 8 exercises.

Week 3: 20-second exercise intervals and 40-second active recovery intervals using 12 exercises

Week 4: 25-second exercise intervals and 35-second active recovery intervals using 12 exercises

Week 5: 30-second exercise intervals and 30-second active recovery intervals using 12 exercises

The treated part was submerged under the water.

Each session ended with a 5-minute cool-down period consisting of stretching and locomotor activities.

Outcome Measures were taken at the start of the intervention in 1st week and then in 5th week.

STATISTICAL ANALYSIS

Data was entered in an MS Excel sheet and analysed using Open Epi software instat version 3.06. Quantitative data was expressed in terms of mean and standard deviation. The data obtained was checked for normality by applying the Kolmogorov-Smirnov test. For pre- and post-treatment analysis paired t-test was used for normally distributed data, and Wilcoxon matched pair test was used for data that were not normally distributed. A p-value of <0.05 was considered statistically significant.

RESULT

Table 2 shows the Baseline demographic data

Characteristics	Mean
Male %	30%
Female %	70%
Age (years)	24.4±1.64

Table 3: Pre- and post-intervention comparison of functional capacity

Variable	Pre-intervention	Post-intervention	t value	p-value	Result
VO ₂ max	11.83±1.11	12.73±1.44	3.726	0.0047	Very significant

Graph 1: Graphical representation of Pre-intervention and post-intervention difference of functional capacity

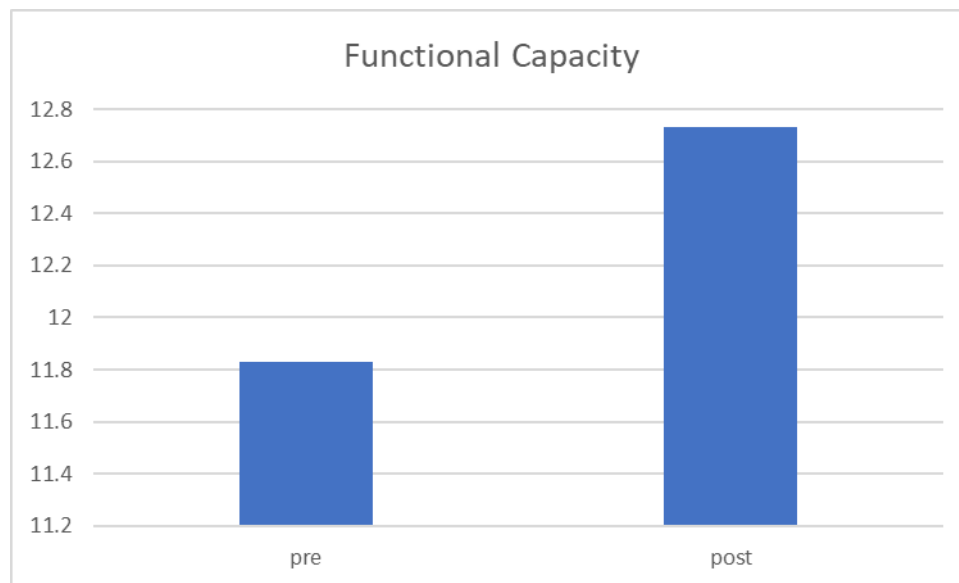


Table 3 and Graph 1 represent pre-intervention and post-intervention mean \pm SD for VO₂ Max obtained by using Six-minute Walk test distance, computed using the paired test as it passed normality. 6 MWT is statistically significant as $p = 0.0047$.

DISCUSSION

The primary purpose of this study is to evaluate the effects of Aquatic Calisthenic High-Intensity Interval Training on Functional Capacity in Overweight subjects. Individuals who are overweight or obese face a high risk of developing various associated health conditions such as cardiovascular disease (CVD), gastrointestinal disorders, type 2 diabetes (T2D), musculoskeletal issues, breathing problems, and mental health issues that might have a big influence on their day-to-day life and increase the risk of death. The conditions related to obesity are numerous; however, even a tiny amount of weight loss could help patients reduce their risk of

CVD, diabetes, obstructive sleep apnea (OSA), hypertension, and many other associated illnesses. [7] Research has demonstrated that reduced functional ability is a trustworthy measure of cardiovascular disease risk and even death. Functional capacity is quantitatively assessed using maximal oxygen uptake (VO₂max). VO₂ max refers to the maximum oxygen consumption during physical activity and is widely regarded as the best method for assessing individuals' cardiovascular fitness levels. [9]

In the study of 10 subjects, the mean age group was 24.4±1.64 and Male/Female 03/07.

In our study, we found statistically significant changes in VO₂max in functional capacity in overweight subjects. Before the intervention, we evaluated functional capacity through a 6-minute walk test. The mean and SD for pre-intervention functional capacity were 11.83±1.11, and after the intervention, functional capacity was 12.73±1.44.

The physical properties of water might be responsible for improving functional capacity. Buoyancy, hydrostatic pressure, viscosity, and density of water significantly contribute to creating resistive forces that enhance muscle strength. Water's resistance during movement increases muscular tension and higher energy expenditure compared to land-based exercises. [10]

Numerous sources backed the study's current results. In 2016, Samara Anastasia examined the impact of Aquatic Exercise on Functional Capacity and Health-Related Quality of Life in Hemodialysis Patients. The research revealed that aquatic exercise enhances the physical functioning and quality of life in hemodialysis patients.

In a study conducted by Natalia-Boneti Moreira et al. (2020), it was noted that water turbulence could increase muscle resistance, mainly when exercises are performed at higher speeds and involve changing direction. [13] According to Vitória Oliveira Silva da Silva et al. (2024), their study highlighted that water could create significant muscle overloads using speed, range of motion, and the specific area covered by hands and feet during movement execution. [14] Therefore, these factors could contribute to enhancing functional capacity.

CONCLUSION

An Aquatic Calisthenic High-Intensity Interval Training exercise program for five weeks has proven effective in increasing functional capacity in overweight subjects.

LIMITATION

In this study, the intervention period was too small of 5 weeks and there was no follow up period taken for the samples.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: I would like to thank my parents. I am highly grateful to Dr. Archana Nagargoje and Dr. Pranali Gaikwad and my colleagues for helpful feedback. Authors would like to thank all the participants for cooperation.

Source of Funding: None

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

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- How to cite this article: Sakshi Achyut Mahajan, Arijit Kumar Das, Abhijit Diliprao Diwate. Effects of aquatic calisthenic high intensity interval training on functional capacity in overweight- an experimental study. *Int J Health Sci Res*. 2024; 14(10):31-36. DOI: <https://doi.org/10.52403/ijhsr.20241004>
