



Analysis of Physiological Responses of Double and Single Pickleball Players Over the Age of 40

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History Article

Received April 2026

Approved April 2026

Published vol 13 no 1 2026

Keywords

Pickleball; Physiological Response; Match Characteristic.

Abstract

The sport of pickleball is increasingly popular in the adult age group, including those over 40 years of age, but studies of physiological responses and game characteristics, especially comparisons between singles and doubles, are still limited. This study aimed to analyze differences in physiological responses and game characteristics between singles and doubles games in pickleball players over the age of 40. This study used a cross-sectional design with participants who were selected as members of the GMPP Pickleball club using the purposive sampling technique. Physiological responses were measured through pulse rate (5 minutes, average, and maximum), while game characteristics included steps per minute, total steps, game duration, rally time, rest time between rallies, and number of strokes. Data were collected using a Polar clock device and direct observation during the game, then analyzed using descriptive statistics and an Independent Sample t-test with a significance level of 0.05. The results showed that there was no significant difference in all physiological variables between singles and doubles ($p > 0.05$). However, there were significant differences in the characteristics of the game, namely rally time, game duration, rest time between rallies, and total steps ($p < 0.05$), where doubles games had a higher duration and total activity than singles. Meanwhile, no significant differences were found in steps per minute and number of strokes. It can be concluded that the difference in the form of play does not affect the physiological response of players, but does affect the activity patterns and characteristics of the game. These findings show that singles and doubles games have different activity demands, even though they are at the same level of physiological intensity, so that both can be used as a form of physical activity for players over 40 years of age according to the purpose of training.

How to Cite

Wijaksana, A., Rusdiana, A., & Hidayat, I. I. (2026). Analysis of Physiological Responses of Double and Single Pickleball Players Over the Age of 40. *Journal of Physical Education, Health and Sport*, 13 (1), 667-672.

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INTRODUCTION

Pickleball is becoming increasingly popular among people of all ages, including those 40 and older, thanks to its ease of learning, flexible intensity, and lower risk of injury compared to other racket sports (Vitale & Liu, 2020). This activity is crucial for adult fitness, particularly for cardiovascular function (Casper et al., 2023). Heart rate serves as a key indicator of the body's response to exercise, reflecting the intensity of physiological exertion (Gronwald & Hoos, 2020). Therefore, it is essential to first understand the baseline response of pickleball players before comparing variations in gameplay.

Pickleball offers two main game formats: singles and doubles, which differ in movement dynamics and strategy (Prieto-Lage et al., 2025). In singles play, a player is responsible for covering the entire court alone, resulting in broader, faster, and more physically demanding movements (Bortolotti et al., 2023). Conversely, in doubles, the court is divided between teammates, which reduces the individual workload, although matches tend to last longer with higher rally frequencies and intense team interaction (Bauer et al., 2022). This fundamental difference directly influences players' physical activity levels and physiological responses, encompassing parameters such as heart rate, total steps taken, overall game duration, and patterns of rest and attack (Zarei et al., 2025). Consequently, a comprehensive analysis is needed to map how these format variations impact overall physical workload.

Several previous studies have explored physiological responses in similar racket sports such as tennis and badminton, where patterns of play have been shown to influence cardiovascular and metabolic intensity (Huang et al., 2023). However, research specifically focused on pickleball, particularly involving participants over 40 years of age, remains very limited (Lauxtermann & Stubbs, 2025). Furthermore, direct comparisons between singles and doubles in the context of pickleball that integrate physiological data with game analysis metrics have not been extensively conducted (Ortega-Zayas et al., 2025). This situation creates a significant research opportunity to delve deeper into the relationship between game format and players' physiological adaptations. Therefore, this study is designed to fill this knowledge gap through a more holistic and integrated approach, combining on-court measurements with empirical data analysis.

