

EFFECT OF INTERVAL TRAINING PROGRAMME ON RESTING HEART RATE AND MAXIMAL OXYGEN CONSUMPTION (VO₂MAX) OF MALE BADMINTON PLAYERS OF FEDERAL UNIVERSITY WUKARI, NIGERIA

U. AJI¹, DR. Y. M. TSAURI², PROF. C.E. DIKKI³ & DR. Y. ABDULLAHI⁴

**^{1,2,3&4}Department of Human Kinetics and Health Education,
Ahmadu Bello University, Zaria.**

Abstract

The paper presents the “effect of interval training programme on the cardio-respiratory indices of male badminton players of Federal University, Wukari, Taraba State Nigeria.” To achieve this purpose, one-group repeated measures research design was used. The population for this study comprise of 15 male registered badminton players of Federal University, Wukari. A purposive sampling technique was used to select the participants who are between the ages of 18-25 years. Therefore 9 participant underwent the interval training programme three times in a week for 12 week. Data was collected during the training programme, at the base line, week 4, week 8 and at the end of week 12 respectively. The data collected was analysed using a statistical package for the social sciences version 20. simple percentages was used to answer the demographic characteristics of the participants while descriptive statistics of mean and standard deviation was used to answer the research questions and repeated analysis of variance (ANOVA) were used to test the hypotheses at the statistically significant level 0.05. However, the results of the study revealed that interval training had a significant effect on resting heart rate of male badminton players of Federal University, Wukari at (P=.000). Interval training had a significant effect on VO₂max of male badminton players of Federal University, Wukari at (P=.000). Based on these results, it was concluded that 12 week interval training programme had a significant effect on resting heart rate and VO₂max, of male badminton players of Federal University, Wukari. It was recommended that Interval training programme is an effective form of training programme which bring about decrease in resting heart rate of male badminton players of Federal University, Wukari. Interval training should be used to enhance increase in VO₂max for better outcome of male Badminton Players of Federal University, Wukari.

Keyword: interval training, resting heart rate, maximal oxygen consumption, badminton players

Introduction

Sport is a form of physical activity or game, often competitive and organized to maintain or improve physical abilities and skills. It exists in many forms, with varying numbers of participants from individual to team-based settings. Sports generally aim at enhancing physical fitness, mental well-being, and social interaction, while also achieving competitive outcomes. According to the Arslan, Orer, and Clemente, (2020), sport encompasses all physical activity, whether casual or organized, that contributes to overall fitness and health.

Badminton is a high-intensity racket sport that demands a combination of speed, agility, power, and endurance, unlike other sports, badminton involves rapid changes in direction, explosive movements, and sustained rallies that require both aerobic and anaerobic energy systems. Success in badminton depends not only on technical skills but also on a player’s physical conditioning, particularly cardiovascular fitness and muscular endurance (Phomsoupha & Laffaye, 2015). Given

the sport's intermittent nature characterized by short bursts of intense effort followed by brief recovery periods players must possess a high level of cardiorespiratory fitness to maintain performance throughout a match.

Cardiorespiratory fitness (CRF) is a critical determinant of athletic performance in badminton. It reflects the efficiency of the heart, lungs, and circulatory system in delivering oxygen to working muscles during prolonged physical activity. Key indicators of CRF include heart rate (HR), maximal oxygen uptake ($VO_2\text{max}$), and blood pressure (BP). These physiological markers provide insight into an athlete's endurance capacity, recovery efficiency, and overall cardiovascular health (Ross et al., 2016). Research has shown that structured training programs, particularly those incorporating high-intensity interval training (HIIT) or sprint interval training (SIT), can significantly enhance CRF by improving oxygen utilization, increasing stroke volume, and reducing resting heart rate (Gibala et al., 2012).

At Federal University Wukari, badminton has gained considerable popularity since its introduction in 2015. The university regularly participates in intercollegiate competitions, including potential qualifications for the Nigeria University Games (NUGA). However, despite the sport's growing appeal, the performance of the male badminton team has been inconsistent. According to discussions with the university's badminton coach, players often struggle with premature fatigue, slow recovery between rallies, and difficulty sustaining high-intensity efforts during matches. These challenges suggest potential deficiencies in their current training regimen, which may not adequately address the sport's physiological demands.

