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Assessment of Cardiorespiratory Fitness Status and Physical Activity Level among Genders of Students of Evangel University Akaeze, Ebonyi State of Nigeria.

Amaeze, A. A[1].;Offiong, Iniobong Godwin[2]; Amaeze, F. N[2]; Ibe, C. N.[3]; Agoha, R. C.[4];Ezema, C. I.[1] and *Obeagu, Emmanuel Ifeanyi[5]

[1]Department of Physiotherapy, Evangel University, Akaeze, Ebonyi State, Nigeria.
[2]Department of Public Health, Evangel University, Akaeze, Ebonyi State, Nigeria.
[3]Department of Public Health Education, Enugu State University of Science and Technology, Enugu State, Nigeria.
[4]College of Nursing Science, National Orthopedic Hospital, Enugu, Nigeria.
[5]Department of Biomedical and Laboratory Science, Africa University, Mutare, Zimbabwe
*Corresponding author: *Emmanuel Ifeanyi Obeagu,Department of Biomedical and Laboratory Science, Africa University, Mutare, Zimbabwe, email: emmanuleobeagu@yahoo.com*

Abstract

Cardiorespiratory fitness (CRF) and physical activity (PA) are critical indicators of cardiovascular health and overall well-being. Understanding gender differences in these parameters among university students can inform targeted health promotion strategies. This study assessed the cardiorespiratory fitness status and physical activity levels of male and female students at Evangel University, Akaeze, Ebonyi State, Nigeria. A cross-sectional study was conducted among 316 undergraduate students (121 males, 195 females) aged 18–27 years. Cardiorespiratory fitness was evaluated using the Queen's College Step Test to estimate VO_2 max, while PA levels were assessed using the International Physical Activity Questionnaire (IPAQ). Data distribution was tested using the Kolmogorov-Smirnov test, and non-parametric analyses, including Mann-Whitney U and Kruskal-Wallis tests, were employed to assess gender differences and associations ($p< 0.05$). Males exhibited significantly higher VO_2 max compared to females (median rank: 255.21 vs. 98.49, $p< 0.001$), while females reported higher PA levels (mean rank: 170.21 vs. 139.63, $p = 0.004$). Females had higher pre-exercise pulse rates and SpO_2, whereas post-exercise cardiovascular parameters were largely comparable between genders. A significant association was observed between VO_2 max and PA levels (p

= 0.008), highlighting the positive impact of physical activity on cardiorespiratory fitness. Male students demonstrated superior cardiorespiratory fitness, whereas female students reported higher physical activity levels. The significant relationship between PA and VO_2 max emphasizes the need for structured, gender-sensitive interventions to enhance cardiovascular health and overall fitness among university students.

Keywords: Cardiorespiratory fitness, Physical activity, University students, Gender differences, VO_2 max.

Introduction

Cardiorespiratory fitness (CRF) is widely acknowledged as a fundamental indicator of physical health and overall well-being. It reflects the efficiency of the cardiovascular, respiratory, and muscular systems in delivering and utilizing oxygen during sustained physical activity. High levels of CRF are strongly associated with reduced risk of chronic diseases such as cardiovascular disease, type 2 diabetes, obesity, and certain cancers, while low CRF is recognized as an independent predictor of morbidity and mortality [1]. Physical activity (PA), defined as any bodily movement produced by skeletal muscles that requires energy expenditure, is a primary determinant of CRF. Regular engagement in moderate-to-vigorous physical activity enhances aerobic capacity, muscular strength, metabolic function, and psychological health. Despite these well-established benefits, global and regional trends indicate a decline in PA levels, particularly among young adults and university students, who often experience sedentary lifestyles due to academic pressures, prolonged screen time, and limited access to recreational facilities [2].

Gender differences in CRF and PA have been consistently reported, with males typically demonstrating higher aerobic capacity and greater engagement in physical activity compared to females. These disparities are influenced by physiological factors such as higher hemoglobin concentration, greater muscle mass, and elevated testosterone levels in males, as well as socio-cultural and behavioral factors that may limit female participation in sports or structured physical activity [3]. In Nigeria, limited research has examined CRF and PA levels among university students, particularly in southeastern regions such as Ebonyi State. Evangel University, Akaeze, attracts a diverse population of undergraduate students, presenting a unique opportunity to assess fitness and activity patterns within this demographic. Investigating the CRF status and PA levels among students not only provides insight into current health behaviors but also informs the design of interventions to promote active lifestyles, reduce sedentary behaviors, and mitigate the risk of lifestyle-related chronic diseases [4].This study aimed to assess the cardiorespiratory fitness status and physical activity levels among male and female students of Evangel University, Akaeze. Specifically, it sought to (i) determine the differences in CRF between male and female students, (ii) assess the variations in PA levels across genders, and (iii) explore the relationship between physical activity and cardiorespir.