Based on the background described above, this study explicitly aims to analyze the differences in physiological responses between singles and doubles play among pickleball players over the age of 40. Additionally, this study aims to compare game characteristics in detail, including: total number of steps, overall game duration, average time per rally, rest duration between rallies, and the number of strokes performed. The results of this study are expected to provide a deeper and clearer understanding of the intensity levels of physical activity in pickleball, while also serving as a practical reference for coaches, players, and sports program administrators. Specifically, this information will help in understanding the differing physical demands between singles (more anaerobic and explosive) and doubles (more aerobic and sustained) (Jung et al., 2024). Overall, this study is anticipated to contribute to the advancement of pickleball sports science, with an emphasis on the adult population that increasingly dominates participation in this sport.

The novelty of this study lies in the integration of physiological responses and match characteristic analysis in pickleball players over 40 years old by directly comparing singles and doubles play formats. Previous studies have generally focused on physiological responses or match analysis separately and were predominantly conducted in other racket sports such as tennis and badminton. In contrast, this study provides a more comprehensive understanding of pickleball performance among older adults by combining heart rate responses, temporal analysis, and notational analysis within the same investigation.

METHOD

This study employed a cross-sectional design, in which data were collected at a single point in time to simultaneously examine the physiological responses and game characteristics of pickleball players. This approach was used to compare physiological responses between singles and doubles play without conducting long-term observations (Dong et al., 2025). Because data were collected at the same time, this method allows for direct analysis of differences between groups in accordance with the research objectives (Hahnefeld et al., 2021). This study was conducted at the training and match venue of the GMPP Pickleball Club. It was carried out after training sessions or matches had concluded, so that the data obtained could be used to determine current operational conditions.

Participants in this study included members of the GMPP Pickleball Club who were at

least 40 years old. Purposive sampling was used to select the sample based on the study's requirements. Inclusion criteria included male players of the GMPP Pickleball Club who were at least 40 years old, in good health, and able to participate throughout the entire study period. Exclusion criteria included players with injuries or health conditions that could affect performance during play, as well as players who did not complete the entire data collection process. Participants were then divided into two groups: the singles group and the doubles group. The number of participants in this study was adjusted to include only those who met all the established criteria.

This study has one independent variable, namely game type (singles and doubles), as well as several dependent variables, including physiological responses and game characteristics. Physiological responses were measured using heart rate after 5 minutes, average heart rate, and maximum heart rate. Game characteristics include steps per minute, total steps, game duration, rally time, rest time between rallies, and number of strokes. Heart rate and step data were obtained using a Polar Smart Watch, while other variables were obtained through direct observation and recording during the match.

Data collection was conducted directly in the field while the game was in progress. Each participant used the same measurement device to ensure data consistency (SMF Jugessur, 2022). Researchers systematically recorded game variables such as duration, rally time, rest time, and number of strokes during the match. To reduce bias, all measurements were taken under identical game conditions without intervention, and uniform measurement tools were used for all participants (Franja et al., 2023). Additionally, data recording was performed meticulously and repeatedly to minimize measurement errors (Segovia-Cardozo et al., 2023).

Data analysis was conducted using descriptive statistics to describe the characteristics of the data (Siregar, 2025), as well as an independent samples t-test to determine differences between the singles and doubles groups (Siregar, 2025). Prior to hypothesis testing, normality and homogeneity tests were conducted to ensure the data met the assumptions of parametric analysis (Sari et al., 2024). All data were analyzed using statistical software with a significance level set at $\alpha = 0.05$ (Nurisnaini et al., 2023).

RESULTS AND DISCUSSION

According to **Table 1**, the average heart

rate after 5 minutes in the singles match was 115 bpm with a standard deviation of 10.5, while in the doubles match it was 111 bpm with a standard deviation of 9.2. The average heart rate during the single game was 127 bpm with a standard deviation of 9.9, while during the double game it was 131 bpm with a standard deviation of 9.3. The maximum heart rate during the single game was 153 bpm with a standard deviation of 10.1, while during the double game it was 151 bpm with a standard deviation of 11.5. The results of the Independent Sample t-test showed that there were no significant differences in all physiological variables between singles and doubles matches, namely heart rate after 5 minutes ($p = .442$), average heart rate ($p = .407$), and maximum heart rate ($p = .767$).