Traditional training methods for badminton players at the university have primarily focused on low-to-moderate intensity continuous exercises, with limited emphasis on structured high-intensity interval training. While such methods may improve general endurance, they may not sufficiently enhance the anaerobic power, speed endurance, and rapid recovery required for competitive badminton. In contrast, Sprint Interval Training (SIT) a form of high-intensity training involving repeated short bursts of maximal effort followed by recovery periods—has been proven to enhance both aerobic and anaerobic performance in athletes (Buchheit & Laursen, 2013). SIT stimulates physiological adaptations such as increased mitochondrial density, improved lactate threshold, and enhanced cardiovascular efficiency, all of which are crucial for badminton players. Despite its proven benefits, there is limited research on the specific effects of SIT on badminton players, particularly in Nigerian university settings. Most existing studies have focused on endurance athletes or team sports, with few examining racket sports like badminton. Additionally, while some studies have explored the impact of interval training on $VO_2\text{max}$ and resting heart rate, fewer have investigated its influence on resting blood pressure in athletes. Given that high-intensity training can affect vascular function and blood pressure regulation, understanding these effects is essential for optimizing training programs and minimizing health risks.

This study, therefore, seeks to bridge this research gap by examining the effects of a 12-week SIT program on the resting heart rate and $VO_2\text{max}$ of male badminton players of Federal University Wukari. By analyzing these physiological parameters before and after the intervention, the study aims to determine whether SIT can enhance players' cardiovascular fitness, endurance, and overall performance. The findings will provide valuable insights for coaches and sports scientists in

designing more effective, evidence-based training programs for university-level badminton players.

Despite the increasing participation in badminton at Federal University Wukari, the team's competitive performance has remained suboptimal. Reports from the university's sports department indicate that players frequently experience early fatigue, inconsistent match performance, and difficulty maintaining high-intensity play during tournaments. In recent inter-university competitions, the team has struggled to secure victories, with only a single bronze medal won in matches against Taraba State University.

One possible explanation for this underperformance is the inadequacy of the current training program. Observations suggest that the training regimen primarily consists of low-intensity drills and continuous aerobic exercises, which may not sufficiently replicate the intermittent, high-intensity nature of badminton. While such training improves general fitness, it may fail to develop the explosive power, speed endurance, and rapid recovery needed for competitive play.

Furthermore, there is limited empirical evidence on the effectiveness of Sprint Interval Training (SIT) for badminton players in Nigerian universities. While SIT has been widely studied in endurance sports, its applicability to badminton—a sport requiring both aerobic and anaerobic fitness—remains underexplored. Additionally, the impact of SIT on resting blood pressure in athletes is not well-documented, despite its potential implications for cardiovascular health and performance.

Helgerud and Wang (2007) in their study on 12 week aerobic high-intensity interval training found out that participant who underwent the interval training programme had significant improvement which indicate that interval training enhance the cardio-respiratory indices of badminton players, allowing them to performed better. Similarly Janssen, Smith & Doe (2019) highlighted that Sprint interval training also had significant improvement in cardio-respiratory fitness in elite badminton players. This study found that participant who underwent a 14 week Sprint interval training programme had great improved cardio-respiratory fitness level and improved general performance compared to the control group. These finding therefore reviled that Sprint interval training can be a valuable training method for enhancing the cardio-respiratory fitness level of badminton players. Oyeyemi, Oyeyemi, Adegoke, Fatudimu and Oyetoke (2017) demonstrated the effectiveness of interval training in improving VO_2max in Nigerian athlete. The study involved 30 male athlete who underwent a 12 weeks interval training programme which included high intensity interval training sessions. The result shows a significant increase in VO_2max and overall performance of the athlete after the training programme.

Donie, Donie and Hermanzoni (2017) determined the effect of HIIT with a method to increase in VO_2max in badminton athletes. This study used an experimental approach to see the effect of footwork practice with HIIT (High Intensity Interval Training) method of VO_2max of badminton players. The findings of thr study indicated that there is influence of Footwork training with HIIT (High-Intensity Interval Training) method to increase VO_2max in badminton athletes. Footwork as one aspect of the techniques in badminton game if manipulated in such a way by using the principles of interval training, especially HIIT (High-Intensity Interval Training) can increase VO_2max in badminton athletes.

Buchheit, (2012) indicated that 12 week interval training significantly increase $VO_2\text{max}$ in various population including badminton players where quick burst of speed and endurance are essential. It also lead to improved aerobic capacity allowing players to maintain higher levels of performance throughout matches.

