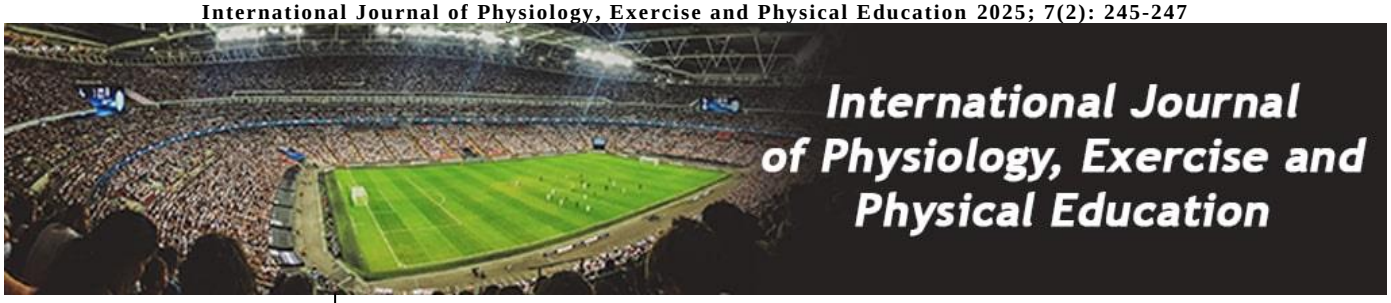

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Comparative Analysis of Physiological Parameters Between Athletes and Non-Athletes

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Abstract
The comparative study of physiological parameters between athletes and non-athletes provides key insights into how regular exercise training influences cardiovascular, metabolic, and anthropometric health. This study analyzes resting heart rate (RHR), resting blood pressure (BP), and body mass index (BMI) to understand how physical activity modifies fundamental physiological processes. Athletes generally demonstrate lower RHR and BP levels and maintain a healthier BMI range compared to sedentary individuals, reflecting superior cardiovascular efficiency and metabolic regulation. These adaptations arise from consistent training, leading to increased stroke volume, improved vascular compliance, and optimized body composition. By synthesizing empirical research, this study emphasizes the physiological advantages of habitual exercise and highlights its importance in promoting long-term health and performance.

Keywords: Athletes, non-athletes, resting heart rate, blood pressure, body mass index, cardiovascular fitness

Introduction
Physiological parameters serve as vital indicators of human health and functional capacity. Among these, resting heart rate, blood pressure, and body mass index are key metrics that reflect cardiovascular, metabolic, and overall physical status. Comparing these measures between athletes and non-athletes provides a scientific understanding of the adaptations induced by regular physical training (McArdle, Katch, & Katch, 2014) [10].

Athletes engage in structured physical activity that enhances cardiac output, vascular compliance, and energy metabolism, resulting in improved efficiency at rest and during exertion (Kenney, Wilmore, & Costill, 2021) [7]. In contrast, non-athletes often exhibit elevated heart rate and blood pressure values due to limited cardiovascular conditioning and higher body fat percentage (Zhang & Jordan, 2016) [21]. Understanding these differences contributes to both sports' science and public health, as exercise remains a cornerstone of disease prevention and performance optimization.

The purpose of this paper is to analyze and compare resting heart rate, resting blood pressure, and BMI among athletes and non-athletes, emphasizing the physiological mechanisms behind these differences and their implications for health and longevity.

Importance of Physiological Parameters in Health and Performance
Physiological markers such as RHR, BP, and BMI provide direct insights into cardiovascular efficiency, vascular integrity, and metabolic health.

Resting Heart Rate and Cardiovascular Efficiency
Resting heart rate (RHR) reflects the frequency of cardiac contractions per minute under resting conditions. Athletes typically present lower RHR values, often between 40–60 bpm, due to enhanced stroke volume, increased vagal tone, and reduced sympathetic drive (Baggish & Wood, 2011; Fletcher *et al.*, 2018) [1]. Lower RHR indicates a more efficient heart that pumps more blood per beat, reducing the need for high frequency at rest. Non-athletes, conversely, often exhibit higher RHR (70–80 bpm or more), reflecting reduced parasympathetic modulation and limited cardiac adaptation (Zinner & Sperlich, 2016) [22].

Chronically elevated RHR is linked to increased cardiovascular morbidity (Leeper & Myers, 2012) [9].

Resting Blood Pressure and Vascular Health

Blood pressure represents the force of circulating blood on arterial walls and serves as a major indicator of cardiovascular strain. Regular physical training lowers both systolic and diastolic BP by improving endothelial function, arterial elasticity, and autonomic regulation (Cornelissen & Smart, 2013) [4]. Aerobic and resistance exercises promote vasodilation through nitric oxide release, reducing total peripheral resistance (Tanaka & Seals, 2008) [16].

