

CARDIOVASCULAR FITNESS AND RECOVERY RATE THROUGH ZUMBA EXERCISE

APTIDÃO CARDIOVASCULAR E TAXA DE RECUPERAÇÃO POR MEIO DO EXERCÍCIO DE ZUMBA

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RESUMO

Uma pesquisa quase-experimental utilizando o delineamento de séries temporais foi empregada para avaliar a aptidão cardiovascular e a recuperação da frequência cardíaca dos estudantes do Programa Nacional de Treinamento de Serviço (NSTP) expostos ao exercício de Zumba. Participaram como sujeitos do estudo 66 estudantes do NSTP da Universidade Estadual de Aklan, Visayas Ocidental, Filipinas. A recuperação da frequência cardíaca (RFC) dos estudantes foi a medida cardiovascular estudada. Utilizou-se um oxímetro de pulso para medir a frequência cardíaca dos estudantes durante a prática do exercício de Zumba. A frequência cardíaca em repouso (FCR) dos estudantes foi monitorada ao longo das 6 semanas de duração da atividade. Os resultados revelaram que houve uma diferença significativa na RFC dos estudantes avaliada por meio do teste de 1 minuto e do teste de 2 minutos. Também foi observada uma diferença significativa na recuperação da frequência cardíaca dos estudantes utilizando o teste de 1 minuto entre a semana 1 e a semana 6, semana 2 e semana 6, e semana 2 e semana 5. Foi ainda constatado que, no teste de 2 minutos, houve uma diferença significativa na RFC dos estudantes entre a semana 1 e a semana 3, semana 1 e semana 5, semana 1 e semana 6, semana 2 e semana 4, semana 2 e semana 5, semana 2 e semana 6, semana 3 e semana 5, e semana 3 e semana 6. Verificou-se também uma relação inversa significativa entre a FCR e a RFC dos estudantes no teste de 1 minuto. Uma relação inversa significativa também foi encontrada entre a FCR e a RFC no teste de 2 minutos. Além disso, observou-se uma relação direta significativa entre a FCR e a RFC no teste de 1 minuto. Assim, a recuperação da frequência cardíaca dos estudantes melhorou durante a participação nas aulas de Zumba. Os achados sugerem que a participação no exercício de Zumba melhorou significativamente tanto a FCR quanto a RFC dos estudantes ao longo do programa. Essas melhorias refletem uma melhor aptidão e saúde cardiovascular, ressaltando a importância de incorporar exercícios aeróbicos regulares, como a Zumba, na rotina para promover a saúde do coração entre os jovens.

Palavras-chave: Aptidão cardiovascular, recuperação da frequência cardíaca, exercício de Zumba, educação para a cidadania global.

ABSTRACT

A quasi-experimental research using the time-series design was employed to evaluate the cardiovascular fitness and heart rate recovery of the National Service Training Program (NSTP) students exposed to zumba exercise. 66 NSTP students of Aklan State University, Western Visayas, Philippines took part as subjects of the study. The students' heart rate recovery (HRR) was the cardiovascular measure that was studied. The pulse oximeter was used to measure the heart rate of the students participating in the zumba exercise. The resting heart rate (RHR) of the students was monitored during the 6-week duration of the activity. Results revealed that there was a significant difference in the HRR of the students evaluated using the 1-minute test and the 2-minute test. A significant difference also existed in the students' heart rate recovery using the 1-minute test between week 1 and week 6, week 2 and week 6, and week 2 and week 5. It was also revealed that, in a 2-minute test, a significant difference in the students' HRR happened between week 1 and week 3, week 1 and week 5, week 1 and week 6, week 2 and week 4, week 2 and week 5, week 2 and week 6, week 3 and week 5, and week 3 and week 6. It was also revealed that there was a significant inverse relationship between students' RHR and HRR in a 1-minute test. A significant inverse relationship also existed between students' RHR and HRR in a 2-minute test. Moreover, a significant direct relationship exists between the students' RHR and HRR in a 1-minute test. Hence, the heart rate recovery of the students had improved while participating in the Zumba Dance Exercise. The findings suggest that participation in the Zumba Dance Exercise significantly improved both the RHR and HRR of the students over the course of the program. These enhancements reflect better cardiovascular fitness and health, underscoring the importance of incorporating regular aerobic exercise like Zumba into the routine for improving heart health in youth.

