



COMPARATIVE STUDY ON SELECTED PHYSIOLOGICAL VARIABLES AND BODY COMPOSITION AMONG SPORTSPERSONS OF GURU GHASIDAS VISHWAVIDYALAYA BILASPUR CHHATTISGARH

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Abstract

Background: Participation of sports influence the development of physiological and body compositional, yet comparative data specific to university-level athletes in central India remain limited. **Objective:** This study try to compare selected physiological variables (resting heart rate, blood pressure, VO_2 Max, and respiratory rate) and body composition components between female and male sportspersons at Guru Ghasidas Vishwavidyalaya, Bilaspur. **Methodology:** A comparative study was employed with 60 university sportspersons (30 male and 30 female). Physiological parameters were assessed using standard laboratory protocols and body composition was accessed by bioelectrical impedance analysis (BIA). Descriptive statistical analysis was performed to analyze data with independent *t*-tests. **Results:** Significant gender-based differences were observed in resting heart rate ($p < 0.001$), VO_{2max} ($p < 0.001$), respiratory rate ($p = 0.036$), body fat percentage ($p < 0.001$) and lean body mass ($p < 0.001$). Male sportspersons demonstrated higher cardiorespiratory fitness (VO_{2max} : 46.83 ± 4.91 vs. 39.12 ± 5.24 ml/kg/min) and lower body fat percentages ($17.83 \pm 4.21\%$ vs. $24.67 \pm 4.83\%$) compared to their female participants, while female participants had higher resting heart rates (74.23 ± 6.12 vs. 68.47 ± 5.23 bpm). Blood pressure and BMI not significantly differ between groups ($p > 0.05$). **Conclusion:** Findings underscore influence by the gender on physiological adaptations to sports training and provide normative data for university sportspersons in this region.

Keywords: Physiological Variables, Body Composition, University Sportspersons, Comparative Study, Gender Differences, VO_{2Max}

1. Introduction

An athlete's physical and physiological fitness are essential factors for athletic performance. Physiological parameters like resting heart rate, blood pressure, maximal oxygen consumption (VO_2 max) and respiratory depend on body composition parameters, which are essential markers of an athlete's functional capacity and health status measurement (Pajapati et al. 57). Body composition assessment is vital in understanding physical performance and can often be indicative of overall health status, making it very relevant to athletes as well as physically active populations (Cattem et al. "One-Year Changes" 701). It is important to understand that university level sportspersons are a specific group of individuals who are required to study and train at very high level. Physiological analysis of body composition profiles of such athletes is essential in programming training and injury prevention and promoting long term health (Kumar et al. 55). Previous study established that athletes need an appropriate level of anthropometric traits which make them appropriate to their sport demands, which includes a low percentage of body fat and a higher percentage of muscle (Pajapati et al. 58). Research has increasingly examined sex-related differences in physiological responses to training, with evidence indicating variations between male and female athletes in aerobic capacity, body-fat distribution, and cardiovascular responses (Alcantara et al. 12). Guru Ghasidas Vishwavidyalaya of Bilaspur, Chhattisgarh is perfect place for this study. As it has a variety of sportspersons taking up different sports activities. The University has conducted previous studies on various aspects of anthropometry, body composition, and motor fitness in students and faculty. Some researchers have investigated body composition and hypertension in faculties of a University (Menon et al. 2021), Body composition among volleyball and handball players (Kumar, M. D. & Yadav, M.). Rathore and Yadav (2019, 2021) examined the association between BMI and physical condition among physical-education students and investigated the effects of BMI on their physical health. However, a comprehensive comparison of physiological variables and body-composition characteristics among university sportspersons has not yet been reported. Therefore, this study seeks to address this research gap by comparing selected physiological and body-composition parameters between male and female sportspersons at Guru Ghasidas Vishwavidyalaya.

1.1 Research Objectives

- i). To assess resting heart rate, diastolic and systolic blood pressure, VO_2 max, and respiratory rate between female and male university sportspersons.
- ii). To evaluate body composition parameters (body fat percentage, muscle mass, BMI) between female and male university sportspersons.
- iii). To compare improvement of gender-based differences in these physiological and body composition variables.