Non-athletes often experience higher BP values, averaging 125/85 mmHg or above, predisposing them to hypertension and related cardiovascular diseases (Whelton *et al*., 2018) [19]. In contrast, athletes typically maintain readings near 110/70 mmHg (Ozemek *et al*., 2018) [12], reflecting optimal vascular adaptation and cardiac efficiency.

Body Mass Index and Body Composition

BMI serves as a useful proxy for assessing general body composition, although it does not distinguish fat from muscle mass. Athletes usually exhibit lower Bvalues within the healthy range (20–24 kg/m²), resulting from greater lean mass and reduced fat percentage (Nindl *et al*., 2012) [11]. Conversely, non-athletes often present higher BMI (>25 kg/m²), which correlates with increased adiposity, metabolic inefficiency, and higher chronic disease risk (WHO, 2020; Zhang & Jordan, 2016) [21].

Comparative Analysis of Physiological Parameters

Resting Heart Rate (RHR)

Athletes exhibit significantly lower resting heart rates due to cardiovascular conditioning and autonomic balance. Endurance training increases stroke volume and myocardial contractility, allowing efficient oxygen delivery with fewer contractions (Seals *et al*., 1984) [15]. Pluim *et al*. (2000) [13] demonstrated that athletic hearts exhibit structural remodelling, including increased ventricular chamber size, which supports this enhanced function. Non-athletes' higher RHRs indicate a less efficient cardiac system, contributing to increased energy expenditure at rest and greater susceptibility to fatigue and cardiovascular stress (Hall & Hall, 2020) [6].

Resting Blood Pressure (BP)

Regular exercise reduces BP through several physiological pathways, including improved arterial compliance, enhanced baroreceptor sensitivity, and decreased sympathetic activity (Cornelissen & Smart, 2013) [4]. Longitudinal studies (Whelton *et al*., 2018; Zhou *et al*., 2017) [19] confirm that active individuals have significantly lower hypertension prevalence compared to sedentary populations. Non-athletes demonstrate higher resting BP due to decreased vascular elasticity and greater peripheral resistance (Froelicher & Myers, 2006) [5]. Chronic inactivity accelerates vascular aging, leading to arterial stiffness and endothelial dysfunction (Tanaka & Seals, 2008) [17].

Body Mass Index (BMI)

Athletes maintain lower or normal BMI values due to favourable body composition and efficient energy metabolism. Strength and endurance training increase lean muscle mass, reducing fat accumulation and promoting metabolic health (Powers & Howley, 2018) [14]. Booth *et al*. (2012) [3] note that habitual physical activity modulates hormonal pathways that regulate appetite and lipid oxidation, preventing obesity.

Non-athletes, in contrast, often display elevated BMI due to caloric imbalance and reduced metabolic rate. High BMI is strongly associated with cardiovascular disease, type 2 diabetes, and reduced life expectancy (Blair *et al*., 1989; Zhang & Jordan, 2016) [2, 21].

Physiological Adaptations and Mechanisms

Physical training induces multiple cardiovascular, vascular, and metabolic adaptations:

Cardiac Adaptations: Endurance training promotes eccentric hypertrophy and increased ventricular volume, enhancing cardiac output and lowering RHR (Baggish & Wood, 2011; Pluim *et al*., 2000) [1, 13].

Vascular Adaptations: Exercise increases capillary density, reduces arterial stiffness, and improves endothelial nitric oxide synthesis, resulting in lower BP (Seals *et al*., 2009) [16].

Metabolic Adaptations: Training enhances mitochondrial biogenesis, improves insulin sensitivity, and elevates fat oxidation capacity, contributing to stable BMI and reduced metabolic risk (Booth *et al*., 2012; Warburton *et al*., 2006) [3, 18]. These physiological mechanisms collectively explain why athletes display superior efficiency at rest and under stress compared to non-athletes.

Practical Implications

Understanding these differences underscores the importance of regular physical activity for both athletes and the general population. Moderate-to-vigorous exercise for at least 150 minutes per week as recommended by the World Health Organization (2020) significantly reduces resting HR, lowers BP, and improves body composition.

Health practitioners should integrate exercise prescriptions into preventive care, while sports educators should emphasize training balance to maintain cardiovascular health without pathological adaptations (Lavie, Milani, & O'Keefe, 2015) [12].

Conclusion

The comparative analysis clearly demonstrates that athletes exhibit superior physiological parameters compared to non-athletes. Lower resting heart rate, optimal blood pressure, and healthier BMI values reflect the profound cardiovascular and metabolic benefits of regular training. These adaptations stem from efficient cardiac and vascular remodelling, improved autonomic control, and favourable body composition. For non-athletes, even moderate physical activity can induce measurable improvements in these parameters, thereby reducing chronic disease risk and enhancing overall well-being. Promoting consistent exercise across all age groups is vital for public health and performance sustainability.

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