Keywords: Cardiovascular fitness, heart rate recovery, zumba exercise, global citizenship education.

Introduction



A significant global concern is the rising incidence of non-communicable diseases (NCDs). As per the World Health Organization (WHO)¹ Fact Sheet, non-communicable diseases (NCDs) were responsible for over 71% of fatalities worldwide, with low- and middle-income countries accounting for approximately 75% of these deaths¹.

A common roadmap for peace and prosperity for people and the planet, both now and in the future, is provided by the 2030 Agenda for Sustainable Development, which was accepted by all United Nations Member States in 2015. Additionally, the SDG3 guarantees healthy lives and promotes wellbeing for people of all ages². Through the promotion of global citizenship, higher education is seen to be able to improve global health³. Hence, GCED contributes to the realization of the values and vision of the United Nations, and the Sustainable Development Goals (SDGs).

For this purpose, exercise is being defined as “a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective the improvement or maintenance of physical fitness⁴. Exercise has also been found to have beneficial effects on the heart⁵. It is widely accepted that regular physical activity is beneficial for cardiovascular health. It is also being discussed by Tikkanen, Gustafsson and Ingelsson⁶ that fitness and physical activity demonstrated inverse associations with incident cardiovascular disease in the general population. Frequent physical activity has significant and long-lasting preventive benefits against the onset of cardiovascular disease⁷. However, Wang, Qu, Yangm, Yang, Lu, and Ren⁸, mentioned that there is an extensive body of research demonstrating a negative correlation between the risk of cardiovascular morbidity and mortality with the degree of habitual exercise and cardiorespiratory fitness. Vendramin, Bergamin, Gobbo, et.al⁹ also emphasized that Zumba is an alternative to the traditional approach to physical exercise having new kinds of organized physical activity which have been developed and designed to engage large segments of the population.

In addition, Barranco-Ruiz, Yaira and Villa-González¹⁰ mentioned that exercise interventions based on Zumba fitness combined with an extra muscle-strengthening workout based on bodyweight training exercises are effective strategies to improve the health-related physical fitness.

Santa Packyanathan and Preetha¹¹ also pointed on how zumba dancing can lower blood pressure because it lowers the morbidity and death rates associated with cardiovascular illnesses. Puspodari, Wiriawan, Setijono, et.al¹² also found that when students participated in Zumba exercise for 30 minutes each training session, their VO2max, muscle power, and agility increased. Nonetheless, according to DiPietro, Al-Ansari, Biddle et al.¹³, 28% of adults over the age of 18 and 81% of teens aged 11 to 17 worldwide still do not meet the WHO's recommendations for physical exercise.

To achieve the goals of the Global Citizenship Education Development (GCED), people must acquire the values, knowledge, and abilities necessary to become engaged, accountable, and responsible citizens who help create more just, peaceful, and sustainable societies³. Tran, Silvestri-Elmore and Sojobi¹⁴ examined the three co-occurrences of cardiovascular risk factors: drinking alcohol and being overweight, drinking alcohol and having a family history of heart disease, and overweight and having a history of heart disease.

Involving student to physical activities that could develop their social and emotional values is of great importance. With this, they can contribute well for a healthy environment and become a productive citizen of the country. Thus, keeping track of the heart rate is a simple activity which can give an insight into one's fitness level both heart health and emotional health¹⁵. Hence, through Zumba exercise, this study will ascertain the students' cardiovascular fitness and recovery rate, both of which have significance for achieving the GCED goals and objectives.

