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Velocity of nerve conduction of the tibial and peroneal nerves of Jordan's national badminton team

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ABSTRACT

This study aimed to identify velocity of nerve conduction of the tibial and peroneal nerves of the lower end. This was an experimental study and the sample consisted of two groups: the experimental group (A) which consisted of 10 badminton players and their average age was 20-+70 years, regulated in training and every one of them plays with his right hand from the Jordan national badminton team players, and the second, the control group (B), who didn't practice any physical activity, and their number was (10) who are healthy with average age (20+-60). The results revealed statistically significant differences at (≥α 0.05) between the variables velocity of nerve conduction of the tibial nerves and peroneal nerves for the experimental group, there were no statistically significant differences at (≥α 0.05) in the velocity of nerve conduction of the tibial nerves and peroneal nerves according to the variable of age, whereas there were statistically significant differences at (≥α 0.05) between the variables velocity of nerve conduction of right peroneal nerves according to the variable of years of experience, where these differences were for people who have experience of more than 5 years.

KEYWORDS

Velocity; Nerve Conduction; Tibial Nerves; Peroneal Nerves; Badminton

1. INTRODUCTION

Badminton is considered one of the racket sports of two or four people (single men and women, double of men and women, double mixed). It has a time structure characterized with short-term actions and high intensity that sets psychological, nerves and physical stresses on the players. This requires a special preparation concerning technique, control and physical fitness, as this sport is considered one of the public sports. Because of its accession to the Olympic Games in Barcelona in (1992), it spread all over the world (Michael et al., 2015).

YI-Ming et al. (2005) thinks that football players have velocity of nerve conduction more than boxing players and individuals who don't practice physical activities since training football is long-term and linked to their movement requirement in order to change direction and speed. He confirms that strength athletes have velocity of nerve conduction faster than endurance athletes do, and trained athletes have velocity in nerve responses more than untrained ones. Therefore, interaction, coordination, ability and fast are considered essential in sports, and all these abilities are related to velocity of nerve conduction. Adrian (2008) indicated that motor performance in badminton emerged from a complex interaction between the psychological, physiological and technical skills.

So, reaching a high level and fulfilling achievement in sports competitions are related to healthy body and systems through which the required aim can be achieved; where human body consisted of a set of big and complex systems including muscular and nerves system, respiratory system, lymphatic, hormonal, digestive, skeletal system and joints, where all these systems involve to produce movements. The velocity nerve conduction is a major part of nerve system which the base of controlling movements as it receives sensory information through their receptors, and after analyzing them, the motor nerves give commands to the muscles involved in the desired activity or movement (Khazali, 2012).

Badminton requires high levels of velocity as they are the critical factor in it such as reaction time and velocity of single movement, and it is characterized with high levels of nerves stress and agility (fit), and the reaction time among individuals practicing badminton was shorter than the non-practitioners, and the reaction time of badminton practicing individuals was shorter than that of the non-practitioners (Ziemowit et al., 2013).

Manish et al. (2014) confirm that there were no differences in latency and velocity of nerve conduction between the dominant and non-dominant upper limb among the badminton players. The performance in badminton is characterized with a rapid repetition and high intensity, then stop when ending interchange where a player needs speed, fit, strength and endurance as physical requirements to fulfill achievement and excel; it is a sport primarily depending on kinetic speed with great pressure on the anaerobic lactic system and to a lesser extent on the aerobic system of the player. This sport also requires many changes in directions to reach the shuttlecock, sudden stop, fast jumps, arm movements, and repetitive wrist movements, where this sport includes various skills such short and long serves, smash front and back strikes, drop strikes and front and back. As for tibial nerve, it is one of the terminal branches of the femoral nerve that supplies the calf muscles and foot, where tibial nerve receives nerve fibers from the roots of the spine. After its separation from the common peroneal nerve, it moves through the popliteal fossa, which passes between the two heads of the calf muscle and the deep muscle, then it extends to the back side of the leg, where it gives branches to the calf muscle, soleus muscle, back tibial, long flexible muscle responsible for plantar flexion and inversion of the foot, fingers' movements and the long flexor muscle responsible for the flexion of all the joints of the big toes and the plantar flexion of the ankle (So, 2014).

Masu (2021) thinks that high-performance badminton players are considered to be able to move quickly by synchronizing motor units of the rectus femoris muscle at the onset of motion and perform actions by exerting. Nerve conduction study is considered a diagnostic medical test that is commonly used in evaluating the nerve system function especially in its ability of electrical conduction to sensory and motor nerves in human body (Pryse-Philips, 2021).

Therefore, the study problem lies in that participants in racquet sports especially the badminton ones are at risk of a group of soft tissue injuries in the legs because of rapid movement and intersection which caused a great pressure on muscles, tendons and ligaments of the feet, as Jorgensen & Wine (1987) indicated that the injury average among badminton players was 2.9 for every 1000 player.

