Journal of Sports Physiology and Athletic Conditioning (J.S.P.A.C) 2025; 5 (16): 62-68

Research Article

The Relationship between Physical Fitness and Cardiac Waves in Volleyball Referees

Saeideh Zabihi[1], Rahim Shirazinejad*[1], Ahmad Torkfar[1], Seyed Ali Hosseini [2], Mehrzad Moghadasi[1]

1. Department of Exercise Management, Sh.C., Islamic Azad University, Shiraz, Iran
2. Department of Exercise Physiology, Marv.C, Islamic Azad University, Marvdasht, Iran

Received: 15 July 2025
Accepted: 29 July 2025

Keywords:
Cardiac Waves, Physical Fitness, Volleyball

Abstract

Introduction: In today's professional world of refereeing, besides having specialized skills, capabilities, and personality traits, appropriate physical performance is one of the effective factors in sports advancement. The aim of the present study was to investigate the relationship between physical fitness and cardiac waves in volleyball referees.

Methods: In this semi-experimental comparative study, 60 volleyball referees from the national secondary school competitions for boys and girls (year 2023) were selected as the statistical sample. On the first day of the competitions, after the opening session, the research process, along with the benefits and strengths of participation, was explained to all referees in a predetermined meeting, and volunteer registration was conducted. On the following day, demographic questionnaires were first distributed among the volunteer referees, collected after completion, and then cardiac waves were measured using an electrocardiogram device. Additionally, to assess physical fitness, the factors of flexibility, muscular endurance, body mass index (BMI), and waist-to-hip ratio (WHR) were measured. For inferential data analysis, Pearson's correlation coefficient test was used ($P \leq 0.05$).

Results: There was a significant correlation between the P wave and flexibility ($P = 0.02$) and WHR ($P = 0.01$); between the PQ interval and flexibility ($P = 0.01$) and muscular endurance ($P = 0.004$); and between the QT interval and muscular endurance ($P = 0.02$).

Conclusion: It appears that in volleyball referees, with improved physical fitness, cardiac function also improves.

***Corresponding author:** Rahim Shirazinejad
Address: Department of Exercise Management, Sh.C., Islamic Azad University, Shiraz, Iran
Email: shirazinejad2295265010@iau.ir **Tell**:
R SH:

1. Introduction

Physical health refers to the complete functioning of the body and the normal condition of all its parts, which is a subset of health as defined by the World Health Organization (1). Physical health is a key factor and foundational for diseases such as hypertension, diabetes, cardiovascular diseases, and others. Lifestyle is one of the most important factors in promoting health, which, by developing and modifying health-promoting behaviors and empowering individuals in controlling their health, leads to improvement in individual and community health status (2). Studies have shown that physical health is related to mental health (3,4). Given these issues, it can be understood that mental and physical health are of great importance. Mental health means emotional and psychological well-being, such that an individual can utilize their thinking and abilities, function well in society, and meet daily life needs (5). Various social, psychological, and biological factors determine an individual's mental health at any given time (6). Considering the referees' responsibilities in enforcing game rules and their key role in ensuring fair play, they must possess various qualities and competencies to perform their duties appropriately (7). Today, in professional sports, in addition to physical fitness, specialized skills, abilities, and personality traits are among the factors influencing athletic progress (8). For this reason, many personality theories have sought to predict individuals' success and behavior by understanding their personality traits (9). In refereeing classes and clinics, emphasis is placed on physical techniques, rules interpretation, proper appearance, and written and practical tests; therefore, a specific combination of physical and psychological skills is necessary for success in refereeing (10).