Table 1. Physiological Analysis

Variable	Single		Double		p
	M	SD	M	SD	
Hr 5 Minute	115	10.5	111	9.2	.442
Hr Avg	127	9.9	131	9.3	.407
Hr Max	153	10.1	151	11.5	.767

Table 2. Temporal Analysis

Variable	Single		Double		p
	M	SD	M	SD	
Rally Time	6	1.91	9	2.6	.002*
Game Duration	9	2.28	17	163	.001*
Break Between Rallies	9	1.67	8	1.3	.040*

Table 3. Notational Analysis

Variable	Single		Double		p
	M	SD	M	SD	
Steps per Minute	69	5.1	66	5.2	.141
Total Steps	643	179	1151	163	.001*
Total Hits	70	19.4	85	17	.062

According to **Table 2**, the average rally duration in singles matches was 6 seconds with a standard deviation of 1.91, while in doubles matches it was 9 seconds with a standard deviation of 2.6. The game duration in singles matches was 9 minutes with a standard deviation of 2.28, while in doubles matches it was 17 minutes with a standard deviation of 1.63. The rest time between rallies in singles matches was 9 seconds with a standard deviation of 1.67, while in doubles matches it was 8 seconds with a standard deviation of 1.3. The results of the Independent Sample t-test indicate that there are significant differences in rally duration ($p = .002$), match duration ($p =$

.001), and rest time between rallies ($p = .040$) between singles and doubles matches.

According to **Table 3**, the average number of steps per minute in singles play was 69 with a standard deviation of 5.1, while in doubles play it was 66 with a standard deviation of 5.2. The total number of steps in singles matches was 643 with a standard deviation of 179, while in doubles matches it was 1,151 with a standard deviation of 163. The number of strokes in singles matches was 70 with a standard deviation of 19.4, while in doubles matches it was 85 with a standard deviation of 17. The results of the Independent Sample t-test indicate that there is a significant difference in the total steps variable between single and double play ($p = .001$). Meanwhile, there is no significant difference in steps per minute ($p = .141$) and number of hits ($p = .062$). A comparison of the values for the notational analysis variables can also be seen in **Figure 1**.

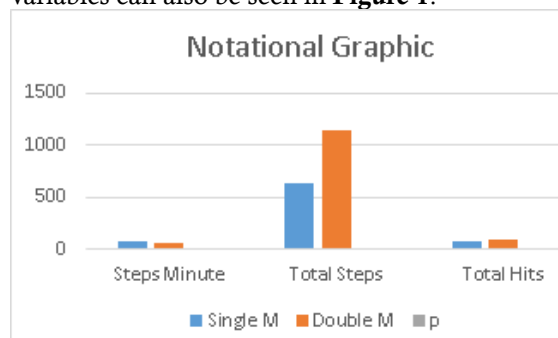


Figure 1. Comparison of notational and analysis in single and double play

The results of the study indicate that there were no significant differences in physiological variables namely, heart rate after 5 minutes, average heart rate, and maximum heart rate between singles and doubles matches ($p > 0.05$). These findings suggest that, in general, the physiological intensity experienced by players is relatively similar in both types of matches. In studies of racket sports, heart Rate is often used as an indicator of physical exertion (Siregar, 2025), and several previous studies have shown that physiological intensity does not always differ significantly across different game formats when the rhythm and patterns of activity are relatively similar (Björklund, 2026). The results of this study reinforce these findings, indicating that although there are differences in game formats, players' physiological responses do not show significant differences. This may be influenced by the characteristics of the study sample players over 40 years of age whose playing patterns tend to be more controlled, stable, and less explosive compared to youn-

ger age groups (Andersson et al., 2025).

