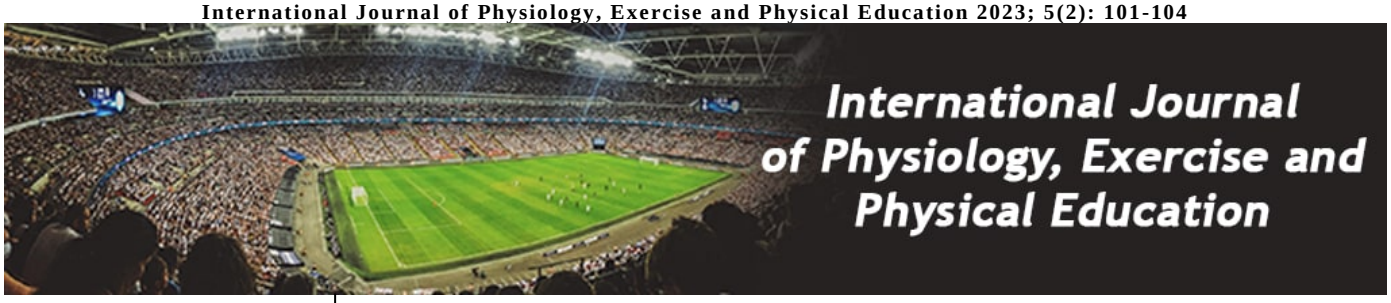

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Effects of a 6-week hydrodynamic conditioning program on physiological variables in young tennis athletes

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Abstract
This study explores the impact of a 6-week hydrodynamic conditioning program on selected physiological variables among tennis athletes aged 18 to 25 in Chennai, Tamil Nadu. A total of 30 participants were divided into an experimental group (n=15) that underwent hydrodynamic training and a control group (n=15) that received no special training. The investigation specifically assesses the effect of the 6-week hydrodynamic conditioning program on resting pulse rate, systolic, and diastolic blood pressure. Analysis of Covariance (ANCOVA) was employed to compare post-intervention scores while controlling for baseline measures, enhancing the study's internal validity. The results revealed significant improvements in resting pulse rate, systolic, and diastolic blood pressure within the experimental group compared to the control group. In the experimental group, the resting pulse rate exhibited a statistically significant decrease, indicating enhanced cardiovascular efficiency. Systolic and diastolic blood pressure also showed significant reductions, suggesting positive adaptations in vascular health. These findings highlight the potential cardiovascular benefits associated with the implementation of hydrodynamic conditioning in the training regimen of young tennis athletes.

Keywords: Hydrodynamic conditioning, tennis athletes, resting pulse rate, systolic, and diastolic blood pressure

Introduction
Hydrodynamic training, conducted in an aquatic environment, offers a novel approach that combines buoyancy and resistance to create a comprehensive and low-impact workout (Nagle, 2017) [7]. The buoyancy of water minimizes stress on joints, making hydrodynamic conditioning an attractive option for individuals recovering from injuries or seeking a preventive measure against the strains of high-impact training (Brody, 2009) [3]. The resistance provided by water fosters engagement of multiple muscle groups, delivering a holistic training experience that transcends traditional land-based exercises (Ahmed, 2021) [1]. This introduction heralds the advent of a dynamic and adaptable training paradigm, aiming to explore the far-reaching implications of hydrodynamic conditioning in the realms of sports performance, rehabilitation, and overall physical well-being. As we delve into the intricacies of this innovative training modality, our goal is to unravel its potential to revolutionize the way athletes train, recover, and optimize their physiological capabilities.

The hydrodynamic program offers a plethora of benefits, including low-impact training that reduces stress on joints, comprehensive muscular engagement leading to improved strength and endurance, and a cardiovascular challenge enhancing overall fitness and stamina. Its versatility allows for a range of exercises tailored to individual needs. For tennis players, the advantages are manifold-improved core strength vital for rotational movements, enhanced agility and quickness essential for court dynamics, joint health preservation, and effective injury rehabilitation (Ivancevic, 2015) [5]. Furthermore, the mental refreshment provided by water training and the cross-training benefits contribute to a holistic approach to tennis player development, promising to revolutionize the way athletes train, recover, and optimize their performance (Calder, 2010) [4].

Training Programme

The duration of training was planned 45min to 1 hour that is from 6.30 to 7.30 a.m., for three days per week for 6 weeks. The training on each day begins with, warm-up followed by prescribed training packages and ended with warm-down process.

Table 1: Training Programme

S. No.	Weeks	Phases	Programmes
1	Week 1 to 2	Introduction of hydrodynamic Training	Water Walking, Aquatic Leg Drives, Water Jogging, Aqua Cycling, Aquatic Jumping Jacks, Aquatic Lunges
2	Week 3 to 4	Increasing Intensity	Aquatic Sprints, Aqua Jogging with High Knees, Aqua Plyometrics, Aqua Power Walk, Water Aerobics
3	Week 5 to 6	Sport-Specific Training	Tennis-Specific Drills, Aqua Shuttle Runs, Water Resistance Band Exercises, Aqua Endurance Challenge, Aqua Yoga

Statistical Procedure

The Analysis of Co-Variance (ANCOVA) which has a set value of $p<0.05$ was performed to find out the significant mean differences.

