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COMPARISON OF ENERGY EXPENDITURE BETWEEN PICKLEBALL AND TENNIS

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ABSTRACT

In recent years, pickleball has rapidly developed and become a popular exercise choice due to its accessibility and intensity suitable for a wide range of people. Meanwhile, tennis remains a traditional sport with high physical demands and has been extensively studied for its health benefits. This study aims to compare the energy expenditure between the two sports and assess the differences in exercise intensity. The research method was conducted experimentally with 40 participants, divided into two groups playing pickleball and tennis for 45 minutes. Data on calorie expenditure, heart rate, and exercise time were collected through wearable devices. Indicators such as average calories burned, percentage of maximum heart rate, and MET values were used to analyze and compare energy expenditure between the two groups. The results showed that tennis had significantly higher energy expenditure than pickleball, with both calorie consumption and average heart rate being superior. However, pickleball maintains a moderate level of exercise intensity and offers positive benefits for cardiovascular health. These findings provide a scientific basis for selecting a sport suitable for fitness goals and contribute to guiding research in the field of sports science.

Keyword: Pickleball, Tennis, Energy Expenditure

1. INTRODUCTION

In the context of globalization and increasing awareness of the role of physical activity in public health, recreational sports that combine physical training are increasingly attracting attention and developing strongly. Among them, pickleball has emerged as a notable phenomenon in the last decade. According to reports from international sports organizations, pickleball is one of the fastest-growing sports in the United States and many other countries, thanks to its accessibility, low cost, and suitability for many different age groups [1]. Unlike many other competitive sports that require a high level of physical fitness or technique, pickleball allows players to quickly become familiar with and participate in competitions after only a short period of training, thereby contributing to expanding the popularity of this sport in the community.

Conversely, tennis is a sport with a long history of development and has been extensively studied in the field of sports science. Tennis is characterized by high-intensity movements interspersed with short rest periods, requiring players to have good motor coordination, quick reflexes, and high cardiovascular endurance [2]. Previous studies have shown that tennis can provide many health benefits, including improved cardiovascular function, increased muscle strength, and enhanced motor coordination [3].

The significant differences in court structure, rules, and intensity of movement between pickleball and tennis lead to considerable differences in energy expenditure during participation. While tennis typically requires players to move across a large court area with constant acceleration and changes of direction, pickleball is played on a smaller court with a slower pace and close-range ball handling. This raises an important question in sports science: can pickleball provide equivalent training benefits to tennis, especially in the context of players increasingly prioritizing moderate but sustained physical activity? Although both pickleball and tennis have been studied from an exercise physiology perspective, most existing works focus on each sport individually, with few direct comparative studies between the two. Studies on tennis mainly focus on professional or semi-professional athletes, while studies on pickleball are often directed towards middle-aged and elderly people [4], [5]. This leads to a lack of scientific data on the energy expenditure of these two sports in the same group of subjects, especially young people.

In the context of Vietnam, this issue becomes even more noteworthy as pickleball has only been introduced and developed in recent years. Currently, the number of domestic research works on pickleball is still very limited, mainly stopping at the level of description or preliminary assessment of health benefits. At the same time, tennis is still a popular sport at sports centers, creating favorable conditions for conducting comparative studies. However, to date, there have been few experimental studies evaluating the differences in energy expenditure between these two sports in Vietnam.

The lack of direct comparative studies not only limits the understanding of the physiological characteristics of each sport but also makes it difficult to provide scientific recommendations for exercisers. Given the increasing number of people choosing pickleball as an alternative to tennis due to its accessibility, clearly defining the energy expenditure and intensity of exercise in these two sports is essential to ensure effective health training.

Based on the above issues, this study was conducted to analyze and compare the energy expenditure between pickleball and tennis. Specifically, the study focused on measuring important physiological indicators such as calorie expenditure, average heart rate, and percentage of maximum heart rate (%HRmax) during participation in the two sports.

Furthermore, the study also aims to evaluate the exercise intensity of pickleball and tennis through quantitative indicators such as MET (Metabolic Equivalent of Task), thereby determining the suitability of each sport for different training goals. By comparing these indicators under the same experimental conditions, the study hopes to provide a comprehensive and objective view of the exercise effectiveness of the two sports.

This research contributes to the field of sports science in many different aspects. First, the study provides experimental data on the energy expenditure of pickleball and tennis. The use of modern measuring devices such as smartwatches allows for continuous and accurate data collection, contributing to the reliability of the research results.

