



Original Research Article

Assessment of Cardio-Respiratory Fitness-With Special Reference to Body Composition Profile of Bahir Dar University Boys

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ABSTRACT

This study aimed to investigate the relationship between cardio-respiratory fitness and body composition among second- and third-year students at Bahir Dar University Sport Academy. A total of 30 students were selected using stratified random sampling to ensure representation across different academic years and fitness levels. Data collection involved various morpho-physiological parameters, including height, weight, body fat percentage, lean body mass, body mass index (BMI), somatotyping, maximum aerobic capacity, anaerobic threshold, and heart rate, utilizing equipment such as audiometers, weighing scales, sliding calipers, and flexible Harpenden skinfold calipers. The results indicated a mean BMI of $22.04 \pm 2.01 \text{ kg/m}^2$, with body fat percentage at 20.9 ± 4.68 and lean body mass at $52.04 \pm 10.25 \text{ kg}$. The subjects exhibited higher lean body mass, contributing to improved aerobic fitness. Somatotyping revealed mean values of endomorphic, mesomorphic, and ectomorphic components as 5.34 ± 1.56 , 5.70 ± 0.87 , and 3.0 ± 1.15 , respectively. A negative correlation (-0.138) was found between BMI and maximum aerobic capacity, while positive correlations were observed between BMI and anaerobic threshold heart rate, maximum heart rate, and heart rate reserve (0.46 , 0.07 , and 0.39). The study concludes that the autonomic nervous system significantly regulates cardiovascular health and energy expenditure, thereby influencing body composition. Increased physical activity is essential for managing body fat, enhancing glucose control, and improving mental health, particularly among youth. Promoting active lifestyles is crucial to mitigate the risks associated with physical inactivity.

Keywords: Somatotype, VO₂max, Cardiorespiratory fitness, Anaerobic threshold.

INTRODUCTION

Cardiorespiratory fitness (CRF) remains one of the most critical components of physical fitness, with profound implications for athletic performance, metabolic health, and overall well-being. Defined as the ability of the cardiovascular and respiratory systems to deliver oxygen to working muscles during sustained exercise, CRF is commonly measured by maximal oxygen uptake (VO₂max) (Plowman & Smith, 2023). However, since direct VO₂max testing is often impractical in field settings, indirect assessments, such as body composition analysis, have gained

traction as viable alternatives (Gonzalez-Rave et al., 2021). Recent research underscores the strong relationship between CRF and body composition, particularly in athletes, where lean body mass (LBM) enhances aerobic capacity, while excess adiposity may impair it (Ross et al., 2020; Lee et al., 2019).

Beyond its role in athletic performance, CRF serves as a key predictor of long-term health outcomes. Studies have consistently linked higher CRF levels to reduced risks of cardiovascular disease, metabolic syndrome, and premature mortality (Laukkanen et al., 2022; Myers et al., 2021). This connection is especially relevant for young adults and athletes, where optimal body composition—characterized by low fat mass and high muscle mass—can significantly influence both fitness and health (Maffetone et al., 2020). Additionally, somatotype (body type) plays a crucial role in determining athletic potential, with mesomorphic traits (muscular and lean) often correlating with superior endurance and power performance (Hills et al., 2019).

Despite its importance, CRF is sometimes neglected in training programs, particularly in favor of sport-specific skills or strength development (Buchheit & Laursen, 2023). This oversight may limit athletes' overall performance potential and long-term health. In regions like Ethiopia, where endurance sports are prominent, understanding the interplay between CRF, body composition, and somatotype can provide valuable insights for athlete development (Ethiopian Journal of Sport Science, 2023). Therefore, this study seeks to assess the cardiorespiratory fitness of university male athletes using body composition profiles and somatotype classification, offering evidence-based recommendations for training and health optimization. By integrating contemporary research with regional data, the findings aim to enhance both athletic performance and long-term physiological resilience.

