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Investigation of Athletic Performances of Racket Sportsmen

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Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.

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Abstract

The aim of this study was to determine the performance and physical fitness of racket sports players. Sport is a biological and social pursuit that involves an individual's physical activity and motor skills, aiming to enhance their mental, emotional, and social behaviors within specific regulations and compete under certain rules. The study included 36 male athletes, with 12 participants in each of the table tennis, badminton, and tennis branches. Measurements were taken for the age, height, body weight, body mass index, t-test, reaction test, 30-meter speed test, aerobic power test, and anaerobic power test for the participating athletes. The data were recorded using the SPSS 22.00 package program. Npar tests were used for the overall averages of the groups. One-Way Anova Analysis test was used for the pairwise averages of the groups ($p<0.05$). Duncan's multiple comparison test was used for intergroup differences ($p<0.05$). In terms of body weight values, the tennis group is similar to the badminton and table tennis groups, with the table tennis group significantly higher than the badminton group ($p<0.05$). T-test values for agility are similar for badminton and table tennis, while the tennis group's agility test performance is significantly higher than both the table tennis and badminton groups ($p<0.05$). MaxVo2 levels are similar for the table tennis group and the tennis and badminton groups, with the badminton group significantly higher than the tennis group ($p<0.05$). No statistically significant results were found in other measurements examined ($p>0.05$). In conclusion, the differences in body weight, agility, aerobic power, and field-movement dimensions are thought to be influenced by the duration and types of competitions.

Keywords: Athletic performance, badminton, table tennis, tennis.

Raket Sporcularının Atletik Performanslarının İncelenmesi

Özet

Bu çalışmanın amacı raket sporları oyuncularının performansını ve fiziksel fitness'ını belirlemektir. Spor, bireyin fiziksel aktivitesi ve motor becerilerini içeren biyolojik ve sosyal bir uğraştır; zihinsel, duygusal ve sosyal davranışlarını geliştirmeyi ve belirli kurallar altında yarışmayı amaçlar. Çalışmaya 36 erkek sporcu dahil edildi; masa tenisi, badminton ve tenis branşlarında her birinde 12 katılımcı bulunmaktadır. Katılımcı sporcuların yaş, boy, vücut ağırlığı, vücut kitle indeksi, t-testi, reaksiyon testi, 30 metre hız testi, aerobik güç testi ve anaerobik güç testi ölçümleri alınmıştır. Veriler SPSS 22.00 paket programı kullanılarak kaydedilmiştir. Grupların genel ortalamaları için Npar testleri kullanılmıştır. Grupların ikili ortalamaları için Tek Yönlü Anova Analiz testi uygulanmıştır ($p<0.05$). Gruplar arası farklılıklar için Duncan'ın çoklu karşılaştırma testi kullanılmıştır ($p<0.05$). Vücut ağırlığı değerleri açısından tenis grubu, badminton ve masa tenisi gruplarıyla benzerlik göstermektedir; masa tenisi grubunun vücut ağırlığı badminton grubundan anlamlı derecede yüksektir ($p<0.05$). Çeviklik için t-testi değerleri badminton ve masa tenisi için benzerdir, ancak tenis grubunun çeviklik testi performansı hem masa tenisi hem de badminton gruplarından anlamlı derecede yüksektir ($p<0.05$). MaxVo2 seviyeleri açısından masa tenisi grubu ile tenis ve badminton grupları benzerdir; badminton grubu tenis grubundan anlamlı derecede yüksektir ($p<0.05$). Diğer incelenen ölçümlerde istatistiksel olarak anlamlı sonuçlar bulunamamıştır ($p>0.05$). Sonuç olarak, vücut ağırlığı, çeviklik, aerobik güç ve saha-hareket boyutlarındaki farklılıkların, yarışma süreleri ve türlerinden etkilendiği düşünülmektedir.

Anahtar Kelimeler: Atletik performans, badminton, masa tenisi, tenis.

INTRODUCTION

Sports should be introduced into a child's life at an early age because it plays a crucial role in their growth, maturation, cognitive development, and socialization (1). In today's world, there is a need for talented athletes to compete on international platforms and establish a presence in the field globally. The development of these children requires systematic and coordinated efforts, along with the selection of individuals suitable for sports (2).