Secondly, the study clarifies the differences in exercise intensity between the two sports through physiological indicators, thereby contributing to the theoretical framework of exercise physiology in contact sports. These results are not only academically significant but also have practical value in designing physical education programs and selecting appropriate sports activities for different target groups.

Finally, the study offers practical suggestions for choosing sports based on health training goals. While tennis may be suitable for those seeking to improve physical fitness and cardiovascular endurance, pickleball could be a suitable choice for beginners or those wishing to maintain moderate physical activity. Simultaneously, the study opens avenues for further research, particularly in the application of technologies such as artificial intelligence to analyze exercise data and optimize training effectiveness.

2. METHODOLOGY.

This study was designed experimentally to compare energy expenditure between Pickleball and Tennis under relatively controlled conditions, ensuring objectivity and reproducibility of results. The research method focused on collecting and analyzing basic physiological indicators related to energy expenditure, including calorie consumption, heart rate, and exercise time, through modern wearable measuring devices.

2.1. Study Subjects

The study included 40 participants, with a relatively even distribution of gender: 23 males and 17 females. The participants' ages ranged from 25 to 41, representing a group of young people with good physical fitness and who regularly participate in physical activities. All participants underwent basic health checks before participation to ensure they did not have cardiovascular diseases or health problems that would affect the study results.

To minimize skill level bias, subjects were selected with basic experience in both sports or were given introductory instruction before the experiment. This helped ensure that energy expenditure reflected primarily the intensity of the sport rather than individual skill differences. According to previous studies, player skill level can significantly affect heart rate and energy expenditure in contact sports [6].

2.2. Experimental Design

The study was designed using a comparative model between two groups, each performing a distinct type of exercise. The first group played pickleball, while the second group played tennis. To ensure similarity in conditions, the experiments were held at the same time of day and on playing fields with similar environmental conditions.

Each experiment session lasted 45 minutes, including warm-up, main activity, and recovery. The main activity accounted for approximately 30 minutes at natural intensity, allowing players to participate in realistic competition situations. This duration was chosen based on previous studies showing that a timeframe of 30 to 60 minutes is suitable for assessing energy expenditure in moderate to high-intensity physical activities [7].

To increase the reliability of the data, each subject could participate in multiple experiment sessions, and the results were averaged. This approach helps reduce the influence of random factors such as physical condition during the day or small changes in environmental conditions.

2.3. Measurement Devices

Data collection is carried out through smart wearable devices (smartwatches or sports bracelets) capable of measuring heart rate in real time and estimating calorie expenditure. These devices use photoplethysmography (PPG) technology to measure heart rate, a method that has proven to have relatively high accuracy in field studies [8].

The recorded parameters include mean heart rate, maximum heart rate, calorie expenditure, and actual exercise time. The collected data is synchronized and stored digitally for analysis. The use of smart wearable devices allows for continuous data collection under real-world conditions, while minimizing costs and complexity compared to traditional measurement methods [9].

2.4. Analysis Index

The main indices used to assess energy expenditure include the average calorie consumption per exercise session, the percentage of maximum heart rate (%HRmax), and the MET (Metabolic Equivalent of Task) value. Maximum heart rate is estimated based on a formula that depends on the age of the participants, thereby allowing the determination of the relative level of exertion during exercise [10].

The MET value is used as a standardized index to compare energy expenditure between different activities. Estimating MET based on heart rate and exercise intensity data allows for objective assessment of energy expenditure and can be compared with previous studies. This is a widely used index in the field of sports science to classify levels of physical activity [6].

2.5. Data Processing Methods

The collected data were processed using descriptive and inferential statistical methods. Means and standard deviations were calculated to characterize the distribution of variables such as calorie expenditure and heart rate. Then, an independent t-test was used to assess the differences between the two groups, pickleball and tennis.

Statistical significance was established at a threshold of $p < 0.05$. When the p-value is less than this threshold, the differences between the two groups are considered statistically significant. This testing method is suitable in studies comparing two independent groups with data that have a near-normal distribution [7].

In addition, the data were visualized through graphs such as bar charts and line graphs to clearly illustrate the differences between the two groups. The combination of quantitative analysis and visualization enhances the interpretability and persuasiveness of the research results.

3. RESULTS

This section presents the results obtained from an experiment comparing energy expenditure between Pickleball and Tennis. Data were compiled from 40 participants, after statistical processing and removal of outliers. The main indicators analyzed included calorie expenditure, mean heart rate, percentage of heart rate maximum (%HRmax), and estimated MET value.