Results and Discussion

The data collected prior and after the experimental period on

Statistical Procedure

The Analysis of Co-Variance (ANCOVA) which has a set value of $p<0.05$ was performed to find out the significant mean differences.

Results and Discussion

The data collected prior and after the experimental period on problem solving & decision making and Mental Toughness and CG is analysed and presented in table – 2, 3 and 4.

Table 2: ANCOVA for pre and post data on resting heart rate

Test	EG	CG	SV	SS	df	MS	F
Pre	69.13	69.53	B	2	2	0.67	0.71
mean			W	52.40	57	0.94	
Post	66.60	69.40	B	132.60	2	44.20	38.20*
mean			W	64.80	57	1.16	
Adjusted	66.81	69.29	B	128.70	2	42.90	76.57*
mean			W	30.82	56	0.56	

The Pre-Test: The calculated "F" value was 0.71 correspondingly lower and indicates no significant changes. The post-test the obtained "F" value was 38.20 correspondingly higher than the required value and affirmed significant changes. The adjusted post-test: The obtained "F" value was 76.57 correspondingly higher than the required value and affirmed significant changes.

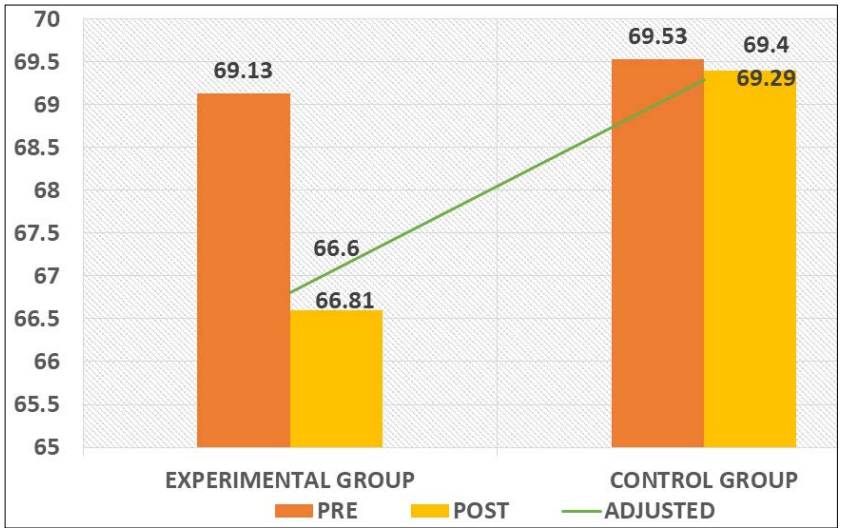

Fig 1: Test differences on resting heart rate

Table 3: ANCOVA for pre and post data on systolic blood pressure

Test	EG	CG	SV	SS	df	MS	F
Pre	112.73	113.00	B	2.33	2	0.78	0.03
mean			W	1625.60	57	29.02	
Post	109.53	113.13	B	342.58	2	114.19	5.08*
mean			W	1260.00	57	22.50	
Adjusted	109.78	113.16	B	356.83	2	118.95	74.31*
mean			W	88.04	56	1.60	

The Pre-Test: The calculated "F" value was 0.03 correspondingly lower and indicates no significant changes. The post-test the obtained "F" value was 5.08 correspondingly higher than the required value and affirmed significant changes. The adjusted post-test: The obtained "F" value was 74.31 correspondingly higher than the required value and affirmed significant changes.