The effect of practicing a regular and intensive sport on nerves such as complex and multi-skills sports like badminton requires testing its neurological impact as an adaptation is a tempt to reveal asymmetry between the dominant and non-dominant leg, as Bravo-Sánchez et al. (2019) indicated that there is no difference as a result of intensive training in the muscle and tendons in both legs among the badminton players; the reason of asymmetry may be the difference of velocity of nerve conduction between the two legs, as the current study will reveal it.

Through the researchers' reviewing of the most studies related to badminton, they observed that the majority of researchers didn't investigate well the nerve physiological changes that may occur as a result of practicing this game which is possible to be so beneficial in the stage of their selection of talented, or even to show the safety extent of nerve system of players in this sport. Therefore, the current study aims to identify the velocity of practicing badminton on the velocity of nerve conduction of tibial and peroneal nerves among practitioners of this sport. This will help players and coaches in designing training programs and avoid injuries through developing and improving parts of the body that bear greater pressure during performance.

1.1. Study Hypotheses

- There are statistically significant differences in velocity of nerve conduction of tibial and peroneal nerves between the experimental group (A) and control group (B) at $p = 0.05$.
- There are differences in the effect of practicing badminton on the velocity of nerve conduction of peroneal and tibial nerves due to variables of age and experience at ($\alpha \leq 0.05$).

2. METHODS

2.1. Study Design and Participants

The researchers adopted the descriptive method on a sample consisted of two groups, the experimental group (A) containing practitioners of badminton 10 players of the Jordanian National Team (males), with average age of 20+-70 years, playing with the right hand and training regularly (5) days weekly. Inclusion criteria was: badminton practitioner for a period of not less than 3 year, free from diseases such as diabetes, hypothyroidism or any diseases that may affect the health of the nervous system, not to have been injured during the three months preceding the test, BMI within the normal range and they do not take alcohol, drugs and psychotropic drugs. The control group (B) that does not practice any physical activity consisted of 10 players chosen by the intentional way. They have all the conditions of the experimental group except practicing badminton or any kind of physical activity. The two groups are homogeneous in terms of sex, age and mass index.

2.2. Procedures of Nerve Conduction Velocity Test (NCV).

Nerve Conduction Velocity Test of the tibial and peroneal nerves of both right and left sides was conducted on 23/10/2021, where the temperature inside the hall was 28. The test lasted for a period ranged from 20 – 25 minutes for every individual of the sample. The test was conducted as follows:

1. After the player lies down, the place of each tested nerve was located.

2. Two electrodes were placed on the skin, the first electrode stimulates the nerve and the other records the stimulation.

3. Each nerve was motivated by a short light electric shock from the nerve motivating electrode.

4. The electric activity resulted from the other electrode was recorded so that the results appear through the computer connected to electrode.

5. The distance between the electrodes and time needs for electrical impulses to move between the electrodes was recorded to count the velocity of nerve conduction.

2.3. Statistical Analysis

Statistical Package for Social Sciences (SPSS) was used to analyze the data. We used the following statistical analysis: arithmetic mean, standard deviation, Mann-Whitney – U Test and Wilcoxon Test.

3. RESULTS AND DISCUSSION

To make sure that the groups are equal, the researchers used Mann Whitney Test to see if there are statistically significant differences between the two groups (control and experimental) related to variable of height, age, weight and mass index. The results revealed that there were no statistically significant differences between the two groups related to variable of height, age, weight and mass index, which emphasizes the equivalence of the two groups before conducting the study ($p > 0.05$) (Table 1).

Table 1. Differences between the two groups (experimental = A and control = B) related to variable of height, age, weight and mass index.

Variable	Group	Number	Mediator Rank	Sum of ranks	Mean	Z	Statistical significance
Age	Group B	10	10.45	104.50	20.60 years	-.039	.969
	Group A	10	10.55	105.50	20.70 years		
Height	Group B	10	9.85	98.50	1.76 m	-.495	.621
	Group A	10	11.15	111.50	1.7 8m		
Weight	Group B	10	9.15	91.50	66.50 kg	-1.023	.306
	Group A	10	11.85	118.50	71.50 kg		
Mass Index	Group B	10	9.20	92.00	21.78	-.985	.325
	Group A	10	11.80	118.00	22.59		

To answer the first hypothesis of our study, we used Mann-Whitney –U Test to see if there are statistically significant differences between the two groups (control and experimental) related to the variables of velocity of nerve conduction of lower extremities (tibial and peroneal nerve) (Table 2).