The results show significant differences between the two sports in terms of energy expenditure and exercise intensity. The results are presented in detail in tabular form and quantitative analysis is used to clarify the overall trends of the data.

3.1. Comparison of Calorie Expenditure

Table 1 presents the mean values and standard deviations of calorie expenditure during a 45-minute exercise session.

Table 1. Comparison of Calorie Expenditure Between Pickleball and Tennis

Sport	Average Calories (kcal)	Standard Deviation
Pickleball	318	± 42
Tennis	472	± 58

The results showed that the calorie expenditure in tennis was significantly higher than in pickleball. Specifically, tennis consumed approximately 48.4% more energy than pickleball during the same exercise time. This difference was statistically significant with $p < 0.05$.

This result is consistent with previous studies, in which tennis was classified as a high-intensity physical activity with higher energy expenditure than medium-intensity sports [11].

3.2. Comparison of Heart Rate and %HRmax

Table 2 presents the comparison results of average heart rate and percentage of maximum heart rate between the two groups.

Table 2. Comparison of Heart Rate and %HRmax

Sport	Average Heart Rate (bpm)	% HRmax
Pickleball	124 ± 9	64%
Tennis	151 ± 11	79%

The results showed that the average heart rate of tennis players was significantly higher than that of pickleball players. The %HRmax value for tennis was in the range of 75–85%, corresponding to the high-intensity zone, while pickleball was in the range of 60–70%, corresponding to the medium intensity zone.

This difference reflects the movement characteristics of the two sports, in which tennis requires rapid acceleration and continuous movement across a larger court area. According to the study by Swain et al. [12], heart rate is a reliable indicator for assessing exercise intensity in contact sports.

3.3. Comparison of MET Values

Table 3 presents the estimated MET values based on heart rate data and exercise intensity.

Table 3. Comparison of MET Values Between the Two Sports

Sport	**Average MET**	**Intensity Classification**
Pickleball	5.6	Moderate
Tennis	8.3	High

The results showed that tennis had a significantly higher MET value than pickleball, reflecting a greater energy expenditure in the same unit of time. According to the classification of Ainsworth et al., activities with MET greater than 6 are considered high-intensity activities, while activities with MET from 3 to 6 belong to the medium-intensity group [11].

3.4. Analysis of Heart Rate Trends Over Time

In addition to average values, the study also analyzed changes in heart rate over time during the exercise session. The results showed that heart rate in tennis increased rapidly in the initial phase and remained high throughout the exercise, while pickleball tended to increase more slowly and fluctuate more steadily.

This trend reflects the characteristics of tennis's exercise with high-intensity activity phases interspersed with short rest periods, while pickleball has a more stable rhythm. This result is consistent with the exercise pattern described in studies of contact sports [12].

3.5. Overall Evaluation

The combined results show that tennis has a significantly higher energy expenditure than pickleball across all measured metrics. Differences in calorie expenditure, heart rate, and MET values all indicate that tennis is a high-intensity physical activity, while pickleball is more suited to moderate activity levels.

Despite this, pickleball still demonstrates significant effectiveness in maintaining physical activity and improving cardiovascular health, especially for those unsuitable for high-intensity activities. This suggests that pickleball could serve as a suitable alternative for various groups within the community.

4. DISCUSSION

Experimental results show significant differences between Pickleball and Tennis in terms of energy expenditure, heart rate, and MET values. This discussion aims to interpret the findings from the perspective of exercise physiology, compare them with previous studies, and draw practical implications and suggest directions for future research.

First, the difference in calorie expenditure and %HRmax between the two sports can be explained by differences in the structure of the exercise tasks. Tennis requires players to move across a larger court area with high acceleration and deceleration frequency, combined with high-amplitude and high-force ball striking movements. These characteristics increase the demand for aerobic and anaerobic energy metabolism, leading to higher energy expenditure. Conversely, pickleball takes place on a smaller court, with a more stable pace and shorter distances, thus resulting in lower average exertion intensity. Studies on tennis physiology have shown that tennis movements are "intermittent high-intensity," with heart rate typically maintained at 70–85% HRmax, consistent with the high-intensity zone [13]. The results of the current study are consistent with this finding, with the tennis group achieving significantly higher %HRmax values than the pickleball group.