Methods

Research Design

This study employs a quasi-experimental research design, specifically a time series design, to investigate the effects of a 6-week Zumba exercise program on participants. Quasi-experimental designs are often used when randomization or a control group is not feasible due to ethical, logistical, or practical constraints¹⁶. In a time series design, data is collected at multiple intervals before, during, and after the intervention to observe trends and changes over time. This approach allows the study to track the progress of participants and evaluate the potential effects of the intervention, even in the absence of a control group¹⁷.

The decision not to include a control group is primarily due to practical and ethical considerations. Denying a potentially beneficial intervention like Zumba to a control group might raise ethical concerns, especially when the program is expected to enhance participants' physical and mental well-being¹⁸. Moreover, the primary objective of the study is to assess how participants respond to the Zumba program over time rather than comparing them to a separate group. This makes the time series design an appropriate and practical choice despite its inherent limitations.

Sample

The subjects were purposively selected, taking the National Service Training Program subject, both male and female, aged from 18 years old to 21 years old, and enrolled as first-year students at Aklan State University in New Washington, Aklan, Western Visayas, Philippines, during the academic year 2023–2024. Among the 243 students, only 66 completed the program. The study excludes students who have serious cardiovascular problems or medical illnesses that make vigorous physical exercise inappropriate, including those who are recuperating from injuries that could make participation difficult.

Procedures

The students' heart rate recovery (HRR) was the cardiovascular measure that was studied. The pulse oximeter was used to measure the heart rate of the students participating in the zumba exercise. The resting heart rate (RHR) of the students was monitored during the 6-week duration of the activity. In order to ensure the subjects' health and obtain permission from their parents, a medical certificate and waiver were needed from them. Every student who was eligible to take part in the activity was included in the study's subject list. The training program was considered prior to the intervention that included Zumba exercise sets of several intensities, including low, moderate, and high, as well as input from fitness professionals. Improvisation was integrated with other techniques to create the program. A qualified Zumba instructor and a physical education instructor were among the five specialists that validated the developed training program afterwards, evaluating its efficacy. Iterative improvement and expert input were used to validate the program. The five experts' opinions, recommendations, and criticisms were taken into consideration, guaranteeing that the program satisfied a range of demands while upholding its fundamental values of enjoyment and participation. To determine the heart rate of the students, the pulse oximeter was the device used to assess the cardiovascular fitness and recovery rate of the students exposed to Zumba exercise. The researcher also sought support from other government agencies, like Local Government Unit and the Department of Health. Further, the school nurse and graduate education students were requested to assist the researcher in getting the heart rate of the students after the exercise. The study was conducted every Saturday for 6 weeks for 45 minutes, starting at 8:00 a.m. to 8:45 a.m. among the NSTP students. To conduct the activity smoothly, the subjects of the study were grouped into small

groups and assisted by the graduate education students. The graduate education students were assigned to a particular group, and they were responsible for getting the heart rate of the students before and after the zumba. This was a strategy used in order to get the heart rate of the students right away after the zumba exercise.

Before the start of the exercise, the heart rate of the students was obtained using the pulse oximeter. The obtained data served as their resting heart rate. Thereafter, zumba was introduced, consisting of low, moderate, and high-intensity exercises among the subjects of the study for 45 minutes. After the exercise, the researcher, together with the sixty-three (63) graduate education students and supervised by the school nurse, automatically got the heart rate of the students. The heart rate was monitored every minute until it returns to its resting heart rate. Once the heart rate of the students returns to its pre-exercise resting heart rate, the monitoring of heart rate ends. After the 6-week activity, only 66 students completed the program. After the 6-week activity, only 66 students completed the program. Energy levels and the capacity to perform Zumba are significantly influenced by diet. In fact, the physical surroundings may make it more difficult to engage in physical activity. Hence, these characteristics may have an impact on participants' success outside of the program.