1.2 Hypotheses

Null Hypothesis (H_0):

- i) There is no significant variation in selected physiological variables and body composition components between female and male sportspersons.

Alternative Hypothesis (H₁):

- i) There is a significant variation in selected physiological variables and body composition components between male and female sportspersons.

Methodology

2.1 Research Design

Comparative Cross Sectional study was design for this study to make comparison of selected physiological variables and components of body composition between the two independent sets of the selected sportspersons male and female.

2.2 Population and Sample

Population: University students (Undergraduate and Postgraduate) at Guru Ghasidas Vishwavidyalaya of Bilaspur, Chhattisgarh, actively participating in sports.

Sample: A total of 60 sportspersons (30 male, 30 female) were selected using purposive sampling.

Participants were included if they were:

- Enrolled as regular students (UG & PG) at Guru Ghasidas Vishwavidyalaya.
- Actively engaged in university-level sports participation.
- Age range between 18-28 years.
- Free from any cardiovascular, respiratory or metabolic disorders.

2.3 Variables

Table 2.1: Variables and Measurement Tools

Category	Variables	Measurement Tool
Physiological Parameters	Resting Heart Rate (RHR)	Digital heart rate monitor, radial pulse count (1 minute)
	Systolic Blood Pressure (SBP)	Digital sphygmomanometer
	Diastolic Blood Pressure (DBP)	Digital sphygmomanometer
	VO ₂ max	Queen's College Step Test
	Respiratory Rate (RR)	Chest expansion count (breaths/min)
Body Composition Parameters	Body Fat Percentage (BFP)	Bioelectrical Impedance Analysis (BIA)
	Body Mass Index (BMI)	Weight (kg) / Height (m ²)
	Lean Body Mass (LBM)	BIA

2.4 Data Collection Procedures

1. Pre-assessment Preparation: Participants were instructed to avoid strenuous exercise, caffeine intake, and heavy meals for at least three hours before the assessment.
2. Anthropometric Measurements: Height (cm) was measured using a stadiometer, and weight (kg) was recorded using a digital weighing scale. BMI was calculated accordingly.
3. Resting Heart Rate: Measured after a 10-minute seated rest using a digital heart rate monitor, confirmed by manual radial pulse count for 60 seconds.

4. Blood Pressure: Blood pressure was assessed using a validated digital sphygmomanometer following a five-minute seated rest. Three measurements were obtained, and their average was used for analysis.

5. Respiratory Rate: Counted by observing chest movements for 1 minute in a seated relaxed position.

6. VO₂ max Estimation: Queen's College Step Test was administered, with heart rate recovery used to estimate VO₂ max. Test was performed by using a tool of 16.25 inches height, with stepping performed design for a total time of 3 minutes at rate of 22 steps for females and 24 steps per minute for males were set by a metronome. Following equations were used to compute VO₂ max:

- For females: VO₂ max = 65.81 - (0.1847 × HR)

- For males: VO₂ max = 111.33 - (0.42 × HR) (Zia 3)

7. Body Composition: Bioelectrical impedance analysis (BIA) which measures body fat percentage, lean body mass and over all body water. Multi-frequency BIA was employed as it can yield reliable and reasonably accurate assessments even under uncontrolled conditions in physically active populations (Uchizawa, A., & Miles-Chan, J. L. 2025).

2.5 Statistical Applications

SPSS (Statistical Package for Social Sciences) software was used to perform all the statistical analysis of data.

The specific statistical methods were used for explain:

1. Descriptive Statistics: Descriptive statistics, including mean, standard deviation (SD), minimum, and maximum values, were calculated separately for male and female participants.

2. An independent-samples t-test was performed to assess differences in mean values between male and female sportspersons across physiological and body-composition variables. Statistical significance was set at $p < 0.05$.

Results and Discussion

3.0 This study was to compare the various physiological factors and body composition metrics of 30 female and 30 male athletes from Guru Ghasidas Vishwavidyalaya in Bilaspur. 30 female and 30 male athletes made up the study's total of 60 participants. Data were statistically analyzed by using independent samples t-test and descriptive statistics methods. Following tables and graphs display the results.