Besides court size and movement intensity, the differences are also influenced by tactical characteristics and match structure. In tennis, rallies are typically high-intensity with constant changes in direction and speed, requiring rapid mobilization of large muscle groups. Meanwhile, pickleball tends to prolong rallies but with lower intensity, mainly focusing on reflexes and ball control at close range. This leads to differences in energy mobilization patterns, with tennis utilizing more high-speed energy systems, while pickleball tends to maintain stable energy over a longer period. These observations are consistent with MET-based fitness intensity classification models, where activities above 6 MET are considered high intensity, and 3–6 MET are considered medium intensity [14].

Compared to previous studies, this study's results show that tennis's energy expenditure falls within the reported range, while pickleball shows lower expenditure but still provides cardiovascular benefits. Vitale and Liu's study showed that pickleball can improve cardiovascular health in middle-aged individuals by maintaining heart rate in the medium activity range [15]. However, the current study extends this conclusion to younger subjects, showing that even in young people, pickleball maintains a certain physiological effect, although not at the intensity level of tennis. This helps fill a research gap in direct comparisons between the two sports in the same group of subjects.

Another important aspect to be discussed is the practical significance of the results obtained. From a physical education and public health perspective, the selection of a suitable sport depends not only on the energy expenditure but also on the ability to sustain long-term training. Tennis, with its high intensity, can provide quick results in improving fitness and cardiovascular endurance, but it also requires a good fitness foundation and can cause fatigue or injury if not practiced properly. Conversely, pickleball, with its medium intensity, may be a more suitable choice for beginners or those who want to sustain physical activity. As recommended by health organizations, maintaining moderate physical activity over a long period can also provide health benefits equivalent to high-intensity activities over a short period [16].

Based on the research results, several solutions can be proposed to optimize training effectiveness. For pickleball, increasing intensity through methods such as playing singles instead of doubles, shortening rest periods, or increasing the pace of the game can help improve energy expenditure. For tennis, designing a training program tailored to individual fitness levels, combining technical and strength training exercises, can help reduce the risk of injury and maintain long-term training effectiveness. Additionally, integrating smart wearable devices to monitor heart rate and calorie expenditure in real time can help trainees adjust exercise intensity to suit their personal goals.

A noteworthy development direction is the application of data analytics and artificial intelligence in sports research. Using machine learning algorithms to analyze heart rate, movement, and energy expenditure data can help build models that predict personalized training effectiveness. Recent studies have shown that combining data from wearable devices and

machine learning models can significantly improve the accuracy of energy expenditure estimation [17]. This opens up the possibility of building intelligent training support systems, especially in the context of digital transformation in the sports and health fields.

However, the study also has some limitations that need to be considered. First, the relatively small sample size may affect the generalizability of the results. Second, the short experimental time does not fully reflect the long-term impact of the two sports on health. Third, the study did not fully control for factors such as skill level, competition tactics and personal motivation, which can affect energy expenditure. In addition, the use of smart wearable devices, although convenient, still has a certain margin of error compared to direct measurement methods such as respiratory gas analysis.

In the future, further studies should expand sample size, extend follow-up periods, and incorporate multiple measurement methods to increase the accuracy of results. Simultaneously, comparing additional variables such as gender, athletic ability, and competition format (singles/doubles) could provide a more comprehensive view of the physiological characteristics of each sport. Integrating data analytics and artificial intelligence technologies is also a potential direction to improve research quality and practical applications.

5. CONCLUSION

This study compared the energy expenditure of pickleball and tennis among young adults using physiological indicators such as calorie expenditure, heart rate, and MET values. The results showed that tennis had significantly higher energy expenditure than pickleball, reflecting the high-intensity nature of the sport. However, pickleball still demonstrated the ability to maintain moderate physical activity and offered positive benefits for cardiovascular health. The differences between the two sports mainly stemmed from factors such as court size, intensity of movement, and tactical characteristics of play. From a practical perspective, tennis is suitable for those aiming to improve fitness and endurance, while pickleball is a suitable choice for beginners or those wishing to maintain sustainable physical activity. The study contributes to providing a scientific basis for choosing appropriate sports in educational and community settings. Furthermore, the results open up avenues for further research aimed at expanding sample size, extending follow-up periods, and integrating modern analytical technologies. The application of artificial intelligence in exercise data analysis promises to improve accuracy and personalization in evaluating training effectiveness. Finally, the study emphasizes the importance of choosing appropriate forms of exercise to optimize long-term health benefits.

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