Almost all interpretations and perceptions of refereeing by coaches and players are negative, and rarely do they refer to the quality of refereeing. Players and coaches who lose competitions often partly attribute their loss to refereeing. The referees' task on the field is very difficult because any wrong decision can provoke many spectators' emotions and lead to aggression (11). Many factors influence referees' judgments, including physical, personality, environmental, individual, social, structural, executive, economic, facilities, and equipment factors. Given the referees' impact on sports competitions and the importance of improving their health status, their well-being has always been a concern. The focus on improving referees' health aspects and institutionalizing empowerment issues has led to challenges in improving their health status. Judging in sports, especially professional sports, is closely related to physical health. In professions such as refereeing, where judgment quality depends on a combination of physical, cultural, economic, social, and security factors, referees experience high psychological pressure during judgment. Thus, referees are more vulnerable to occupational burnout. Refereeing is a stressful, exciting, and valuable profession. Considering today's professional world and the close relationship between sports and economic factors, abundant resources resulting from success in international events, it appears that investigating factors affecting the quality of referees' judgments and providing practical strategies to prevent burnout as an effective factor in this area can significantly help prevent disturbances and unrest caused by refereeing errors. The number of refereeing errors is one of the most important indices for determining the referee's performance and player aggression.

Therefore, a referee's performance depends on physical health, personality factors, visual skills, and social competence. The most important factor in refereeing is attention to human resources and having an appropriate refereeing staff, since better physical health is associated with higher motivation and consequently better performance. Therefore, considering the above, the present study seeks to answer whether there is a relationship between body composition components and self-efficacy of volleyball referees.

2. Materials and Methods

The statistical population of the present study consisted of all volleyball referees in the national secondary school competitions for boys and girls (year 1402). Based on Morgan's table, 60 volunteer referees were selected as the sample. To conduct this research, initial coordination was done with the Shiraz Department of Education, and the research process was fully explained to the director of physical education of this department. After obtaining approval from the director and the competition organizers, a letter introducing the researcher from Islamic Azad University, Shiraz Branch, was submitted to the Department of Education, and preliminary coordination with the competition officials was done. On the first day of the competitions, after the opening session, the research process, advantages, and strengths of participation were explained to all referees in a predetermined meeting, and volunteer registration was done. On the following day, demographic questionnaires were distributed and collected after completion.

Cardiac waves were then measured using an electrocardiogram device. To evaluate physical fitness, flexibility, muscular endurance, body mass index, and waist-to-hip ratio were measured. It is worth noting that flexibility was measured by the sit-and-reach test using the Wells box; muscular endurance by the sit-up test; waist-to-hip ratio by tape measurement (waist circumference at the narrowest point and hip circumference at the widest point); and body mass index by measuring weight and height (weight in kilograms divided by height in meters squared). Pearson's correlation coefficient was used for inferential analysis. The significance level for all tests was set at 0.05.

3. Results

Table 1 reports the mean and standard deviation of participants' age, height, and weight. Table 2 presents the mean and standard deviation of heart rate, P wave, PQ interval, QRS wave, QT interval, flexibility, muscular endurance, body mass index, and waist-to-hip ratio. Pearson's correlation results in Table 3 showed a significant correlation between P wave and flexibility (r = -0.30, P = 0.02) and waist-to-hip ratio (r = 0.31, P = 0.01); between PQ interval and flexibility (r = -0.30, P = 0.01) and muscular endurance (r = -0.37, P = 0.004); and between QT interval and muscular endurance (r = 0.28, P = 0.02). However, no significant correlations were found between heart rate and flexibility (r = 0.02, P = 0.84), muscular endurance (r = -0.17, P = 0.17), body mass index (r = 0.20, P = 0.11), and waist-to-hip ratio (r = 0.11, P = 0.37). There were also no significant correlations between P wave and muscular endurance (r = -0.24, P = 0.06) and body mass index (r = -0.04, P = 0.72). No significant correlation was found between PQ interval and body mass index (r = -0.11, P = 0.37) and waist-to-hip ratio (r = 0.14, P = 0.28). Likewise, no significant correlation was found between QRS wave and flexibility (r = -0.24, P = 0.06), muscular endurance (r = -0.008, P = 0.98), body mass index (r = 0.16, P = 0.20), and waist-to-hip ratio (r = 0.24, P = 0.06). Finally, no significant correlation was found between QT interval and flexibility (r = 0.06, P = 0.60), body mass index (r = -0.20, P = 0.12), and waist-to-hip ratio (r = -0.18, P = 0.17).