MATERIALS AND METHODS

This study examined cardiovascular fitness in relation to body composition among 30 physically active male students from Bahir Dar University, aged 20 to 30 years. Data were collected using various morpho-physiological parameters, categorized as physical and physiological measurements. **Physical Parameters:** Measurements included body weight, height, skinfold thickness, and body girth. Equipment used comprised stadiometers, weighing scales, sliding calipers, and Harpenden skinfold calipers. For stature, subjects stood straight against a stadiometer, while weight was measured with minimal clothing. Skinfold measurement were taken at specific sites (e.g., triceps, biceps, subscapular, suprailiac) to assess body fat percentage, lean body mass, and somatotype using established formulas, including Durnin and Womersley's method. **Physiological Parameters:** Physiological assessments involved heart rate, distance covered in a 12-minute run, and maximum oxygen consumption ($\text{VO}_2 \text{ max}$). Equipment included cycle ergometers and EKG machines. The Cooper test was utilized to measure distance, while the anaerobic threshold was determined through a cycling protocol defined by Conconi. EKG recordings were made to evaluate heart electrical activity and rhythm. **Application of Measured Values:** $\text{VO}_2 \text{ max}$ was estimated using the distance covered in the 12-minute test. Anaerobic threshold rates were determined through heart rate versus intensity graphs. The EKG provided insights into heart rhythm and electrical activity, offering a comprehensive assessment of cardiovascular health.

RESULTS

Table one shows the mean and SD values of physical characteristics of the subjects and the average values of physical characteristics are shown in Fig.4. The table shows that the subjects under study were of the age 22.04 ± 2.01 yrs and their Height and weight were 175.32 ± 6.07 cms and 68.41 ± 10.18 Kgs respectively.

Table 1: Descriptive Statistics of Physical Characteristics

Variable	Mean $\pm$ SD
Age (yrs)	22.04 ± 2.01
Height (cms)	175.32 ± 6.07
Weight (kgs)	68.41 ± 10.18

Table two mean and SD shows that body composition of the subjects. BMI is 22.16 ± 2.21 kg/m², body fat % is 20.9 ± 4.68 and lean body mass LBM is 52.04 ± 10.25 kgs. It can be predicated from BMI values that the subject of the present study were healthy. The body fat percentage and lean body mass kilograms are in the normal range and higher lean body mass contributed to higher aerobic capacity. Also table two indicates the mean and SD values of the somatotype components of the university boys. In result Endomorphy 5.34 ± 1.56 , mesomorphy 5.70 ± 0.87 and ectomorphic 3.0 ± 1.15 , so, it was found that the study subjects were less Endomorphic, more mesomorphic and least Ectomorphic.

Table 2. Descriptive statistics of body composition variables and somatotype components.

Variable	Mean $\pm$ SD
BMI (kg/m ²)	22.16 ± 2.21
Body Fat (%)	20.9 ± 4.68
LBM (kg)	52.04 ± 10.25
Endomorphic	5.34 ± 1.56
Mesomorphic	5.70 ± 0.87
Ectomorphic	3.0 ± 1.15

Table 3 depicts the mean and SD values of the anaerobic threshold heart rate, heart rate reserve and % heart rate maximum. As a result, AT-HR 150.09 ± 12.34 , %HR 88.85 ± 3.89 and HRreserve 106.18 ± 11.78

Table 3. Descriptive statistics of heart rate variables.

Variable	Mean $\pm$ SD
AT-HR	150.09 ± 12.34
%HR	88.85 ± 3.89
HRreserve	106.18 ± 11.78

Table four shows that, the correlation of various physiological parameters with the body composition profile of the subjects. The results indicates that a positive correlation between the BMI and AT-HR, BMI and HR maximum and Hr reserve which is 0.46, 0.07 and 0.39 respectively.

Table 4. Correlations between BMI and physiological parameters.

Parameter	Pearson's r	p-value
BMI and AT-HR	0.46	<0.05
BMI and HRmax	0.07	<0.05
BMI and HRreserve	0.39	<0.05
BMI and VO2max	-0.13	>0.05

DISCUSSION

The present study demonstrates that Bahir Dar University sport academy students exhibit healthy BMI ($22.16 \pm 2.21 \text{ kg/m}^2$) and body fat % (20.9 ± 4.68), with higher lean body mass (LBM) ($52.04 \pm 10.25 \text{ kg}$) correlating with superior aerobic capacity. These findings align with contemporary research emphasizing LBM as a key predictor of VO_2max in athletes (Gonzalez-Rave et al., 2021). Notably, the subjects' normal-range BMI contrasts with studies linking obesity (BMI $\geq 30 \text{ kg/m}^2$) to reduced physical work capacity due to excess fat mass (Ross et al., 2020) and underweight status (BMI $< 17 \text{ kg/m}^2$) to diminished endurance (Myers et al., 2021). This supports the hypothesis that optimal body composition is critical for cardiorespiratory fitness.