In the temporal analysis, it was found that rally duration, match duration, and rest time between rallies showed significant differences between singles and doubles matches ($p < 0.05$). Doubles matches have longer rally times and match durations, while rest periods between rallies are shorter compared to singles matches. These findings align with the general characteristics of doubles play in racket sports, where the division of the playing area allows players to keep the ball in play longer, resulting in longer rallies (L. Mansec et al., 2023). Additionally, cooperation among players in doubles can enhance game stability, leading to longer match durations (Paulauskas et al., 2025). Conversely, in singles, players must cover the entire court individually, which can increase movement load and cause rallies to end more quickly (Sales et al., 2021). This condition also affects rest periods, as singles players tend to require a longer recovery time before starting the next rally (Lima et al., 2025). These findings reinforce previous research indicating that game structure influences rally patterns and the distribution of activity time during matches (Tamburro et al., 2023).

In the notational analysis, the results showed a significant difference in the total steps variable between singles and doubles games ($p < 0.05$), with doubles having a higher number of steps than singles. Meanwhile, the steps per minute and number of strokes variables did not show a significant difference ($p > 0.05$). This finding suggests that although the intensity per unit of time is relatively similar, the accumulated physical activity in doubles is higher. In previous research on racket sports, total physical activity is often influenced by game duration, where the longer the game duration, the greater the total activity performed by players (Mellado-Arbelo & Baiget, 2022). The results of this study align with these findings, as the doubles game in this study had a longer duration, resulting in a higher total steps. However, the absence of a difference in steps per minute indicates that the rhythm of play between singles and doubles is relatively similar, so the intensity per unit of time does not differ significantly (Y. Le Mansec et al., 2023). Similarly, in terms of the number of strokes, although the average for doubles play was higher, the difference was not significant, indicating that the frequency of ball interaction in both types of play was still within a relatively similar range (Filipic et al., 2023).

Overall, the results of this study indicate that there are no significant differences in phy-

siological responses between singles and doubles play. However, there are differences in game characteristics, particularly in total steps, rally time, game duration, and rest time between rallies. This suggests that physiological responses are influenced not only by the form of play but also by activity patterns and load distribution during play (Denysovets et al., 2025). The contribution of this study lies in presenting an analysis that combines physiological aspects and game characteristics in the context of pickleball in the age group over 40 years, which has been limited in previous studies (Lauxtermann & Stubbs, 2025). However, this study has several limitations, including the limited sample size and the relatively short data collection period. Furthermore, this study did not consider other factors such as player skill level, individual physical condition, and game strategy, which may influence the results (Wehovszky et al., 2025). Therefore, future research is recommended to involve a larger sample size and examine additional variables to obtain more comprehensive results.

CONCLUSION

This study showed no differences in physiological responses between singles and doubles play in pickleball players aged 40 and over. This indicates that both types of play impose a relatively similar cardiovascular workload on players. However, differences in the characteristics of singles and doubles play were found. Doubles play tended to have longer durations, longer rallies, and more sustained activity, while singles play exhibited a pattern of play with shorter rallies and relatively longer rest periods. These findings suggest that differences in the form of play do not necessarily influence physiological responses, but are more evident in the activity patterns and characteristics of play that occur during the match. Therefore, both singles and doubles play can be used as forms of physical activity for players aged 40 and over, with different load characteristics but still at a relatively balanced level of intensity.

The results of this study imply that coaches and players can tailor game types to their desired training goals, whether to improve endurance through longer games or to develop individual movement through single-player games. Furthermore, this study contributes to the development of pickleball studies, particularly in adults, a topic that has been limited in previous research. Future research is recommended to involve a larger sample size and consider other variables such as player skill level, physical condition, and game strategy,

which can influence physiological responses and game performance. Therefore, future research is expected to provide a more comprehensive picture of the characteristics of pickleball.

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