Materials and Methods

Research Design

The research involved both experimental and survey design.

Research Population

This study comprised the students of all Colleges of Evangel University Akaeze.

Eligibility Criteria

Inclusion Criteria

The participants of this study were the genders of all Colleges in Evangel University, Akaeze, who were willing and able to participate in the study from 100 to 500 levels, between ages 18 to 35 years.

Exclusion Criteria

The following persons were excluded from this study:

1. The students of the university who suffer ill health that can affect their participation.
2. Other adults residing around the university

Sampling Technique

Purposive sampling technique was be used for this study.

Sample Size

Participants were selected from a total number of 1,201 students from all Colleges of university. The Taro Yamane method for sample size calculation was used and this was formulated by the statistician Tara Yamane in 1967 to determine the sample size from a given population. Below is the mathematical illustration for the Taro Yamane method:

$n=N/ (1+N (e)^2$
Where:
n = Sampling size
N = population size
e = level of precision or sampling of error $(0.05)^2$
1 =constant figure
Therefore
$e = 0.05^2$
N = 1,201
$n = 1,201/1+1,201\times0.05^2$
N = 300
Plus 0.15 marginal error = 316 5

Research instrument

The study utilized the following instruments:

1. **A step box:** This step box is of 16.25 inches high and 30 inches wide constructed locally and will be used to improve the body muscles and overall fitness level.
2. **Bathroom scale (**Model Hamason in china**):** will be used for measuring the weight of the participant.
3. **Stop watch (**kadio model KD-1069 made in china**):** was used for measuring the pulse rate of the participant.
4. **Height meter** (made in Nigeria)**:** The height meter was used for measuring the height of the students.
5. **The OMRON (**Sphygmomanometer made in china): this was used for measuring the blood pressure of the participants.
6. **Bio-data;** participants gender was noted and information about their age will be obtained from them.
7. **Weight;** the weight of the participants was obtained with the participant`s standing barefoot erect on a weighing scale with light clothing using a Bathroom scale (Model Hamason, China).
8. **Height;** the height was measured using a height meter, with the participant standing erect on the platform of the height meter and the back turned to the height meter.
9. **Body Mass Index (BMI):** BMI was calculated using the participant`s height and weight. The formula is BMI = $Kg/m^2$ where kg is the participant`s weight in Kilograms and M is their height in meters squared.
10. **Heart Rate:** The heart rate will be taken using an electronic blood pressure monitor.
11. **Blood Pressure**: The blood pressure was measured using an electronic blood pressure monitor with the participant sitting down in a comfortable position.

Procedure for data collection

- Ethical approval was obtained from the ethical review committee of the Molecular Pathology Institute Health Research Ethics Committee Enugu State.
- Information sheet consent form was given to the students and their demographic details was be taken before the test will be carried out.
- The experimental protocol will be fully explained to the subjects who will be filling the inclusion.
- Upon arrival at the venue of the research, each participant will be made to rest for at least 5 minutes after which resting blood pressure and heart rate will be taken in a sitting position with the left arm placed at the same level with the heart.

- The subject steps up and down on the platform of 16.25 inches at a rate set by metronome app of 22 steps per minute for females and 24 steps per minute for male. The subjects are to step using a four- step cadence, up-up-down-down' for 3 minutes. The subject stops immediately on a completion of the test, and the radial pulse will be counted 5 seconds after stopping, for a period 0f 15 seconds and multiplied by four to get the pulse rate/min.

Test protocol

Queens' College Step Test (QCT) was required for the subject to step up and down a step or platform of 16.5 inches or 43cm at a rate set by a metronome app, upon arrival at the research venue, the participants was be at rest for at least 5 minutes after which their resting heart and blood pressure was be taken (Davis *et al.,* 2018). Then the metronome will be set at 96 beats per minute a stepping rate of 22 steps per minute for female. The participant stepped using a four-step cadence, 'up-up-down-down' for 3 minutes. The participant was stopped immediately on completion of the test, and the heart beats was be recorded after resting for 10 minutes the heart rate will be measured again (Bandy and Padyay 2017).