Statistical analysis

After exercise, the heart rate was monitored and tracked. The bpm was got right after the exercise (peak heart rate), then measuring again after 1 minute and 2 minutes¹⁹. Microsoft Excel was used to compile and total the data, and the Statistical Package for Social Sciences (SPSS) was used for statistical analysis and subsequent interpretation. Frequency, mean, and percentage were used for descriptive statistics, while the Spearman rho and Friedman test with pairwise comparison and Bonferonni adjustment were used for inferential analysis. Moreover, Cohen's d was used to determine the effects size and interpreted as follows: 0.0 – 0.1, no effect, 0.2 – 0.4, small effect, 0.5 – 0.7, intermediate effect, and 0.8 - >1.0, large effect²⁰.

In the Friedman test for repeated measures, adjusted significance accounts for the increased likelihood of Type I errors due to multiple pairwise comparisons. Adjusted significance values are p-values that have been corrected using the Bonferroni adjustment, which ensures that the overall family-wise error rate (FWER) does not exceed the specified significance level²¹.

Moreover, the use of nonparametric test such as Spearman rho and Friedman test were due to the noncompliance of the data to the normality assumption. The table below shows the test of normality using Kolmogorov-Smirnov test.

Table 1. Test of Normality Using Kolmogorov-Smirnov Test.

		Kolmogorov-Smirnov ^a			Interpretation
		Statistic	df	Sig.	
1-Minute Test					
	Week 1	0.109	66	0.048	Not Normal
	Week 2	0.099	66	0.176	Normal
	Week 3	0.137	66	0.003	Not Normal
	Week 4	0.117	66	0.026	Not Normal
	Week 5	0.123	66	0.014	Not Normal
	Week 6	0.151	66	0.001	Not Normal
2-Minute Test					
	Week 1	0.070	66	0.200	Normal
	Week 2	0.123	66	0.014	Not Normal
	Week 3	0.085	66	0.200	Normal
	Week 4	0.109	66	0.048	Not Normal
	Week 5	0.130	66	0.008	Not Normal
	Week 6	0.123	66	0.015	Not Normal

Source: The author.

Heart Rate Recovery (HRR) was computed using the following:

1-Minute Test: Peak Heart Rate – Heart Rate (After 1 Minute) = HRR

2-Minute Test: Peak Heart Rate – Heart Rate (After 2 Minute) = HRR

HRR less than or equal to 12 beats per minute (1-Minute Test) and HRR less than 22 beats per minute (2-Minute Test) were considered “Not Normal”¹⁷. On the other hand, 50 to 90 beats per minute is considered a “normal” Resting Heart Rate¹⁹.

Results

Table 2 illustrates significant difference in the heart rate recovery of the students ($X^2 = 33.826$, $p\text{-value} = 0.000$) evaluated using the 1-minute test. Moreover, significant difference in the heart rate recovery of the students ($X^2 = 87.769$, $p\text{-value} = 0.000$) evaluated using the 2-minute test is also evident. These results implied that there is an improvement in the heart rate recovery of the students who participated in the Zumba Dance Exercise.

Table 2. Difference in the Heart Rate Recovery of the Students in the Duration of Zumba Dance Exercise

Zumba Dance Exercise					
	Mean	Chi-square Value	Df	p-value	Decision
1-Min. Test					
Week 1	11.76	33.826	5	0.000*	Reject Ho
Week 2	11.55				
Week 3	11.95				
Week 4	12.39				
Week 5	12.62				
Week 6	12.52				
2-Min. Test					
Week 1	18.36	87.769	5	0.000*	Reject Ho
Week 2	19.15				
Week 3	20.42				
Week 4	21.91				
Week 5	22.70				
Week 6	22.61				

Legend: * - significant at 0.05 level

Source: Author

Table 3 showed that significant difference in the students' heart rate recovery using the 1-minute test happened between week 1 and week 6 (Adj. $p\text{-value} = 0.007$, $d = 0.16$), week 1 and week 5 (Adj. $p\text{-value} = 0.006$, $d = 0.18$), week 2 and week 6 (Adj. $p\text{-value} = 0.008$, $d = 0.26$), and week 2 and week 5 (Adj. $p\text{-value} = 0.006$, $d = 0.27$). These results indicate that significant improvement in the heart rate recovery happened in at least 4 weeks of Zumba Dance Exercise (minimum: week 2 to 5). This improvement accounts for small effects size ranging from the Cohen's d value of 0.16 – 0.27. This imply that there is a small improvement in the students' heart rate recovery when 1 min-test was used to determine the impact of the Zumba Dance Exercise. These small effects could stem from the inherent limitations of the 1-minute test in detecting larger physiological changes or from variations in individual fitness levels and

recovery rates among participants. Additionally, it suggests that the cardiovascular benefits of Zumba may require longer engagement or higher intensity to achieve more substantial results.