3.1 Descriptive Statistics

Table 3.1: Descriptive Statistics of Physiological Variables

Variable	Male (n=30) Mean ± SD	Female (n=30) Mean ± SD
Resting Heart Rate (bpm)	68.47 ± 5.23	74.23 ± 6.12
Systolic BP (mmHg)	122.37 ± 8.54	118.23 ± 9.12
Diastolic BP (mmHg)	79.83 ± 6.21	76.47 ± 7.03
VO ₂ max (ml/kg/min)	46.83 ± 4.91	39.12 ± 5.24
Respiratory Rate (breaths/min)	16.83 ± 2.34	18.23 ± 2.67

Interpretation: Table 3. shows the physiological variables (descriptive statistics) for both groups. Male athletes had a lower resting heart rate (68.47 ± 5.23 bpm) than female athletes (74.23 ± 6.12 bpm). Males had a greater VO_2 max (46.83 ± 4.91 ml/kg/min) than females (39.12 ± 5.24 ml/kg/min). Males had a lower respiratory rate (16.83 ± 2.34 breaths/min) than females (18.23 ± 2.67 breaths/min). Males had somewhat higher blood pressure readings, although the disparities were not as great.

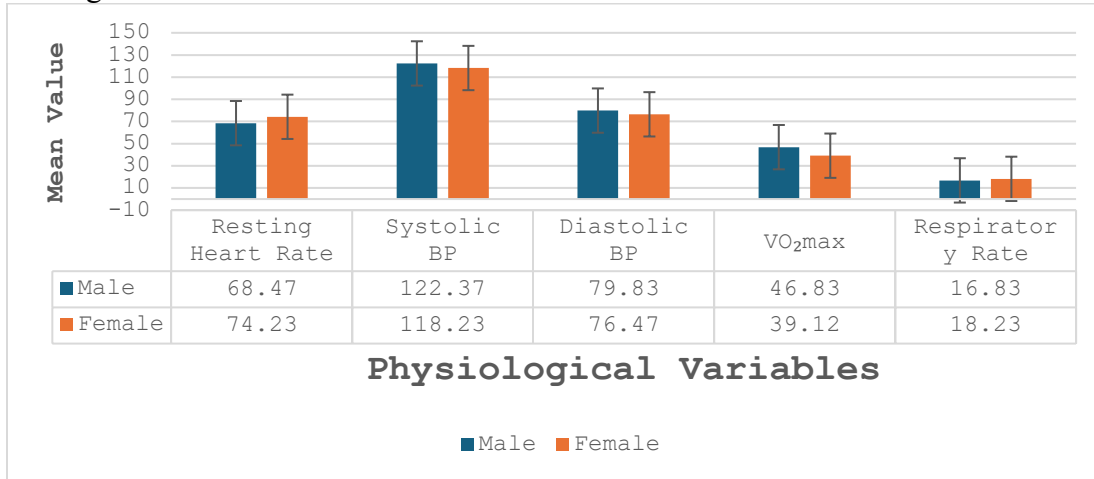


Figure 3.1: Comparison of Physiological Variables Between Male and Female Sportspersons.

Figure 1 shows comparison bar diagram of physiological variables between male and female sportspersons. Male sportspersons had lower resting heart rate and respiratory rate, while female sportspersons showed slightly higher systolic and diastolic blood pressure but VO_2 max was notably higher in males.

Table 3.2: Descriptive Statistics of Body Composition Variables

Variable	Male (n=30) Mean $\pm$ SD	Female (n=30) Mean $\pm$ SD
Body Fat Percentage (%)	17.83 $\pm$ 4.21	24.67 $\pm$ 4.83
BMI (kg/m ²)	21.97 $\pm$ 2.45	21.23 $\pm$ 2.78
Lean Body Mass (kg)	58.23 $\pm$ 6.78	42.67 $\pm$ 5.43

Interpretation: Table 2 shows body composition variables. Body fat percentage of male athletes was substantially lower ($17.83 \pm 4.21\%$) than that of female athletes ($24.67 \pm 4.83\%$). Males had a greater lean body mass (58.23 ± 6.78 kg) than females (42.67 ± 5.43 kg). The groups' BMIs were comparable (21.97 ± 2.45 vs. 21.23 ± 2.78 kg/m²).