Early detection of potential performance in sports, directing athletes to the right sport, and laying the groundwork for optimal success are essential. To achieve this, performance criteria in different sports should be established, and talent selection should be aligned accordingly (2).

One critical aspect of talent selection is the necessity of creating databases that include measurements related to all aspects of talented athletes. It is emphasized that knowing the physical characteristics and anthropometric measurements of Olympic athletes can serve as a reference in talent selection. Additionally, the importance of how coaches perceive and define talent is discussed, with some coaches recognizing talent in individuals in different ways. It is pointed out that cross-sectional analyses may not adequately account for the dynamic development of young athletes in talent identification stages, and longitudinal analyses could be more beneficial. The adoption of a multidisciplinary approach, conducting a holistic assessment, and developing tests that mimic competition tasks are emphasized (3).

Racket sports are among the few individual sports where opponents face each other directly. Athletes in racket sports need to be patient, self-controlled, and demonstrate mastery in both success and failure. They must cope with uncertainty, develop a successful playing style, and learn from their mistakes (4).

Racket sports is an Olympic sport embraced by the modern world, which is exciting to play and awe-inspiring to watch. This sport requires a combination of aerobic and anaerobic loading, as well as a high level of biomotor abilities such as strength, speed, endurance, flexibility, and coordination (5).

Physical fitness values, including the physical, physiological, and anthropometric characteristics of athletes, are crucial in talent selection. For high performance in national and international racket sports competitions, it is essential to assess the sport-specific physical requirements and the capacity of players and teams to meet these requirements. Therefore, to achieve optimal performance, a combination of technical and tactical skills with physical fitness must be evaluated together (6).

Identifying potential performance at an early age in sports will pave the way for directing athletes to the right sport and achieving optimal success. To achieve this, performance criteria in different branches need to be determined, and talent selection should be made accordingly (7, 8).

METHOD

Participants

The study included 36 volunteer athletes with an average age of 15.47±0.50 years, average height of 174.06±7.11 cm, and average weight of 63.34±8.05 kg.

In the tennis group, 12 male athletes participated with an average age of 15.50±0.522 years, average height of 172.58±6.14 cm, and average weight of 63.66±8.32 kg. In the badminton group, 12 male athletes participated with an average age of 15.42±0.51 years, average height of 173.50±9.00 cm, and average weight of 59.58±9.35 kg. In the table tennis group, 12 male athletes participated with an average age of 15.50±0.52 years, average height of 176.08±5.91 cm, and average weight of 66.79±4.60 kg.

Procedure

T-Test:

The T-Test involved athletes starting with a suitable posture at cone 1. Each athlete had to use the same starting position. While in motion, the athlete ran towards cone 2 and touched the top with the right hand. The athlete then ran to cone 3 with lateral movement, touching the top with the left hand. The athlete then ran laterally towards cone 4 and touched the top with the right hand. The athlete returned to cone 2, touched it with the left hand, and finally ran backward from the starting line to cone 1. Timing started with the initial movement, and the athlete stopped when passing the starting line (8).