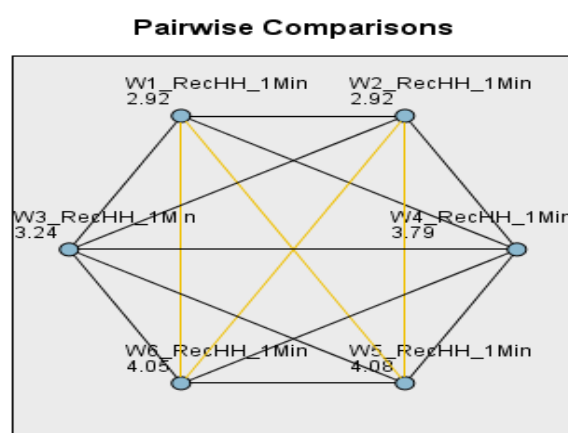


Figure 1. Network Diagram for Pairwise Comparison of the 6-week heart rate recovery of the students in 1-minute test

Source: the author.

Table 3. Pairwise comparison of the 6-week heart rate recovery of the students in 1-minute test

	Test Statistic	Std Error	Std.Test Statistic	Sig.	Adj. Sig.	Effect Size (Cohen's d)
W1_ 2Min- W2_ 2Min	-.477	.326	-1.466	.143	1.000	0.10
W1_ 2Min- W3_ 2Min	-1.000	.326	-3.071	.002	.032	0.27
W1_ 2Min- W4_ 2Min	-1.712	.326	-5.257	.000	.000	0.51
W1_ 2Min- W5_ 2Min	-2.076	.326	-6.374	.000	.000	0.63
W1_ 2Min- W6_ 2Min	-2.098	.326	-6.444	.000	.000	0.66
W2_ 2Min- W3_ 2Min	-.523	.326	-1.605	.108	1.000	0.17
W2_ 2Min- W4_ 2Min	-1.235	.326	-3.792	.000	.002	0.41
W2_ 2Min- W5_ 2Min	-1.598	.326	-4.908	.000	.000	0.53
W2_ 2Min- W6_ 2Min	-1.621	.326	-4.978	.000	.000	0.55
W3_ 2Min- W4_ 2Min	-.712	.326	-2.187	.029	.432	0.24

W3_ 2Min- W5_ 2Min	-1.076	.326	-3.303	.001	.014	0.38
W3_ 2Min- W6_ 2Min	-1.098	.326	-3.373	.001	.011	0.39
W4_ 2Min- W5_ 2Min	-.364	.326	-1.117	.264	1.000	0.15
W4_ 2Min- W6_ 2Min	-.386	.326	-1.186	.235	1.000	0.15
W5_ 2Min- W6_ 2Min	-.023	.326	-.070	.944	1.000	0.02