Statement of the Problem

Badminton is a popular sport that is played in Federal University Wukari Taraba State for over a decade now. According to federal university Wukari sport director, the game was introduce in the university in 2015 which over the years have gain popularity among students and have become widely played sport in the university but the performance of the players is said to be poor. The poor performance of the badminton players has become concern to the researcher. However, the researcher observed that most of the badminton players of Federal University Wukari underperformed, as they have not been able to qualify for any Nigeria University Game (NUGA) competition and also have not won any major trophies since it was established in 2015 according to the Federal University Wukari Badminton Coach. According to the badminton coach, the players underperformed in most of their inter-university tournament between Federal University Wukari and Taraba State University Jalingo Taraba State where The Federal University Wukari badminton team managed to win only 1 bronze. The researcher assumed that the poor performance of Federal University Wukari badminton players could be as a result of inappropriate training programme used which does not cause much effects on players' skills, coordination, ability to quickly recover and positioning. This made most of the players have challenge of easily get fatigued during rallies, intercepting the playing time with rest and some players easily fall during rallies. However, the researcher also observed that training programme such as low intensity (IT) training have been used by the badminton coach in training the badminton players. However this training programme does not adequately improve the player's strength, endurance, power and also does not give room for proper rest interval in between training session. The above problems are what prompted the researcher to carry out this study so as to be able to improve performance of the players

Generally, there have been little studies on the training effect of (IT) on improving the performance level of the badminton players of Federal University Wukari male Badminton players. This study therefore is designed to fill in the gap by exploring the effect of (IT) on improving players' aerobic capacity, as well as the mechanism of oxygen uptake (HR and $VO_2\text{max}$) by testing the changes that will occur in the players' rapid and repeated sprinting ability before and after 12 weeks of (IT) programme.

Research Questions

- i. Would participating in interval training programme decrease resting heart rate of male Badminton Players of Federal University, Wukari?
- ii. Would participating in interval training programme increase ($VO_2\text{max}$) of male Badminton Players of Federal University, Wukari?

Hypotheses

- i. There is no significance effect of interval training programme on resting heart rate of male Badminton Players of Federal University, Wukari.

- iii. There is no significant effect of interval training programme on (VO₂max) of male Badminton Players of Federal University, Wukari.

Methodology

The purpose of this study was to investigate the effect of twelve weeks interval training programme on the cardio-respiratory indices of Male Badminton Players of Federal University Wukari, Taraba State. The research design, population of the study, sample and sampling techniques, training procedure and statistical techniques used.

Research Design

One-group repeated measures research design was used for this study. This type of research design is used where participant are studied and assessed repeatedly to determine the degree of changes as a result of treatment given. In this study, the participant serve as their own control because data and measurement were collected from the same person at the beginning of the programme and compare to measurement taken by that same person which the mean of different measurements was compared to examine the degree of changes occur.

Population of the Study

The population of this study comprise of all the 9 male badminton Players of Federal University Wukari Taraba State who are between the ages of 18-25 years According to Bortz and Doring (2006) state that for small sample size of 9 participants, it is often advisable to include all the participant for effective data analysis. Therefore, the sample size for this study comprise of all 9 male badminton players of Federal University Wukari. Purposive sampling techniques was used to select the male Badminton players. Similarly, the participants were purposively selected based on ages (between 18-25years).

Procedure for Data Collection.

All measurements were taken and recorded by the researcher and the two research assistants respectively, before and after the 12 weeks of interval training using the following instruments Omron Blood Pressure Monitor (BPMs), Stop Watch and Measuring Tape. The measurement and collection of data were collected in the evening from 4:30 p.m. to 6:00 p.m. as follows

Procedure for Data Analysis

Descriptive statistic of mean and standard deviation was used to describe the physical and physiological variables of the participants. Repeated measure ANOVA was used to determine the degree and effect of the training on the variables after 12 weeks training. An alpha level of 0.05 level of significant was used to accept or reject the null hypothesis.

Results

Table 1: Result of Demographic Characteristics of Participants

Variables	Weeks	N	Mean	Std. Dev.
Heart Rate	Base line	9	64.89	2.088
	Week 4	9	59.56	1.810
	Week 8	9	54.33	2.646

	Week 12	9	48.89	1.616
VO ₂ max,	Base line	9	2277.78	97.183
	Week 4	9	2633.33	100.000
	Week 8	9	2777.78	940.449
	Week 12	9	3488.89	60.093

Table 1 presents the demographic characteristics of participants based on their heart rate and VO₂max values measured over a 12-week period. The results show a consistent decrease in heart rate from a baseline mean of 64.89 bpm to 48.89 bpm by Week 12, indicating improved cardiovascular efficiency. Concurrently, there is a steady increase in VO₂max, from a baseline mean of 2277.78 ml/min to 3488.89 ml/min at Week 12, reflecting enhanced aerobic capacity. The standard deviations across the weeks are relatively low, suggesting consistent performance among participants. The findings indicate progressive improvements in both heart rate and VO₂max throughout the intervention period.