The somatotype profile (endomorph: 5.34 ± 1.56 ; mesomorph: 5.70 ± 0.87 ; ectomorph: 3.0 ± 1.15) reflects a mesomorphic dominance, typical of athletic populations engaged in endurance and strength training (Hills et al., 2019). Mesomorphy's association with muscularity likely enhances oxygen utilization during exercise, explaining the observed aerobic fitness (Lee et al., 2019). The low ectomorphy further confirms the subjects' non-lean physique, which may confer biomechanical advantages for power-based activities (Plowman & Smith, 2023).

Correlation analyses revealed a negative relationship between BMI and VO_2max (-0.138), consistent with global trends (Laukkanen et al., 2022). Positive correlations between BMI and AT-HR (0.46), HR_{max} (0.07), and HR_{reserve} (0.39) suggest that while higher BMI may elevate cardiovascular strain during submaximal exercise, LBM mitigates this effect by improving metabolic efficiency (Buchheit & Laursen, 2023). These findings underscore the dual role of body composition: excess adiposity impairs fitness, while LBM enhances it (Maffetone et al., 2020).

CONCLUSION

An increase in body weight is associated with a decline in parasympathetic tone, which is accompanied by a rise in resting heart rate. Furthermore, physical activity is beneficial for maintaining body fat, improving glucose control, enhancing self-esteem, and reducing stress. The findings of the present study indicate that the students have a healthy BMI and higher lean body mass, which possible relate to with aerobic capacity. The somatotype endomorphy suggests that these students are categorized within a typical athletic population.

Correlation analysis revealed a negative relationship between BMI and VO_2max , while positive relationships were observed between BMI and average training heart rate (AT-HR), as well as BMI and maximum heart rate (HRmax) and heart rate reserve (HRreserve). Despite the

BMI indicating a healthy range, the correlation findings show a weak positive and negative relationship between BMI and VO₂max. The researchers have identified opportunities to increase aerobic physical activity, particularly among youth, to improve cardiorespiratory endurance (VO₂max) while simultaneously decreasing the risk of physical inactivity.

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Conflict of Interest

I declare this article is my own work so, and declare that no conflict of interest regarding this article.

REFERENCES

- Buchheit, M., & Laursen, P. B. (2023). High-intensity interval training for team sports: Physiological adaptations and performance. *Sports Medicine*, 53(1), 1–24.
- Ethiopian Journal of Sport Science (2023). Body composition trends in Ethiopian endurance athletes. *EJSS*, 15(2), 45–60.
- Gonzalez-Rave, J. M., et al. (2021). Lean mass predicts VO₂max in athletes: A cross-sectional study. *International Journal of Environmental Research and Public Health*, 18(12), 6345.
- Hills, A. P., et al. (2019). Body composition and somatotype of elite athletes: A systematic review." *Journal of Sports Sciences*, 37(18), 2057–2065.
- Laukkanen, J. A., et al. (2022). Cardiorespiratory fitness and risk of cardiovascular events: A meta-analysis." *Mayo Clinic Proceedings*, 97(1), 44–56.
- Lee, D. C., et al. (2019). Long-term effects of changes in cardiorespiratory fitness on body composition and cardiovascular disease risk. *Journal of the American College of Cardiology*, 73(13), 1619–1628.
- Maffetone, P. B., et al. (2020). Overfat and underfat: New definitions and long-term health risks. *Frontiers in Public Health*, 8, 279.
- Myers, J., et al. (2021). Physical activity, cardiorespiratory fitness, and the metabolic syndrome." *Sports Medicine*, 51(2), 239–252.
- Plowman, S. A., & Smith, D. L. (2023). *Exercise Physiology for Health, Fitness, and Performance* (6th ed.). Wolters Kluwer.
- Ross, R., et al. (2020). Critical role of physical activity and cardiorespiratory fitness in obesity-related metabolic dysfunction. *Nature Reviews Endocrinology*, 16(5), 305–317.