Source: Author

Table 4 revealed that, in 2-minute test, significant difference in the students' heart rate recovery happened between week 1 and week 3 (Adj. p-value = 0.032, $d = 0.27$), week 1 and week 4 (Adj. p-value = 0.000, $d = 0.51$), week 1 and week 5 (Adj. p-value = 0.000, $d = 0.63$), week 1 and week 6 (Adj. p-value = 0.000, $d = 0.66$), week 2 and week 4 (Adj. p-value = 0.002, $d = 0.41$), week 2 and week 5 (Adj. p-value = 0.000, $d = 0.53$), week 2 and week 6 (Adj. p-value = 0.000, $d = 0.55$), week 3 and week 5 (Adj. p-value = 0.014, $d = 0.38$), and week 3 and week 6 (Adj. p-value = 0.011, $d = 0.39$). These results indicate that significant improvement in the heart rate recovery in 2-min. test happened in at least 3 weeks of Zumba Dance Exercise (minimum: week 1 to 3, week 2 to 4, and week 3 to 5) students' participation. Furthermore, computed effect size that ranges from small effects to intermediate effects showed that small effect sizes ($d=0.20-0.49$) indicate that while the differences are statistically significant, the magnitude of the change in heart rate recovery is relatively modest. On the other hand, Moderate effect sizes ($d=0.50-0.79$) represent a more substantial and meaningful improvement. For example, the effect sizes of $d = 0.63$ (Week 1 vs. Week 5) and $d = 0.66$ (Week 1 vs. Week 6) reflect considerable enhancements in heart rate recovery, emphasizing the significant impact of consistent Zumba participation. The study Rodrigues-Krause, Dos, Santos, et.al²⁸ conformed to the result of the study that exercise intensity of Zumba was superior to low-intensity aerobic exercise, with HR and lactate responses corresponding to participants' VT2.

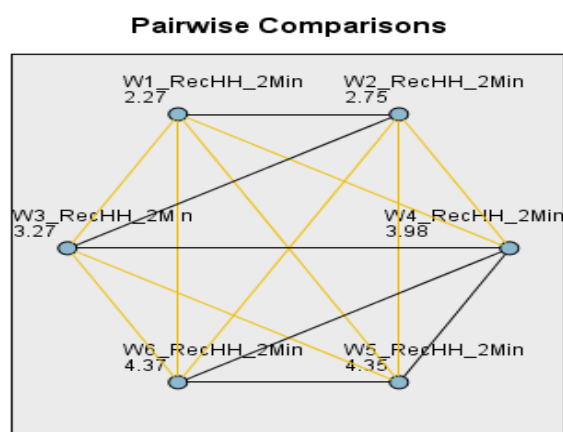


Figure 2. Network Diagram for Pairwise Comparison of the 6-week heart rate recovery of the students in 2-minute test

Source: the author.

Table 4. Pairwise comparison of the 6-week heart rate recovery of the students in 2-minute test

	Test Statistic	Std Error	Std.Test Statistic	Sig.	Adj. Sig.	Effect Size (Cohen's d)
W1_ 2Min- W2_ 2Min	-.477	.326	-1.466	.143	1.000	0.10
W1_ 2Min- W3_ 2Min	-1.000	.326	-3.071	.002	.032	0.27
W1_ 2Min- W4_ 2Min	-1.712	.326	-5.257	.000	.000	0.51
W1_ 2Min- W5_ 2Min	-2.076	.326	-6.374	.000	.000	0.63
W1_ 2Min- W6_ 2Min	-2.098	.326	-6.444	.000	.000	0.66
W2_ 2Min- W3_ 2Min	-.523	.326	-1.605	.108	1.000	0.17
W2_ 2Min- W4_ 2Min	-1.235	.326	-3.792	.000	.002	0.41
W2_ 2Min- W5_ 2Min	-1.598	.326	-4.908	.000	.000	0.53
W2_ 2Min- W6_ 2Min	-1.621	.326	-4.978	.000	.000	0.55
W3_ 2Min- W4_ 2Min	-.712	.326	-2.187	.029	.432	0.24
W3_ 2Min-						

W5_ 2Min	-1.076	.326	-3.303	.001	.014	0.38
W3_ 2Min- W6_ 2Min	-1.098	.326	-3.373	.001	.011	0.39
W4_ 2Min- W5_ 2Min	-.364	.326	-1.117	.264	1.000	0.15
W4_ 2Min- W6_ 2Min	-.386	.326	-1.186	.235	1.000	0.15
W5_ 2Min- W6_ 2Min	-.023	.326	-.070	.944	1.000	0.02