Scoring of the test: An estimation of VO_2 max was calculated from the test results, using this formula: VO_2 max (ml/kg/min) = 111.33 - (0.42*pulse rate beat/min) for male and VO_2 max (ml/kg/min) = 65.81-(0.1847*pulse rate beats/min) (McArdle *et al.,* 2020).

Questionnaire: Scoring and Data Reduction

Overall physical Activities (PA) was assessed using the short last seven days self-administered format of the International Physical Activity Questionnaire (IPAQ) (Spanish version). The short version (4 items) provides information on the time spent walking, in vigorous- and moderate-intensity activity, and in sedentary activity (time spent sitting per week). Note that the sitting question was developed as a separate indicator and not as part of the summed PA score.

The data collected were used to estimate the total weekly PA by weighting the reported minutes per week within each activity category. Metabolic equivalent (MET) levels were obtained from the document "Guidelines for the Data Processing and Analysis of the International Physical Activity Questionnaire" available online at http://www.ipaq.ki.se. The weighted MET-minutes per week ($MET \cdot min \cdot wk^{-1}$) was calculated as duration x frequency per week x MET intensity, which were summed across activities to produce a weighted estimate of total PA from all reported activities per week ($MET\text{-}min/wk^{-1}$). IPAQ defines three levels of PA: Low, Moderate, or High. The IPAQ Research committee proposes two criteria for classification as high: a) vigorous-intensity activity on at least 3 days achieving a minimum total PA of at least 1500 MET-minutes/week or b) 7 or more days of any combination of walking, moderate-intensity, or vigorous-intensity activities achieving a minimum total PA of at least 3000 MET-minutes/week. Moderate category is defined as doing some activity, more than the low category. The pattern of activity to be classified as moderate is either of the following criteria: a) 3 or more days of vigorous-intensity activity of at least 20 minutes per day or b) 5 or more days of moderate-intensity activity and/or walking of at least 30 minutes per day or c) 5 or more days of any combination of walking, moderate-intensity or vigorous intensity activities achieving a minimum total PA of at least 600 MET-minutes/week (www.ipaq.ki.se). The low PA category includes the subjects not achieving the minimum for the moderate PA category.

Method of data analysis

The data obtained was computed using Statistical Package for Social Sciences (SPSS) version 20.0 for windows. Descriptive statistics of median, minimum, maximum, frequency and percentage were used to summarize the statistics. The data distribution was tested to determine the normality using the Kolmogorov-Smirnov test .the Mann-Whitney U and Kruskal-Wallis tests, which are non-parametric were used to test the differences between the pre and post exercises of cardiovascular and cardiorespiratory variables

(cardiovascular variables are heart rate, systolic blood pressure and diastolic blood pressure and) and (cardiorespiratory variable are VO2 max and Physical activity level (IPAQ)).

While the Kruskal-Wallis test was used to test the association between VO_2 max, BMI, Physical Activity Level, an Alpha level of significance was set at 0.05.

Results

The data distribution was tested to determine normality using the Kolmogorov-Smirnov test suitable for sample sizes >50. Descriptive median, minimum, maximum, frequency and percentage statistics were used to summarize participant characteristics. The Mann-Whitney U and Kruskal-Wallis tests, which are non-parametric were used to test for differences in means between groups. Data from 316 participants were analyzed and presented below. Females were 61.7% while males were 38.3%. The data obtained from the participants were mostly not normally distributed, hence non-parametric tests were employed.

Participants' General Characteristics and Data Distribution

The Kolmogorov-Smirnov normality test is presented in table one below.

Table 1: Frequency Distribution of Participants' Data

Variables	Frequency	Percentage	
Gender			
Male	121	38.3	
Female	195	61.7	
	Min.	**Max.**	**Median**
Age	18	27	21.00
Weight	43	110	60.00
Height	1.16	1.79	1.62
BMI	16.20	63.40	23.20

The median values of the cardiovascular parameters (VO_2 max, Pulse rate, Systolic and Diastolic blood pressure and SPO_2) before the test were all within normal ranges and slightly elevated after the step test.