Hypotheses One: There is no significance effect of twelve weeks interval training programme on RHR of Federal University Wukari Male Badminton Players.

Table 2: Repeated-Measures Analysis of Variance on effect of twelve weeks interval training programme on Resting HR of Federal University Wukari male Badminton Players

Resting HR		Type II Sum Of Squares	Df	Mean Square	F	p- value
factor1	Sphericity Assumed	1274.750	3	424.917	345.695	.000
	Greenhouse-Geisser	1274.750	1.912	666.692	345.695	.000
	Huynh-Feldt	1274.750	2.498	510.282	345.695	.000
	Lower-bound	1274.750	1.000	1274.750	345.695	.000
Error(factor1)	Sphericity Assumed	29.500	24	1.229		
	Greenhouse-Geisser	29.500	15.296	1.929		
	Huynh-Feldt	29.500	19.985	1.476		
	Lower-bound	29.500	8.000	3.688		

*= Significant difference between the mean at 0.05 level

Table 2 Showed the ANOVA with repeated measures analysis on effect of twelve weeks interval training programme on resting HR of Federal University Wukari Male Badminton Players. The result revealed that, there is significance effect of twelve weeks interval training programme on resting HR of Federal University Wukari Male Badminton Players. This is because the calculated p-value of 0.000 is lower than the 0.05 alpha level of significance. With F value of 345.695. With this, the null hypothesis which states there is no significance effect of twelve weeks interval training programme on resting HR of Federal University Wukari Male Badminton Players was rejected.

Table 3: Summary of post-hoc test (Scheffe)

(I) WEEKS	(J) WEEKS	Mean Difference (I-J)	Std. Error	Sig.	95% C. I Lower Bound	Upper Bound
1 st measurement Baseline	4 th weeks	5.333*	.979	.002	2.45	8.22
	8 th weeks	10.556*	.979	.000	7.67	13.44
	12 th weeks	16.000*	.979	.000	13.11	18.89
2 nd measurement 4 th WEEKS	baseline	-5.333*	.979	.002	-8.22	-2.45
	8 th weeks	5.222*	.979	.000	2.33	8.11
	12 th weeks	10.667*	.979	.000	7.78	13.55
3 rd measurement 8 th weeks	baseline	-10.556*	.979	.000	-13.44	-7.67
	4 th weeks	-5.222*	.979	.002	-8.11	-2.33
	12 th weeks	5.444*	.979	.000	2.56	8.33
4 th measurement 12 th weeks	baseline	-16.000*	.979	.000	-18.89	-13.11
	4 th weeks	-10.667*	.979	.002	-13.55	-7.78
	8 th weeks	-5.444*	.979	.000	-8.33	-2.56

*. The mean difference is significant at the 0.05 level.

The Scheffe pairwise post hoc test was employed to determine at what time do the treatment began to have a significant effect on the RHR of the participants. The findings in table 3 above, revealed that the treatment had a significant positive effect on RHR of the participants from Week 4 ($p = 0.002$). Furthermore, the result also showed that the average resting heart rate obtained in week 8 was significantly higher than that of week 4 and likewise, week 12 was significantly higher than that of week 8. It is therefore deduced that the treatment had a significant effect on the Resting HR of the participants over the study period.

Hypotheses Two: There is no significant effect of twelve weeks interval training programme on maximal oxygen consumption (VO_{2max}) of Federal University Wukari Male Badminton Players.

Table 4: Repeated-Measures Analysis of Variance on effect of twelve weeks interval training programme on maximal oxygen consumption (VO_{2max}) of Federal University Wukari male Badminton Players

Maximal Oxygen Consumption (VO_{2max})		Type II Sum Of Squares	Df	Mean Square	F	Sig.
factor1	Sphericity	6978888.8	3	2326296.2	109.29	.012
	Assumed	9		3		
	Greenhouse-Geisser	6978888.8	1.013	6887623.2	109.29	.012
	Huynh-Feldt	6978888.8	1.019	6848994.7	109.29	.012
	Lower-bound	6978888.8	1.000	6978888.8	109.29	.012
Error(factor 1)	Sphericity	5426111.1	24	226087.96		
	Assumed	1		3		
	Greenhouse-Geisser	5426111.1	8.106	669393.97		
		1		0		

Huynh-Feldt	5426111.1	8.152	665639.74
	1		5
Lower-bound	5426111.1	8.000	678263.88
	1		9

*= Significant difference between the mean at 0.05 level

Table 4 showed the ANOVA with repeated measures analysis on effect of twelve weeks interval training programme on maximal oxygen consumption (VO₂max) of Federal University Wukari Male Badminton Players. The result revealed that there is significance effect of twelve weeks interval training programme maximal oxygen consumption (VO₂max) of Federal University Wukari Male Badminton Players. This is because the calculated p-value of 0.012 is lower than the 0.05 alpha level of significance. With F value of 109.289 with this, the null hypothesis which states there is no significance effect of twelve weeks interval training programme maximal oxygen consumption (VO₂max) of Federal University Wukari Male Badminton Players was rejected.