Source: Author

Finally, Table 5 revealed that in week 1, there is a significant inverse relationship between students' resting heart rate and heart rate recovery in 1-minute test ($\rho = -0.268$, $p\text{-value} = 0.030$). Significant inverse relationship also exists in students' resting heart rate and heart rate recovery in 2-minute test ($\rho = -0.323$, $p\text{-value} = 0.008$). These results imply that during week 1 of the Zumba Dance Exercise, students with higher resting heart rate tend to have lower heart rate recovery in both 1-minute test and 2-minute test. Moreover, significant direct relationship exists in the students' resting heart rate and heart rate recovery in 1-minute test ($\rho = 0.306$, $p\text{-value} = 0.012$). This could imply that, in week 6, students who have an improved resting heart rate (normal: 50-90 bpm) have also improve their heart rate recovery. This may imply further that students with healthy heart rate could have a faster heart rate recovery. The findings conformed to the study of Vendramin, Bergamin, Gobbo, Cugusi, et.al⁹ discussed that Zumba fitness can be thought of as an efficient kind of exercise that increases aerobic capacity.

Table 5. Relationship in the Resting Heart Rate and Heart Rate Recovery of the Students Exposed to Zumba Dance Exercise

	Rho	p-value	Decision
Week 1			
1-Min. Test	-0.268	0.030*	Reject Ho
2-Min. Test	-0.323	0.008*	Reject Ho
Week 2			
1-Min. Test	-0.203	0.103	Accept Ho
2-Min. Test	-0.107	0.394	Accept Ho
Week 3			
1-Min. Test	-0.012	0.926	Accept Ho
2-Min. Test	0.028	0.821	Accept Ho
Week 4			
1-Min. Test	-0.119	0.341	Accept Ho
2-Min. Test	-0.167	0.180	Accept Ho
Week 5			
1-Min. Test	-0.016	0.897	Accept Ho
2-Min. Test	-0.116	0.354	Accept Ho
Week 6			
1-Min. Test	0.306	0.012*	Reject Ho
2-Min. Test	0.194	0.118	Accept Ho

Note: Legend: * - significant at 0.05 level

Source: Author

Discussion

The students' heart rate recovery as measured by the 1- and 2-minute assessments is statistically significant, indicating that the students who engaged in the Zumba Dance Exercise had a better heart rate recovery. The findings indicated that there was a substantial variation in the students' heart rate recovery utilizing the 1-minute test from week 1 to week 6, week 2 to week 6, and week 2 to week 5. These outcomes show that after at least four weeks of Zumba dancing exercise, there was a noticeable improvement in heart rate recovery. The result conforms to the study of Vijayalakshmi, Kavitha, and Jayachitra²² that after twelve weeks of Zumba dancing instruction, schoolgirls' physical fitness considerably increased. A similar result has been noticed by Alhajri²³ that BMI, body fat percentage, and insulin resistance significantly improve after 16 weeks of moderate-to-intense Zumba dancing classes, held five days a week for 60 minutes each. Further, the research of Prakash²⁴ found that both Zumba training and step aerobics significantly improved blood pressure and lipid profiles after a 6-week intervention. Maximal oxygen uptake and body composition after 40 weeks of Zumba activity showed moderate-to-large absolute effect sizes as observed by Cugusi, Manca, Bergamin, Di Blasio, & Yeo²⁵.

Moreover, there was a discernible difference in the students' heart rate recovery in the 2-minute test between weeks 1 and 3, 1 and 4, 1 and 5, 1 and 6, 2 and 4, 2 and 5, and three weeks 1 and 6. Additionally, a 1-minute test reveals a substantial inverse relationship between students' resting heart rates and their heart rate recovery. In a test of 2 minutes, there is also a substantial inverse link between the resting heart rate of students and their heart rate recovery. These findings suggest that students with a greater resting heart rate during the first week of the Zumba Dance Exercise likely to recover their heart rates more slowly in the 1- and 2-minute tests.