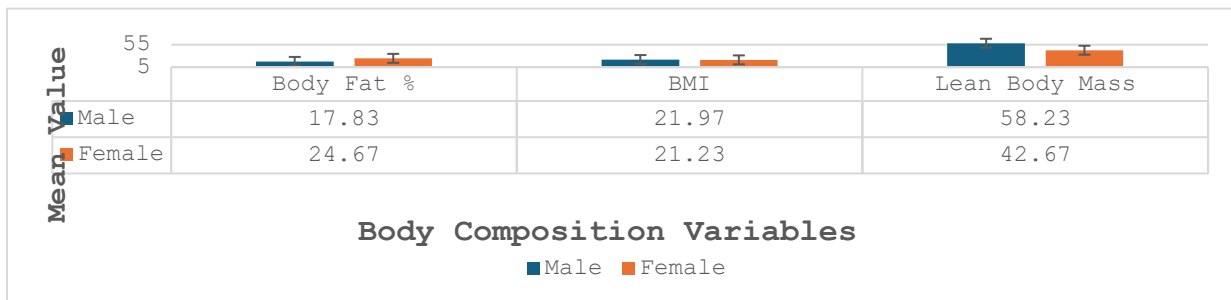


Figure 3.2: Comparison of Body fat, BMI, Lean Body Mass Between Male and Female Sportspersons

Interpretation: Figure 2 describe the comparison of Body fat, BMI, Lean Body Mass between male and female sportspersons. Compared to female athletes, men athletes exhibited more lean body mass and a lower body fat percentage. Both groups' BMIs were comparable.

3.2 Inferential Statistics: Independent t-test

Table 3.3: Independent t-test Results for Physiological Variables

Variable	t-value	df	p-value	Cohen's d	Significance
Resting Heart Rate	-4.132	58	<0.001	1.07	Significant
Systolic BP	1.847	58	0.070	0.48	Not Significant
Diastolic BP	1.956	58	0.055	0.51	Not Significant
VO ₂ max	5.847	58	<0.001	1.51	Significant
Respiratory Rate	-2.142	58	0.036	0.55	Significant

Interpretation: Table 3 presents the independent t-test results for physiological variables. VO₂max ($p < 0.001$), respiratory rate ($p = 0.036$) and resting heart rate ($p < 0.001$) all showed significant differences. Diastolic blood pressure ($p = 0.055$) and systolic blood pressure ($p = 0.070$) did not vary significantly. Cohen's d values for VO₂max (1.51) and resting heart rate (1.07) showed significant effect sizes.

Table 3.4: Independent t-test results of Body Composition Variables

Variable	t- Value	df	p-value	Cohen's d	Significance
Body Fat Percentage	-5.743	58	<0.001	1.48	Significant
BMI	1.093	58	0.279	0.28	Not Significant
Lean Body Mass	9.483	58	<0.001	2.45	Significant

Interpretation : Table 4 shows that the independent t-test results for body composition variables. Body fat percentage ($p < 0.001$) and lean body mass ($p < 0.001$) were significantly different. There was no difference significantly ($p = 0.279$) between BMI. Cohen's d values mention the body fat percentage (1.48) and lean body mass (2.45) were large effect sizes.

3.3. Discussion

3.3.1 Physiological Variables

The study's findings show that among university athletes, there are notable gender-based variations in important physiological factors. Resting heart rate of male athletes (68,47 bpm) was significantly lower than female athletes (74,23 bpm), which was similar with previous studies. It was observed that lower resting heart rates in male athletes that may be due to their improved cardiovascular efficiency and larger stroke volume. Elite runners' resting heart rates of 56 ± 3 beats per minute indicate adaptive cardiovascular changes from training, according to research on marathon runners. (Makwana, P.et al.2024).