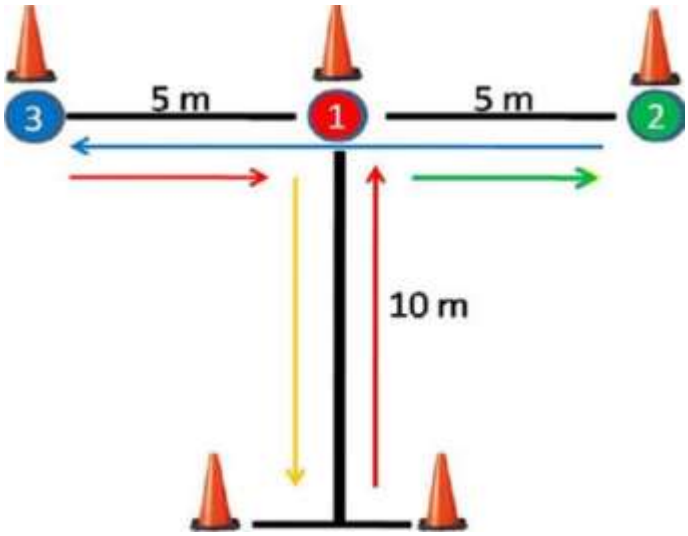

Figure 1. T-Test Setup

Computer Reaction Time Measurement

The reaction time was the elapsed time between the onset of a stimulus and the motor response. To determine visual reaction time, a computer program was used. Random stimuli (appearing between 2-10 seconds) with an unpredictable appearance time were presented on the computer screen, and the subject responded by pressing a designated key to turn off the image. The test data were recorded by the computer, and the average Optical (visual) Reaction Time (ORT) was determined (9).

30-Meter Sprint Test

To determine the participants' speed performance, a 30-meter sprint test was conducted. The 30-meter sprint measurements were taken on a track equipped with photoelectric cells placed at 0 and 30 meters. Participants were given two attempts in the 30-meter sprint test, and the best result, i.e., the fastest time

achieved, was recorded as the test result. All participants underwent a warm-up session before the sprint test (10).

Anaerobic Power Test (Vertical Jump Test)

The subject stood barefoot on the ground, looking straight ahead, and lifted their dominant hand as high as possible, fully extending the shoulder upward. This standing height was recorded in centimeters. The subject then used an arm swing and counter-movement to jump as high as possible. The take-off had to be from both feet without taking a step forward or experiencing friction; however, the feet could separate comfortably. The athlete performed at least three attempts, and the highest distance reached was recorded as the jump height. The vertical jump result was determined by calculating the difference between the jump height and the standing reach height in centimeters (11). Subjects were allowed to perform a few vertical jump attempts after a warm-up session lasting approximately 5 to 10 minutes before starting the test.

Aerobic Power Test (20-Meter Shuttle Run Test)

Participants, adapting to previously recorded sound signals, ran between two lines placed 20 meters apart. The starting speed was 9.0 km/h, with an increase of 0.5 km/h per minute. The test ended when the participant failed to reach the end lines twice in a row following the sound signals or stopped due to fatigue. Results were recorded at the closest stage achieved (12). Participants received necessary explanations before the test and were allowed 5-10 minutes for warm-up.

Statistical Analysis

Data obtained at the end of the research were evaluated using the Statistical Package for Social Science (SPSS) 22.00 statistical program. Npar tests were used for the overall average of the data obtained from the groups. One-Way Anova analysis test was used for the pairwise averages of the groups ($p<0.05$), and Duncan's multiple comparison test was used for intergroup differences ($p<0.05$).

Ethical approval and institutional permission

The study was approved by the local ethics committee (Protocol number 07, 25 January 2016, Ethics Committee of Selcuk University, Faculty of Sports Science, Konya, Turkey) in accordance with the Declaration of Helsinki. Before the assessment, every participant received the same detailed information about the testing procedure. Every participant signed the informed consent.

FINDINGS

Table 1. Physical characteristics of athletes in tennis, badminton, and table tennis groups.

Parameters	Tennis	Badminton	Table Tennis
	Mean±SD	Mean±SD	Mean±SD
Age (years)	15,50±0,52	15,42±0,51	15,50±0,52
Height (cm)	172,58±6,14	173,50±9,00	176,08±5,91
Body Weight (kg)	**63,66±8,32^{ab}**	**59,58±9,35^{b}**	**66,79 ±4,60^{a}**
BMI (Body Mass Index)	21,14±2,44	19,66±1,74	21,60 ±1,98

a,b: The difference between group means with different letters in the same row is significant **($p<0.05$). BMI:** Body Mass Index

There were no statistically significant differences ($p>0.05$) in age, height, years of sports experience, body mass index (BMI), and body fat percentage among the groups participating in the study. Although no significant differences were found in the body weight values of athletes in the tennis group compared to other groups, a significant difference was observed in the body weight of the table tennis group compared to the badminton group, indicating that the table tennis group had a statistically heavier weight ($p<0.05$). While no significant differences were found in the weekly training duration values of the badminton group compared to other groups, a significant difference was detected in the weekly training duration of the tennis group compared to the table tennis group, indicating a higher training time statistically ($p>0.05$).