Moreover, in a 1-minute test, there is a significant direct correlation between the students' resting heart rates and their heart rate recovery. According to Ljubojevic, Jakovljevic, Bijelic, et.al²⁶ following the Zumba Fitness program, forced expiratory volume, vital capacity, and lung age all shown a noteworthy improvement in the experimental group's respiratory function metrics. Body mass, BMI, and fat mass were the three indicators of body composition that saw a substantial decline. Thus, Zumba Fitness is useful forms of exercise that helps ladies who are sedentary improve their respiratory health in addition to decreasing body parameters. Moreover, an 8-week Zumba workout regimen may have a positive impact on parameters related to weight, body fat percentage, muscle mass, MaxVo2, flexibility, and strength¹⁵. Eroğlu Kolayış & Arol²⁷ also discovered that among high school adolescents with a high body mass index, ages 15–17, the eight-week zumba exercise program had favorable impacts on body composition values, functional mobility assessment results, and dynamic balancing parameters.

When compared to rest, zumba and aerobic exercise raised lactate responses at 25 minutes and post-exercise²⁸. Cardiovascular activity was not as energy-dense as Zumba. Additionally, women with lower body fat attained a higher HR, spent less time at light to very light effort, and spent more time at moderate intensity than those with higher body fat²⁹. Furthermore, the study of Soleiman, Elkilany, Al-Sayed, & Abdelsalam³⁰ revealed that zumba activities are a highly effective teaching and learning tool for physical education classes. Additionally, according to Sahin, Uzun, and Çingöz¹⁵, an 8-week Zumba exercise program may have a good impact on parameters related to flexibility, strength, body muscle mass, weight, and body fat percentage. Çağlar³¹ also mentioned that zumba exercise significantly impacted the inactive women's body weight, BMI, FFM, flexibility, balance, fat mass, chest, hip, and waist circumference, and body fat percentage.

Based on the obtained results, it can be recommended that Zumba Dance Exercise can be integrated into regular physical activity routines to improve cardiovascular health among

students. Promote awareness about the benefits of regular aerobic exercise, such as Zumba, to motivate students to participate actively and adopt healthier lifestyle habits. According to Łęcka and de Kuyper³², solutions that are most readily accessible to everyone can likely help fulfill the goal of enabling all residents, regardless of socioeconomic level, to engage in physical activity on a daily basis. Development frequently encourages better health, and good health typically makes society progress easier³³. Marcela³⁴ also stated that subjects exposed to Zumba dancing demonstrated higher levels of brain activity than the control group, which displayed working memory values that were correlated with inferior cognitive capacity. Engaging parents and the broader community in these programs, through extension projects or activities, can further support a culture of health and fitness beyond the school environment. Likewise, educational institutions and health organizations may consider incorporating regular Zumba dance exercise programs into their physical education curriculum and community fitness initiatives.

Conclusion

The results demonstrate that participation in the Zumba Dance Exercise significantly improved both the RHR and HRR of the students over the program. There was a noticeable decrease in the average RHR in week 1 to week 6. Concurrently, the percentage of students with a normal RHR increased in week 1 to week 6. Similarly, the average HRR showed significant improvements in both the 1-minute and 2-minute tests over the 6-week period indicating that regular participation in Zumba Dance Exercise can effectively improve RHR and HRR, suggesting improved cardiovascular health. Furthermore, the identified significant inverse relationship between RHR and HRR in week 1, indicating that students with higher RHR had lower HRR and by week 6, a significant direct relationship was observed in the 1-minute test is suggesting that improvements in RHR were associated with better HRR. This reinforces the benefits of improved resting heart rates on overall heart recovery post-exercise. Finally, a structured Zumba Dance Exercise program can lead to significant improvements in both resting heart rate and heart rate recovery among students. These enhancements reflect better cardiovascular fitness and health, underlining the importance of incorporating regular aerobic exercise like Zumba into the routine for improving heart health in the youth. Further, several methodological enhancements can be proposed to improve the validity and thoroughness of research on Zumba's effects. These include conducting comparative interventions, integrating qualitative assessments like focus groups and interviews, ensuring sample diversity, and incorporating control groups to create a baseline against which Zumba's effects can be measured.

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