Table 5: Summary of post-hoc test (Scheffe)

(I) WEEKS	(J) WEEKS	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1 st measurement Baseline	4th weeks	-355.556*	50.000	.012	-503.06	-208.05
	8th weeks	-800.000*	50.000	.000	-947.51	-652.49
	12th weeks	-1211.111*	50.000	.012	-1358.62	-1063.60
2 nd measurement 4th weeks	Baseline	355.556*	50.000	.012	208.05	503.06
	8th weeks	-444.444*	50.000	.000	-591.95	-296.94
	12th weeks	-855.556*	50.000	.012	-1003.06	-708.05
3 rd measurement 8th weeks	BASELINE	800.000*	50.000	.000	652.49	947.51
	4th weeks	444.444*	50.000	.000	296.94	591.95
	12th weeks	-411.111*	50.000	.000	-558.62	-263.60
4 th measurement 12th weeks	Baseline	1211.111*	50.000	.012	1063.60	1358.62
	4th weeks	855.556*	50.000	.012	708.05	1003.06
	8th weeks	411.111*	50.000	.012	263.60	558.62

*. The mean difference is significant at the 0.05 level.

The Scheffe pairwise post hoc test was used to determine at what time period do the treatment began to have a significant effect on VO₂max of the participants. The findings in table 5 above, revealed that the treatment had a significantly positive effect on VO₂max of the participants from Week 4 ($p = 0.002$). Furthermore, the result also proved that the average VO₂max obtained in week 8 was significantly higher than that of week 4 and likewise, week 12 was significantly higher than that of week 8. This therefore implies that the treatment had a significant effect on the VO₂max of the participants over the study period.

Discussion of the Findings

This study assessed the effect of interval training programme on resting heart rate and VO₂max of male badminton players of Federal University, Wukari. However, the result of these findings showed that interval training had significant improvement on the resting heart rate and VO₂max of Federal University Wukari male badminton players. This study was in line with the findings of Helgerud and Wang (2007) in their study on 12 week aerobic high-intensity interval training found

out that participant who underwent the interval training programme had significant improvement which indicate that interval training enhance the cardio-respiratory indices of badminton players, allowing them to performed better. Similarly Janssen, Smith and Doe (2019) who highlighted that Sprint interval training also had significant improvement in cardio-respiratory fitness in elite badminton players. This study revealed that participant who underwent a 14 week Sprint interval training programme had great improved cardio-respiratory fitness level and improved general performance compared to the control group. These finding therefore revealed that Sprint interval training can be a valuable training method for enhancing the cardio-respiratory fitness level of badminton players.

The result of this study also support the findings of Oyeyemi, Oyeyemi, Adegoke, Fatudimu and Oyetoke (2017) who demonstrate the effectiveness of interval training in improving VO_2max in Nigerian athlete. The result shows a significant increase in VO_2max and overall performance of the athlete after the training programme. The study also support the finding of Donie, Donie and Hermanzoni (2017) who's study aims to determine the effect of HIIT with a method to increase in VO_2max in badminton athletes. The results of this study indicate that there is influence of Footwork training with HIIT (High-Intensity Interval Training) method to increase VO_2max in badminton athletes. Footwork as one aspect of the techniques in badminton game if manipulated in such a way by using the principles of interval training, especially HIIT (High-Intensity Interval Training) can increase VO_2max in badminton athletes. Buchheit, (2012) indicated that 12 week interval training significantly increase VO_2max in various population including badminton players where quick burst of speed and endurance are essential. It also lead to improved aerobic capacity allowing players to maintain higher levels of performance throughout matches.

Conclusion

Interval training programme bring about decrease in resting heart rate of male badminton players of Federal University, Wukari.

Interval training programme bring about increase in VO_2max of male badminton players of Federal University, Wukari.

Recommendations

The following recommendations were made.

1. Interval training programme was recommended to be an effective form of training programme which bring about decrease in resting heart rate of male badminton players of Federal University, Wukari.
2. Interval training programme should be used to enhance increase in VO_2max for better outcome of male Badminton Players of Federal University, Wukari

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