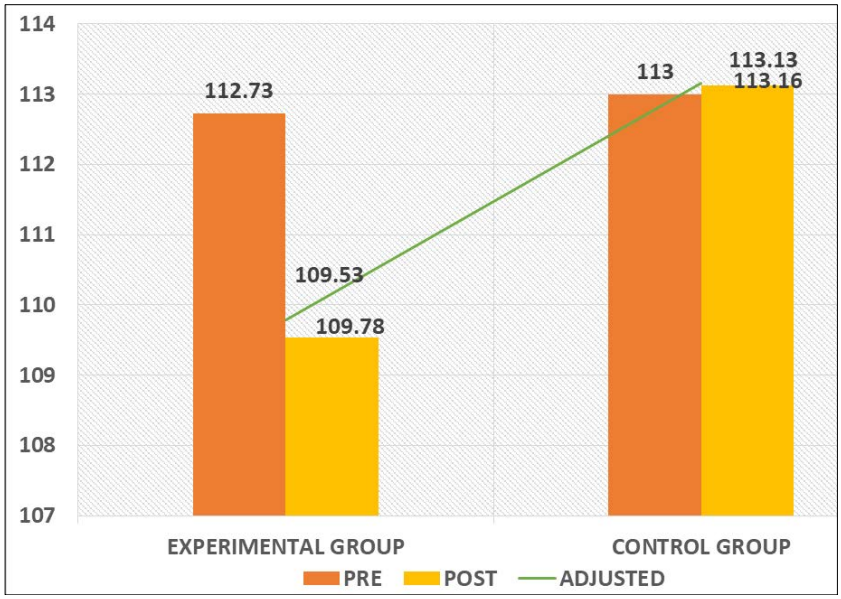

Fig 2: Test differences on systolic blood pressure

Table 4: ANCOVA for pre and post data on diastolic blood pressure

Test	EG	CG	SV	SS	df	MS	F
Pre	77.53	75.86	B	22.53	2	7.51	2.37
mean			W	177.20	57	3.16	
Post	74.73	76.26	B	101.78	2	33.92	10.49*
mean			W	181.07	57	3.23	
Adjusted	74.51	76.50	B	109.19	2	36.39	11.94*
mean			W	167.59	56	3.05	

The Pre-Test: The calculated "F" value was 2.37 correspondingly lower and indicates no significant changes. The post-test the obtained "F" value was 10.49 correspondingly higher than the required value and affirmed significant changes. The adjusted post-test: The obtained "F" value was 11.94 correspondingly higher than the required value and affirmed significant changes.

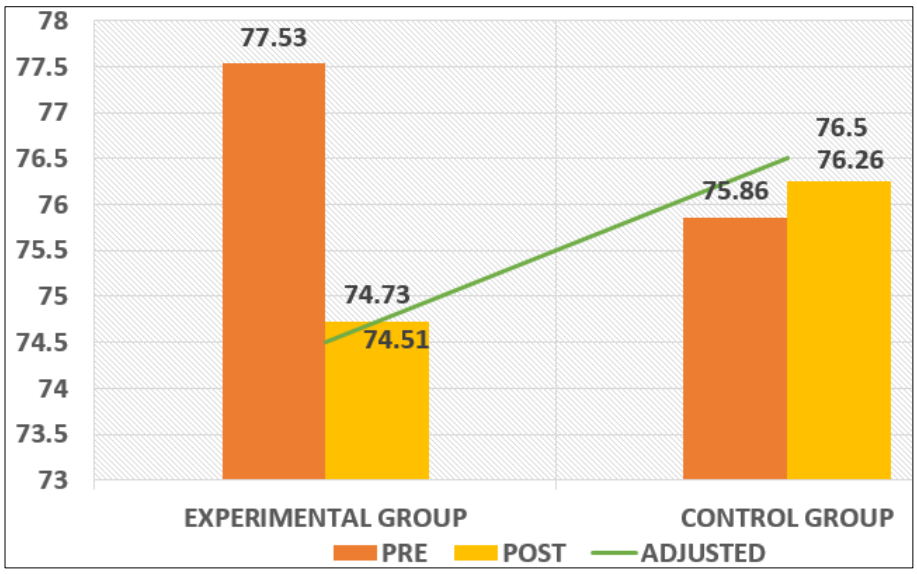

Fig 3: Test differences on diastolic blood pressure

Discussion on findings

Analyzing resting heart rate, systolic, and diastolic blood pressure across pre-test, post-test, and adjusted post-test phases, the findings reveal compelling evidence of significant improvements. The calculated "F" values in the post-test and adjusted post-test consistently exceeded the required values, confirming substantial positive changes. These results align with existing literature, such as Rayar Rozario and Vallimurugan (2020) [10], who found significant improvements in vital capacity and resting heart rate with 12 weeks of aerobic and complex training in football players. Additionally, the outcomes resonate with Avijit and Hiralal (2019) [2], Rohit and Dattaram (2017) [11], Khabiruddin and Deba (2016) [6], and Dharmendra Kaithal and Vikram Singh (2014) [12], all emphasizing the positive impact of aerobic training on variables like resting heart rate and vital

capacity. This collective body of research underscores the effectiveness of structured training programs, including hydrodynamic conditioning. Furthermore, positive effects of a 6-week kettlebell intervention program improving the strength and endurance of volleyball players, as demonstrated by Parasuraman & Mahadevan (2018) [8] and Radhakrishnan (2022) [9], contribute to the understanding of targeted interventions leading to significant improvements in key aspects of physical fitness. The integration of these diverse findings provides valuable insights for optimizing training strategies across different sports.

Conclusion

The findings of this study suggest that a 6-week hydrodynamic conditioning program has a substantial and statistically significant impact on physiological variables, including resting heart rate, systolic, and diastolic blood pressure, among tennis athletes aged 18 to 25 in Chennai, Tamil Nadu.

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