VO₂ max, the most robust indicator of cardiorespiratory fitness, showed a marked between groups are really difference with males (46.83 ml/kg/min) outperforming females (39.12 ml/kg/min). This

result corroborates the previously mentioned research findings that reported superior VO_2max values in males compared to females. A study on Physical Education students found that students (Men) was demonstrated significantly higher VO_2max (50 ± 6 ml/kg/min) compared to females (42 ± 5 ml/kg/min) (S., K., & P, R. 2025). The VO_2max values noted in two groups were superior than sedentary university populations but lower than elite endurance athletes, reflecting the moderate training status of university-level sportspersons.

Male athletes had a significantly lower respiratory rate (16.83 breaths/min) than females (18.23 breaths/min), which means males have a more efficient respiratory system. Research on Korean long-distance runners found that average values of various respiratory functions were within normal limits but tidal volume rate were higher and respiratory rates were smaller than normal values, representing respiratory adaptations against training (Makwana, P. et al. 2024).

In Females it was observed that they had lower systolic and diastolic blood pressure, but the differences were not statistically significant ($p > 0.05$). Previous studies conducted at Guru Ghasidas University revealed positive, substantial correlations between faculty members' blood pressure and body composition variables, indicating that blood pressure patterns may be influenced by body composition parameters. (Menon, S., Pandey, A.K., & Rathore, V.S. 2021).

3.3.2 Body Composition

Body composition describes the significant gap between female and male sportspersons. Body fat percentage was substantially lower in males (17.83%) compared to females (24.67%), a finding consistent with documented gender-based differences in body composition. Study on athletes of adolescent phase significantly prove gender-based gap in body fat percentage, lean body mass, and BMI (Cattam et al. "One-Year Changes" 703-704). Studies utilizing BIA have found that male soccer athletes had lower fat percentage and greater muscle mass compared to female athletes (Cattam et al. "Fat-free mass predictive equation").

Lean body mass was more significantly in male sportspersons (58.23 kg) compared to females (42.67 kg), reflecting the well-established gender disparity in muscle mass driven by hormonal factors, particularly testosterone. Research has shown that multi-frequency BIA provides reliable and accurate assessments of fat-free mass in physically active populations ("Practical applications and challenges" 1234). The significantly greater lean body mass in males is similar with previous studies (Pajapati et al. 60-61).

Interestingly, BMI not shows significantly difference between both groups (21.97 vs 21.23 kg/m²), which means that the while body composition profiles difference, overall weight-for-height indices remain comparable. This result agrees with previous studies on athletes from different sports that have shown no significant differences in BMI despite variations in body fat percentage and muscle mass (Pajapati et al. 62; "Comparison of Anthropometric Characteristics" 80-81).

3.3.3 Implications

The study's conclusions have a number of useful implications:

1. Training Program Design: The observed differences in VO_2max and body composition indicate that training programmes for female sportspersons could place greater emphasis on

cardiorespiratory fitness and muscle-strengthening exercises to support these physiological characteristics.

2. Health Monitoring: The normative data generated can serve as a reference for monitoring the physiological status of university sportspersons at Guru Ghasidas Vishwavidyalaya.

3. Talent Identification: The established profiles may aid in identifying athletes with superior physiological characteristics for specific sports disciplines.

Conclusion

This comparative study examined selected physiological variables and body composition parameters among 60 university sportspersons at Guru Ghasidas Vishwavidyalaya, Bilaspur. The findings revealed significant gender-based differences in resting heart rate, VO_2 max, respiratory rate, body fat percentage, and lean body mass, while blood pressure and BMI showed no statistically significant differences.

Male sportspersons demonstrated superior cardiorespiratory fitness, lower body fat percentages, and greater lean body mass, reflecting the combined influence of hormonal factors, training adaptations, and physiological differences between genders. These findings highlight the value of considering sex-specific factors when designing sports-science assessments, training programmes, and athlete-development strategies. Future research should explore the relationship between specific sports disciplines and physiological profiles, incorporate larger sample sizes, and employ longitudinal designs to track changes over time. Additionally, investigating the influence of training intensity, duration, and type on these physiological and body composition parameters would contribute valuable insights.

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