Table 2: Normality Tests using the Kolmogorov-Smirnozv Test

Variables	Kolmogorov-Smirnov	p-value
Age	0.142	<0.001
BMI	0.156	<0.001
PRE-Systole	0.258	<0.001
PRE-Diastole	0.215	<0.001
PRE PR	0.089	<0.001
PRE SPO2	0.196	<0.001
POST Systole	0.194	<0.001
POST Diastole	0.253	<0.001
POST PR	0.046	0.200
POST SpO_2	0.214	<0.001
VO_2max	0.233	<0.001
Total MET	0.213	<0.001

Table 3: Independent Sample (Mann-Whitney U) Test Comparing Means between Genders

Variables	Male (121) Mean rank	Female (195) Mean rank	Mann-Whitney U	p-value
Age	158.71	158.37	11771.50	0.973
BMI	154.68	160.87	12,260.00	0.558
PRE-Systole	159.26	158.03	11,705.50	0.901
PRE-Diastole	175.57	147.91	9732.50	0.006*
PRE PR	129.60	176.44	15295.00	<0.001*
PRE SpO_2	142.85	168.21	13691.00	0.015*
POST Systole	167.61	152.85	10695.50	0.148
POST Diastole	185.28	141.88	8557.50	<0.001*
POST PR	160.02	157.56	11613.50	0.816
POST SpO_2	158.29	158.63	11823.50	0.972
VO_2 max	255.21	98.49	96.00	<0.001*
Total MET	139.63	170.21	14081.00	0.004*

Analysis of Specific Objective One

To determine the VO_2 max status of the genders in Evangel University, Akaeze following the Queens` College Step Test. An estimation of VO_2 max was calculated from the test results, using this formula: VO_2 max (ml/kg/min) = 111.33 - (0.42*pulse rate beat/min) for male and VO_2 max (ml/kg/min) = 65.81-(0.1847*pulse rate beats/min) for female (McArdle, *et al.,* 2020).

Table 4.1a: **Descriptive statistics of males and females participant's VO_2 scores**

Variable	Minimum Score	Maximum Score	Median
VO_2 max	36.81	76.89	46.60

Table 4.1a shows the minimum (36.81ml/Kg/min) and the maximum (76.89ml/Kg/min) scores of VO_2 max for males and female respectively. And the overall median score (46.60Ml/Kg/min) was obtained.

Table 4.1b: **Independent Sample (Mann-Whitney U) Test Comparing Means between Genders**

Variables	Male (121) Mean rank	Female (195) Mean rank	Mann-Whitney U	p-Value
VO_2 max	255.21	98.49	96.00	<0.001

Table 4.1b above, presents the comparisons of the male and female participants of their VO_2 max using Mann-Whitney U Test. It was used to compare the means values of VO_2 max in male participant (255.21) and females' participants (98.49) respectively. Higher values of VO_2 max was found in male than female. There was a statistically significant difference in VO_2 max means scores for male and female (p-value < 0.001).

Analysis of Specific Objective Two

To determine the pulse rate status of genders in Evangel University, Akaeze before and after the Queen's college test.

Table 4.2a: **Descriptive analysis of males and females participant's Pulse rate**

Variables	Minimum Score	Maximum Score	Median
PRE-Pulse rate	55	107	76.00
POST Pulse rate	82	157	118.00

Table 4.2a shows the (minimum, maximum and the overall median) scores value of Pre and post Pulse rate of male and female participants.

Table 4.2b: **Independent Sample (Mann-Whitney U) Test Comparing Means between Genders**

Variables	Male (121) Mean rank	Female (195) Mean rank	Mann-Whitney U	p-value
PRE-Pulse rate	129.60	176.44	15295.00	<0.001
POST Pulse rate	160.02	157.56	11613.50	0.816

Table 4.2b above, present the comparisons of male and female participants of their (pre and post) pulse rate using the Mann-Whitney U Test. On the comparison of (pre and post) pulse rate, female participants had higher pre pulse rate than the male participants while male participants had higher post pulse rate than the female participants. However, there was statistically significant ($p < 0.001$) difference in pre- pulse rate of male and female participants.

Analysis of Specific Objective Three

To determine the systolic and diastolic blood pressure status of the genders in Evangel University before and after the Queen's College step test.

Table 4.3a: Descriptive analysis of male and female participant's systolic and diastolic blood pressure

Variables	Minimum score	Maximum score	Median
PRE- Systole	100	160	110
POST-Systole	110	210	130
PRE- Diastole	50	99	70
POST- Diastole	50	90	80

Table 4.3a shows the minimum and the maximum score values of (pre and post) systole of male and female participants respectively and minimum and maximum score values of (pre and post) diastole of males and female participants with their overall median score.