Table 2. Performance test data of athletes in tennis, badminton, and table tennis groups.

Parameters	Tennis	Badminton	Table Tennis
	Mean±SD	Mean±SD	Mean±SD
T-Test (Seconds)	**9,89±0,60[b]**	**10,55±0,22[a]**	**10,57±0,55[a]**
Reaction Time Test (Milliseconds)	0,27±0,03	0,26±0,01	0,26±0,02
30-Meter Sprint Test (Seconds)	4,90±0,37	5,30±1,56	4,98±0,36
MaxVO2 (ml/kg/min)	**40,03±3,72[b]**	**44,21±4,65[a]**	**43,07±3,52[ab]**
Anaerobic Power Test (kgm/sec)	90,66±11,20	89,97±17,3	93,48±9,42

a,b: The difference between group means with different letters in the same row is significant **(p<0.05). MaxVO2:** Maximum Oxygen Consumption Capacity

There were no statistically significant differences (p>0.05) in reaction time, 30-meter sprint time, and anaerobic power test among the groups participating in the study. Although no significant differences were found in the t-test values between the badminton and table tennis groups, the t-test value of the tennis group was statistically faster than the other groups, indicating a significant difference with both groups (p<0.05). While no significant differences were found in the maxVO2 value of the table tennis group compared to other groups, a significant difference was detected in the maxVO2 value of the badminton group compared to the tennis group, indicating a higher value statistically (p>0.05).

DISCUSSION AND CONCLUSION

In this study, the physical parameters of 12 male athletes training competitively in the sports of table tennis, tennis, and badminton were determined, and comparisons were made with other studies and sports.

After the measurements, the average ages of the tennis, badminton, and table tennis branches were found to be 15.50±0.52 years, 15.42±0.51 years, and 15.50±0.52 years, respectively. The average heights were 172.58±6.14 cm, 173.50±9.00 cm, and 176.08±5.91 cm, and the average body weights were 63.66±8.32 kg, 59.58±9.35 kg, and 66.79±4.60 kg, respectively (p>0.05).

In the studies of Juárez et al. (13), 21 top-level Spanish young football players reported an average age of 16.1±0.2 years and an average height of 1.77±0.06 cm (p<0.05). Chaleh et al. (14) reported in their findings on 14-16-year-old football players that the average age was 15.25±1.15 years, and the height was 172.3±2.90 cm (p<0.05). The average height values in these studies support the values of the athletes in our study who participated in the research.

In the test where we measured reaction times, the averages for the sports of tennis, badminton, and table tennis were found to be 0.27±0.03 s, 0.26±0.01 s, and 0.26±0.02 s, respectively. Additionally, the average sprint times for 30 meters were determined as 4.90±0.37 s, 5.30±1.56 s, and 4.98±0.36 s for the same sports, respectively (p<0.05).

In the studies of Açikada et al. (15), visual reaction times of star national and young national water polo players with average ages of 16.06±0.57 years and 18.91±1.04 years were found as 397.62±52.84 ms and 383.63±52.26 ms, respectively (p<0.05). Akarsu (16) determined the reaction times of male athletes in the adolescent period aged 14-18 years as 384.44±32.6 ms for the right hand and 385.02±31.97 ms for the left hand (p<0.05).

Yıldız (17) measured the 30m speeds of 11-15-year-old national badminton players, finding averages of 4.89±0.34 s for males and 5.08±0.19 s for females (p<0.05). Gil et al. (18) reported the 30-meter sprint test averages in star-level football players with an average age of 15.5±0.6 years as 3.95±0.24 s (p<0.05). Yamaner (19) determined the 30-meter speed scores of adolescent wrestlers in his study as 4.81±0.75 s in the pre-test and 5.24±0.32 s in the post-test (p<0.05).

Although the results obtained in our study are qualitatively supported by some of the studies mentioned above regarding reaction times and sprint times, it is considered that the values of our study are lower, and this may be due to the fact that the research group's reaction and speed values, specific to racket sports, develop more during competitions in other sports, or differences in measurement methods.