Variable	**Mean**	**Standard Deviation**
Age (years)	43.33	7.56
Height (cm)	171.95	8.72
Weight (kg)	76.48	14.40

Table 1 - mean and standard deviation of demographic characteristics of participants.

Variable	**Mean**	**Standard Deviation**
Heart Rate (beats per minute)	75.18	10.77
P Wave (ms)	87.11	27.47
PQ Interval (ms)	136.21	39.54
QRS Wave (ms)	95.11	9.56
QT Interval (ms)	379.45	26.14
Flexibility (cm)	26.06	11.30
Muscular Endurance (count)	21.50	5.73
Body Mass Index (kg/m^2)	25.74	3.07
Waist-to-Hip Ratio	0.89	0.07

Table 2 - mean and standard deviation of physical fitness components and cardiac waves.

Variable	Flexibility	Muscular Endurance	Body Mass Index (BMI)	Waist-to-Hip Ratio
Heart Rate	r = 0.02, P = 0.84	r = -0.17, P = 0.17	r = 0.20, P = 0.11	r = 0.11, P = 0.37
P Wave	r = -0.30, P = 0.02	r = -0.24, P = 0.06	r = -0.04, P = 0.72	r = 0.31, P = 0.01
PQ Interval	r = -0.30, P = 0.01	r = -0.37, P = 0.004	r = -0.11, P = 0.37	r = 0.14, P = 0.28
QRS Wave	r = -0.24, P = 0.06	r = -0.008, P = 0.98	r = 0.16, P = 0.20	r = 0.24, P = 0.06
QT Interval	r = 0.06, P = 0.60	r = 0.28, P = 0.02	r = -0.20, P = 0.12	r = -0.18, P = 0.17

Table 3 - Pearson correlation results between physical fitness components and cardiac waves

4. Discussion

The aim of the present study was to examine the relationship between physical fitness and cardiac waves in volleyball referees. The findings indicated significant correlations between the P wave and flexibility and waist-to-hip ratio, between the PQ interval and flexibility and muscular endurance, as well as between the QT interval and muscular endurance. This means that with improved physical fitness, the cardiac function of volleyball referees improves.Specific mechanisms in the heart maintain cardiac rhythm and action potentials, resulting in electromechanical activity of the heart, which can be recorded and observed using an electrocardiogram (ECG) device. The QT interval (from the beginning of the QRS complex, which represents ventricular depolarization, to the end of the T wave, representing ventricular repolarization) in the electrocardiogram reflects left ventricular repolarization during the diastolic phase. The most common index of heterogeneity in ventricular repolarization is the dispersion of QT intervals (the difference between the longest and shortest QT intervals) in the 12-lead standard ECG. Shortening or prolongation of the QT interval increases the risk of arrhythmia and is highly associated with sudden cardiac death. QT and heart rate are inversely correlated, but this correlation disappears at very high or low heart rates (12).

Studies have shown that physical activity, especially aerobic exercise, plays a significant role in cardiac rehabilitation and reducing cardiovascular mortality (13). Turkmen et al. investigated whether physiological changes (morphological and functional changes resulting from regular physical training) lead to abnormalities in ventricular repolarization in trained athletes by studying trained athletes and sedentary age- and sex-matched controls. Their findings showed that heart rate, systolic blood pressure, and diastolic blood pressure were similar between the two groups. The maximum and minimum QT intervals did not differ between athletes and controls, and QT and QTc dispersion were also not significantly different. Despite physiological and structural cardiac changes, no differences in ventricular heterogeneity were observed between athletes and sedentary controls (14).Besides training volume (intensity and duration) and sport type, factors such as age, gender, and ethnicity also play specific roles in ECG pattern development (15). Abad et al. (2017) demonstrated that continuous and intermittent aerobic exercise similarly improve cardiac function and autonomic modulation in rats with myocardial infarction (16).