Table 2. Differences between the two groups (experimental = A and control = B) related to the variables of velocity of nerve conduction of lower extremities (tibial and peroneal nerve)

Variable	Group	Number	Mean rank	Sum of ranks	Mean	Z	*p*
Velocity of nerve conduction of peroneal of left side m/s	Group B	10	5.65	56.50	43.32 m/s	-3.668	.000
	Group A	10	15.35	153.50	48.44 m/s		
Velocity of nerve conduction of tibial of left side m/s	Group B	10	8.60	86.00	43.80 m/s	-2.440	.040
	Group A	10	12.40	124.00	47.56 m/s		
Velocity of nerve conduction of peroneal of right side m/s	Group B	10	5.65	56.50	43.59 m/s	-3.765	.000
	Group A	10	15.35	153.50	49.47 m/s		
Velocity of nerve conduction of tibial of right side m/s	Group B	10	9.20	92.00	42.27 m/s	-2.985	.025
	Group A	10	11.80	118.00	47.67 m/s		

According to Table 2 results, we see that there are statistically significant differences for the group of badminton practitioners on all the variables, which indicates that there is an effect of badminton practice on the velocity of nerve conduction of perneal and tibial nerves among players.

The peroneal nerve is responsible for transmitting the nerve signal which is responsible for the flexion movement of the foot, since this nerve enables the person to move the foot up from the ankle joint, and also helps in moving the foot outward (Knipe, 2021). The tibial nerve is also responsible for plantar flexion, foot reversion, finger movement and the long flexor muscle responsible for flexing all joints of the big toe and plantar flexion of the ankle.The researchers refer this result to that badminton firstly depends on repeated feet work and variations the game skills that requires a player to do fast and various movements in sports area and played in narrow area, a player needs to move quickly to the two sides and front and back in a diagonal and crosswise shape, at a high speed and repeatedly because of the fast nature of this sport. In addition, jump movements with smash strikes make the players' legs strong and fast, and this according to the researchers affected the development of velocity of nerve conduction of peroneal and tibial nerves as an adaptation resulted from frequent and varied training. It should be noted that there are three types of feet work inside the badminton court that are side steps, lunges, and scissors and crosses movements. These movements need a high technique, strength and speed to be performed. As a result of more repetitions of these movements in training and competitions, the velocity of nerve conduction of lower extremities is developed among players as a result and physiological adaptation to these required movements of performance. This result agrees with what Ziemowit et al. (2013) indicated that badminton is characterized with high levels of kinetic speed, stress and agility, and it also agrees with what indicated by (Adrian, 2008) that performance in badminton is characterized with rapid repetition and high intensity and a player needs speed, agility and strength as physical requirements. Yi-Ming et al. (2005) indicates that the strength athletes have velocity of nerve conduction more than endurance athletes, and trained athletes also have rapidity in nerve responses more than non-trained, and therefore, interaction, coordination and speed are highly connected to velocity of nerve conduction. Badminton is characterized with these physical features such as jumping, lunge and quick and strong strikes; and this needs producing strength in lower extremities and joints, as the average power in lower extremities among badminton players reached about 32 Watts/kg (Michael et al, 2015).

Referring to the results of this question, we observe that velocity of nerve conduction of tibial nerve among badminton players is higher than the normal range of untrained individuals, as the arithmetic mean of the tibial nerve of right extremity (49.96 m/s) and the left (50,50 m/s), and this is considered higher than the natural speed of non-practitioner person of sports which reaches in its natural limits (41m/sec). The results also showed that velocity of right nerve conduction of peroneal nerve reached (49.47 m/s) and the left one was (48.44 m/s), which is a good value of velocity of nerve conduction which reaches in its natural limits (44 m/s) (Sedano et al., 2013). These results also agree with what indicated by (Al-Khazali, 2012) that there is a correlation between velocity of nerve conduction and kinetic abilities in games requiring a high performance speed like badminton. The results of this study agrees with what Masu et al. (2021) indicated that badminton players of high levels and performance had better kinetic time for the muscles activity in the upper thigh than players with lower levels, and this indicates that badminton players of high performance are able to move quickly by synchronization of the units of motion of the rectus femoral muscle through a large torque. They also agree with what Yi-Ming et al. (2005) indicated that football players have velocity of nerve conduction in the lower extremities better than boxing players because they use their les in football which needs to change direction and speed while performing. The results of this study also agree with the study results of Ziemowit et al. (2013) that the time of player's reactions among badminton players better than non-practitioners. It is probable that these results may explain the inconsistency between the dominant and non-dominant leg of badminton players, as Bravo-Sánchez et al. (2019) confirm in their study that the reason for the lack of coordination between the dominant and non-dominant leg of badminton players that there is no difference as a result of intensive training in muscle structure and the tendons between the dominant and non-dominant legs, where the reason for inconsistency between the two legs may be the difference in velocity of nerve conduction between the two legs, which the results of this study revealed as a result of intensive training.