Table 4.3b: Independent Sample (Mann-Whitney U) Test Comparing Means between Genders

Variables	Male (121) Mean rank	Female (195) Mean rank	Mann-Whitney	p<value
PRE- Systole	159.26	158.03	11,705.50	0.901
POST Systole	167.61	152.85	10695.50	0.148
PRE- Diastole	175.57	147.91	9732.50	0.006
POST Diastole	185.28	141.88	8557.50	<0.001

Table 4.3b above, present the comparisons of male and female participants of their (pre and post) systolic and (pre and post) diastolic using the Mann-Whitney U Test. The test was used to compare the means values scores of (pre and post) pulse rate of male and female participants respectively. Male participants had higher (pre and post) systolic and diastolic pressure than the female participants. And there was no significant difference between both genders.

Analysis of Specific Objective Four

To determine the SpO2 status of the genders of Evangel University before and after the Queen's College step test.

Table 4.4a: Descriptive Analysis of Male and Female participant's SpO2Status

Variables	Minimum score	Maximum Score	Median
PRE- SpO2	90	100	96
POST SpO2	92	100	99

Table 4.4a shows the minimum and maximum score values of (pre and post) SpO2male and female genders respectively. And an overall median score was obtained.

Table 4.4b: Independent Sample (Mann-Whitney U) Test was used to Comparing Means between Genders

Variables	Male (121) Mean rank	Female (195) Mean rank	Mann-Whitney U	P<value
PRE- SPO_2	142.85	168.21	13691.00	0.015
POST SPO_2	158.29	158.63	11823.50	0.972

Table 4.4b above, present the comparisons pre and post SpO2of male and female participants using the Mann-Whitney U Test. The test was used to compare the mean value scores of (pre and post) SPO_2 male and female participants respectively. From the table it was observed that the female had higher pre-SpO2 (168.21 %) than the male participants. And there was no significant differences between the both genders.

Analysis of Specific Objective Five

To determine the physical activity level of the students of Evangel University.

Table 4.5a: Descriptive Analysis of participant's Physical Activity Level (MET

Variable	Minimum Score	Maximum Score	Median
Physical Activity Level (Total MET)	0	16,200	1,278.5

Table 4.5a shows the minimum and the maximum score values of physical Activity Levels of the male and female genders respectively. And the overall median was obtained.

Table 4.5b: Independent Sample (Mann-Whitney U) Test Comparing Means between Genders

Variable	Male (121) Mean rank	Female (195) Mean rank	Mann-Whitney U	P<value
Physical Activity level (Total MET)	139.63	170.21	1408.00	0.004

Table 4.5b above, present the comparisons physical Activity Level of male and female gender using the Mann-Whitney U Test. The test was used to compare the mean rank value of the male (139.63 MET) and female (170.21 MET) participants respectively. The females had higher total MET than males. And there was a statistically significant ($p<0.004$) difference in the participants.

Analysis of Specific Objective Six

To determine the association between VO_2 max and physical activity level of students in Evangel University.

Table 4.6a: Descriptive analysis of participant's VO_2 max and Physical activity Level

Variables	Minimum	Maximum	Median
VO_2 max	36.81	76.89	46.60
Physical Activity Level Total MET	0	16200	1278.50

Table 4.6a shows the minimum (36.81) and the maximum (76.89) VO_2 max, maximum (0) and maximum (16200) Total MET and the overall median scores value of VO_2 max (46.60 mL/Kg/min) and physical Activity Level (1278.50 Total MET) of males and females participants respectively.

Table 4.6b: Kruskal-Wallis test showing comparison between VO_2 and physical activity level

Variables	**Mean Rank**	**Kruskal-Wallis**	**p-value**
BMI		2.571	0.463
Underweight	125.71		
Normal weight	162.00		
Overweight	157.02		
Obesity	154.07		
PA		9.593	0.008*
Inactive	167.91		
Minimally active	169.29		
HEPA active	133.49		

Table 4.6 (B) above shows that the Krukal-Wallis Test was used to compare the means between VO_2 max (dependent variable) with BMI and physical activity (independent variables) to determine the association between VO_2 max and physical activity. A significant difference was observed between VO_2 max and physical activity ($p=0.008$).

Discussion

This study investigated the cardiorespiratory fitness (CRF) status and physical activity (PA) levels among male and female students of Evangel University, Akaeze, Ebonyi State, Nigeria, using the Queen's College Step Test. A total of 316 students participated, comprising 38.3% males and 61.7% females, with ages ranging from 18 to 27 years. The study revealed important gender-specific differences in VO_2 max, pulse rate, blood pressure, SpO_2, and PA levels, as well as associations between CRF and PA.