It has been suggested that most QT changes due to exercise are attributable to heart rate and, to a lesser extent, other factors. Therefore, QT changes resulting from exercise are variable and complex. Disturbances in cardiac waves may indicate life-threatening arrhythmias and sudden death. Effects on QT interval may be due to reduced vagal activity in the ventricular level caused by exercise. Experimental studies have shown that vagal activity significantly influences ventricular arrhythmias. In adult and young animals, experimental vagal withdrawal causes QT prolongation and reduces the threshold for ventricular fibrillation (13). In fact, stress is part of refereeing, and referees in various sports experience different levels of stress before, during, and after matches (17). Today, due to the increasing stressors and decreased human coping ability, stress has become a complex and major phenomenon influenced by multiple interacting factors. Many studies, both domestic and international, have been conducted to identify and prioritize sources of stress for referees in football and related factors. For example, Voight (2009), in a study on 200 referees in the American football league, identified primary stressors including conflict between duty and family demands, interpersonal conflicts, role conflict, exposure, time pressure, fear of failure, and game pressure. He introduced time management, organization, communication training, coping strategies, mental skills training, and optimal physical fitness as effective methods for stress control. Arch et al. (2013) reported verbal abuse, physical injury, contact, and presence of officials as stress sources for referees (18). Nikbakhsh (2013) listed the presence of observers and media, game pressure, inadequate physical fitness, and physical decisions as stressors for referees (19). Nabi et al. (2016) also mentioned physical fitness, visual perception, mental ability, concentration and attention, preparedness and rapid decision-making, game time, intensity, and distance covered by the referee as influential factors (20).

5. Conclusion

It appears that in volleyball referees, improved physical fitness leads to improved cardiac function.

Acknowledgements

The authors hereby express their sincere gratitude to the Research Deputy of Islamic Azad University, Shiraz Branch, and to all participants in this study.

Funding

This study did not have any funds.

Compliance with ethical standards

Conflict of interest None declared.

Ethical approval the research was conducted with regard to the ethical principles.

Informed consent Informed consent was obtained from all participants.

Author contributions

Conceptualization: S.Z, R.SH, A.T , S.A.H, M.M ; Methodology: S.Z, R.SH, A.T , S.A.H, M.M ; Software: S.Z, R.SH, A.T , S.A.H, M.M ; Validation: S.Z, R.SH, A.T , S.A.H, M.M ; Formal analysis: S.Z, R.SH, A.T , S.A.H, M.M ; Investigation: S.Z, R.SH, A.T , S.A.H, M.M ; Resources: S.Z, R.SH, A.T , S.A.H, M.M ; Data curation: S.Z, R.SH, A.T , S.A.H, M.M ; Writing - original draft: S.Z, R.SH, A.T , S.A.H, M.M ; ; Writing - review & editing: S.Z, R.SH, A.T , S.A.H, M.M ; Visualization: S.Z, R.SH, A.T , S.A.H, M.M ; Supervision: S.Z, R.SH, A.T , S.A.H, M.M ; Project administration: M S.Z, R.SH, A.T , S.A.H, M.M ;

References

1. Alimohammadzadeh K, Akhlaghdoust M, Bahrainian SA, Mirzaei A. (2017). Survey on Mental Health of Iranian Medical Students: A Cross -sectional Study in Islamic Azad University. Shiraz E -Med J 2017;18: e14929 .

2. Li WW, Xie G. (2020) Personality and job satisfaction among Chinese health practitioners: The mediating role of professional quality of life. Health Psychol Open 2020;7:2055102920965053.