In the tests conducted to measure agility time, the averages for the sports of tennis, badminton, and table tennis were found to be 9.89±0.60 s, 10.55±0.22 s, and 10.57±0.55 s, respectively. Additionally, the aerobic powers for these same sports were determined as 40.03±3.72 ml/kg/min, 44.21±4.65 ml/kg/min, and 43.07±3.52 ml/kg/min, while their anaerobic powers were also specified as 90.66±11.20 kgm/s, 89.97±17.39 kgm/s, and 93.48±9.42 kgm/s, respectively ($p<0.05$).In the study of Gökten (20), the t-test times of male national indoor and beach volleyball players with an average age of 15.76±0.83 years were reported as 9.06±0.83 s ($p<0.05$). Lovell et al. (21) found t-test times of 16-year-old football players in their study as 9.63±0.48 s in the first quarter, 9.60±0.51 s in the second quarter, 9.61±0.53 s in the third quarter, and 9.80±0.58 s in the fourth quarter ($p<0.05$). The t-test values in the studies support our study and indicate that similar results can be obtained in trained athletes in this age group. Lieshout (22) determined the maxVO2 capacities of male badminton players with an average age of 17.00±1.00 years as 50.7±3.0 ml/kg/min ($p<0.05$). Bilim et al. (23) found maxVO2 averages of athletes aged 16.53±0.51 years as 44.89±4.44 ml/kg/min ($p<0.05$). Some of the results in these studies support our study, while in some studies, the average value was higher. Cicioğlu et al. (23) found anaerobic powers of 15-17-year-old wrestlers to be between 102.26±13.57 kgm/s and 117.94±13.84 kgm/s in a study on seasonal changes in anaerobic capacities before and after the season ($p<0.05$). Ceker (25) determined the anaerobic power values of 16-17-year-old wrestlers in their studies as follows: the pre-test value for the research group was 113.98 kgm/s, the post-test value was 117.89 kgm/s, the pre-test value for the control group was 104.21 kgm/s, and the post-test value was 105.83 kgm/s ($p<0.05$).

The results obtained in our findings regarding agility times are supported by some of the studies mentioned above. According to other studies in the literature, the aerobic capacities of the athletes in our study were observed to be slightly below the average level. This is thought to be due to factors such as competition environments, competition and training durations, being individual or team sports, and the small age-related differences, which may affect muscular development, leading to the conclusion that the studies in the literature are at a higher level compared to our study. In these studies, average anaerobic power values, as seen in our research, support the values in most studies, while in some studies, they have yielded lower or higher results. It is thought that the reason for this may be that athletes in racket sports do not come into contact with opponents, making some individual and team sports more conducive to this, causing differences in strength.

The variation in body weight among athletes of the same age is thought to be influenced by whether the sports branches are in the competition season. The difference in body weight is believed to affect other performance tests of athletes. The faster results in the T-test for the tennis group may suggest that the test protocol is more closely related to tennis, and in other agility tests made according to the general characteristics of the sport, badminton and table tennis groups may perform better. The difference in MaxVO2 values is thought to be due to the measurement times of the branches coinciding with the off-season times for the branches. It can be said that taking measurements during general training periods may yield more homogeneous results. The differences in the general strength performance of the groups are thought to be due to the use of rackets, balls, and court sizes. The varying weights of sport-specific rackets and balls, and the changing structure of court lengths, may lead to specific muscular hypertrophies in different areas of the athlete.

After this research, it is recommended that future studies could enhance the usefulness of research results by increasing the number of subjects and measurement data. The importance of selecting talented children for racket sports, and comparing the performance levels of children based on the results of this study, can be significant. It is recommended to have trained coaches in sports facilities for performance testing and to provide necessary measurement facilities for the cultivation of talented athletes. Measuring the same group of children in older age groups will provide insights into changes in their values during adolescence and facilitate the assessment of technical skills, especially gross motor skills. Additionally, evaluating data from children in different regions, socio-economic levels, and sports branches will enable a comprehensive analysis.

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