Cardiorespiratory Fitness (VO_2 max)

The median VO_2 max of participants was 46.60 mL/kg/min, with males demonstrating significantly higher VO_2 max than females (mean rank: 255.21 vs. 98.49, $p< 0.001$). This finding is consistent with previous studies showing that

male university students typically exhibit higher aerobic capacity than females, likely due to physiological differences such as greater hemoglobin concentration, muscle mass, and testosterone levels, which enhance oxygen transport and utilization during exercise. The observed VO_2 max values for both genders fall within the normal range for young adults, suggesting generally acceptable cardiorespiratory health in this student population, although a subset may benefit from fitness improvement programs [5].

Pulse Rate Response

Analysis of pre- and post-step test pulse rate revealed that female participants had higher pre-exercise pulse rates (median = 76 bpm) compared to males (median rank 176.44 vs. 129.60, $p< 0.001$), whereas post-exercise pulse rates did not significantly differ between genders ($p = 0.816$). Higher resting pulse rates in females have been reported in the literature and may be attributable to smaller stroke volume and differences in autonomic regulation. The lack of significant difference post-exercise suggests comparable cardiovascular responsiveness to the submaximal step test across genders [6].

Blood Pressure Status

Systolic and diastolic blood pressures were generally within normal ranges both before and after the step test. Significant gender differences were observed in diastolic blood pressure, with males exhibiting higher pre- and post-exercise values ($p = 0.006$ and $p< 0.001$, respectively), while systolic differences were not statistically significant. These findings align with prior research indicating higher resting diastolic pressures in young male adults, likely due to differences in vascular resistance and sympathetic tone. The moderate increase in blood pressure post-exercise is consistent with normal physiological responses to submaximal exertion [7-8].

Oxygen Saturation (SpO_2)

Pre-exercise SpO_2 was slightly higher in females compared to males ($p = 0.015$), whereas post-exercise SpO_2 values did not significantly differ between genders. This indicates that both male and female participants maintained adequate oxygenation during the submaximal exercise, reflecting good pulmonary and cardiovascular function. The slight gender differences in pre-exercise SpO_2 may relate to hemoglobin and hematocrit variations [9-10].

Physical Activity Levels

Interestingly, females reported higher total MET scores than males (mean rank: 170.21 vs. 139.63, $p = 0.004$), indicating higher self-reported PA levels despite lower VO_2 max. This discrepancy may reflect differences in PA type, intensity, or accuracy of self-reported measures, as females may engage more in light- to moderate-intensity activities that contribute to MET accumulation but do not significantly enhance VO_2 max. Conversely, male participants may participate in activities with greater impact on cardiorespiratory capacity, explaining their higher VO_2 max despite lower total METs [11].

Association between VO_2 max and Physical Activity

Kruskal-Wallis analysis revealed a significant association between VO_2 max and PA levels ($p = 0.008$), suggesting that higher engagement in physical activity is linked to improved cardiorespiratory fitness. This finding corroborates extensive evidence that regular aerobic exercise enhances oxygen uptake efficiency, cardiovascular function, and overall fitness. No significant association was observed between VO_2 max and BMI ($p = 0.463$), indicating that body composition alone did not strongly predict aerobic capacity in this cohort [12-13].

Implications

These findings highlight the importance of promoting gender-sensitive physical activity interventions in university settings. Structured aerobic programs, cardiovascular conditioning, and fitness education should target both male and female students, with particular emphasis on

activities that improve VO_2 max in females. Additionally, the disparity between self-reported PA and measured fitness underscores the need for objective assessment methods in monitoring student health [14].

Conclusion

The findings of this study indicate significant gender differences in cardiorespiratory fitness and cardiovascular responses among students of Evangel University, Akaeze. Male students demonstrated higher VO_2 max and post-exercise pulse rates, reflecting superior cardiorespiratory fitness, whereas female students reported higher physical activity levels. Pre-exercise pulse rate, diastolic blood pressure, and SpO_2 also showed gender-specific variations, though post-exercise values were largely comparable. Importantly, a significant association was observed between physical activity levels and VO_2 max, highlighting the role of regular physical activity in enhancing aerobic capacity.

These results underscore the need for targeted, gender-sensitive interventions to promote cardiovascular health and fitness among university students. Structured aerobic programs, fitness education, and campus-wide initiatives are recommended, with particular emphasis on strategies that enhance cardiorespiratory fitness in female students. Encouraging regular participation in physical activity can foster long-term health benefits and support overall well-being in this population.

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