3. Esmaeil Zarghami, Milad Olfat. Relationship between physical and mental health, and different housing types for elderly. Payesh 2017; 16 (4) :521-530

4. Alavi M, Jorjoran Shushtari Z, Noroozi M, Mohammadi Shahboulaghi F. Mental Health and Related Factors in Old Population in Tehran 2014-2015. J Mazandaran Univ Med Sci 2018; 27 (158) :112-122

5. Fusar-Poli, P., de Pablo, G. S., De Micheli, A., Nieman, D. H., Correll, C. U., Kessing, L. V., & van Ame lsvoort, T. (2020). What is good mental health? A scoping review. European Neuro psycho pharmacology, 31, 33-46.

6. Lee, H. J., & Lee, D. K. (2019). Do sociodemographic factors and urban green space affect mental health outcomes among the urban elderly population? International Journal of Environmental Research and Public Health, 16(5), Article 789.

7. Samadi, H., Moradi, J., & Ahar, S. (2022). Psychometric Properties of the Persian Version of Referee SelfEfficacy Scale (REFS). Journal of Sports and Motor Development and Learning, 14(2), 69-86.

8. Hanin, Y.L. (2000).Emotions in sport. Champaign. Behavior Modification, (29), 616-641.

9. Khosravi, Shirin, Haghayegh, Sayed Abbas. (2018). Comparison of personality characteristics and personality types of contact and non- contact sport majors. Knowledge & Research in Applied Psychology. 4: 21-34.

10. Mangeshti Y, Sayadi MA, Kashef M. Investigating the relationship between personality traits and self-control factors of male referees in the Premier League.2017; 26 (9): 101- 122.

11. kamali, F. , manochehri Nezhad, M. and hakak zadeh, M. (2021). Designing an Ethical Decision-Making Model for Professional Football Referees in Iran. Sport Psychology Studies, 9(34), 235-258. doi: 10.22089/spsyj.2020.9405.2030.

12. delfani Z, Ghyratmand R. Comparison of functional changes in the heart and QTc intervals in a maximal and isotonic isometric exercise activity in active and inactive men. Research in Medicine 2019; 43 (4) :228-233.

13. Razi K, Hosseini S A, Shadmehri S, Salehi O R, Ahmadi M, et al. Interactive Effects of Aerobic Exercise and Music on Electrical Activity of the Heart in Non-Athletic Men.Mod Care J.2019;17(1):e97858.

14. Turkmen M, Barutcu I, Esen AM, Ocak Y, Melek M, Kaya D, et al. Assessment of QT interval duration and dispersion in athlete's heart. Journal of International Medical Research. 2004; 32(6):626-32.

15. Prakash K, Sharma S. Interpretation of the Electrocardiogram in Athletes. Canadian Journal of Cardiology. 2016; 32(4):438-51.

16. Abad CCC, do Nascimento AM, dos Santos LE, Figueroa D, Ramona P, Sartori M, et al. Interval and continuous aerobic exercise training similarly increase cardiac function and autonomic modulation in infarcted mice. Journal of Exercise Rehabilitation. 2017; 13(3):257-65.

17. Salehi. H, Mohseni. M (2017), Level of Anxiety of Iranian Referees: Selfawareness and Conflict Styles, Quarterly Journal of Sport Management and Motor Behavioral Management, No. 14,: 25-15.

18. Arch, J. J., Ayers, C. R., Baker, A., Almklov, E., Dean, D. J., & Craske, M. G. (2013). Randomized clinical trial of adapted mindfulness-based stress reduction versus group cognitive behavioral therapy for heterogeneous anxiety disorders. Behaviour research and therapy, 51(4-5), 185-196.

19. Nikbakhsh, R., Alam, S., & Monazami, M. (2013). The relationship between emotional intelligence, communication skills and stress among Iranian premier league referees. Annals of Biological Research, 4(4), 196-203.

20. Nabli, M. A., Abdelkrim, N. B., Jabri, I., Batikh, T., Castagna, C., & Chamari, K. (2016). Fitness Field Tests' Correlation with Game Performance in U-19-Category Basketball Referees. International journal of sports physiology and performance, 11(8), 1005-1011.