To answer the second hypothesis of this study, the researchers used Mann-Whitney – U Test to compare the variables of velocity of nerve conduction of the lower extremities (peroneal and tibial nerves) according to the variables of age and experience among the experimental group as follows (Table 3 and 4).

Table 3. Comparison of variables of velocity of nerve conduction of peroneal and tibial nerves according to the variable of age

Variable	Age	Number	Mean rank	Sum of ranks	Mean	Z	*p*
Velocity of nerve conduction of peroneal of left side m/s	From 18- less than 20	5	5.00	25.00	47.74	-.522	.602
	20 – 25	5	6.00	30.00	49.14		
Velocity of nerve conduction of tibial of left side m/s	from 18- less than 20	5	4.20	21.00	44.62	-1.358	.175
	20 – 25	5	6.80	34.00	50.50		
Velocity of nerve conduction of peroneal of right side m/s	From 18 – less than 20	5	3.80	19.00	48.06	-1.781	.075
	20 – 25	5	7.20	36.00	50.88		
Velocity of nerve conduction of tibial of right side m/s	From 18 - 20	5	4.60	23.00	45.40	-.940	.347
	20 – 25	5	6.40	32.00	49.96		

The results of Table 3 show that there were no statistically significant differences between variables of velocity of nerve conduction of the lower extremities (peroneal verve, tibial nerve) according to variable of age ($p>0.05$). The researchers refer this result to the fact that the players ages are similar, where this result agrees with the study result by Yuasa et al. (1996) that there is no relation between age and velocity of nerve conduction of similar age groups.

Table 4. Comparison of variables of velocity of nerve conduction of peroneal and tibial nerves according to the variable of experience

Variable	Years of experience	Number	Mean rank	Sum of ranks	Mean	Z	*p*
Velocity of nerve conduction of peroneal of left side m/s	Less than 5 years	6	4.33	26.00	47.17	-1.492	.136
	More than 5 years	4	7.25	29.00	50.35		
Velocity of nerve conduction of tibial of left side m/s	Less than 5 years	6	4.33	26.00	44.60	-1.492	.136
	More than 5 years	4	7.25	29.00	52.00		
Velocity of nerve conduction of peroneal of right side m/s	Less than 5 years	6	3.92	23.50	48.47	-2.032	.042
	More than 5 years	4	7.88	31.50	50.98		
Velocity of nerve conduction of tibial of right side m/s	Less than 5 years	6	4.83	29.00	45.62	-.853	.394
	More than 5 years	4	6.50	26.00	50.78		

The results of Table 4 show that there were no statistically significant differences between variables of velocity of nerve conduction(left peroneal and tibial nerves) according to the variable of years of experience ($p > 0.05$) whereas the results showed that there were statistically significant differences between variables of velocity of nerve conduction of the lower extremities (right peroneal nerve) according to the variable of years of experience ($p < 0.05$), and these differences were for people who have experience with more than 5 years. The researchers refer velocity of nerve conduction of peroneal nerve of the right extremity for players of more than 5 years of experience to the fact that the right leg (dominant) is the one where the greatest effort fall on as it is the movable foot forwards while performing badminton skill which opposite of the left foot (pivot foot), where we observe that effort of badminton player’s performance is bigger than the left one. It seems that velocity of nerve conduction of peroneal nerve resulted from high repetitions and exerted effort by players of higher experience led to increase of velocity of nerve conduction to this nerve more than the less experience. It can be said that players of more experience are characterized with velocity of nerve conduction more than the less ones. This result agrees with the result of Matsunga et al. (1993)

who found that velocity of nerve conduction in the biceps brachii muscle among badminton players who have more experience are better than players of less experience. This result is also agrees with what indicated by Yi-Ming et al. (2005) in that badminton players of high levels and performance had kinetic time for muscle activity in thigh better than players of less levels, and it also agrees with the result of Ziemowit et al. (2013) study that practitioners players of badminton have shorter time of reaction than individuals of less experience and high-performance badminton players are considered to be able to move quickly by synchronizing motor units of the rectus femoris muscle at the onset of motion and perform actions by exerting (Masu, 2021).

4. CONCLUSIONS

In light of the study results and discussion, the study concluded that there is an increase in velocity of nerve conduction of peroneal and tibial nerves among practitioners of badminton, and the velocity of nerve conduction of peroneal and tibial nerves is equal among players according to the variable of age. There is also a positive effect of years of experience on the velocity of nerve conduction of the right nerve peroneal for players of more experience.

5. RECOMMENDATIONS

The researchers recommend that it is necessary to conduct (NCV) test to select talented in badminton to reveal the safety of nerve system and measure the velocity of nerve conduction who intend to practice this sport. It is also essential to adopt the results of this study in continuous checking the safety of nerve system of players through conducting periodical tests and concentration in training programs on the exercises of lower extremities of players in order to develop the velocity of nerve conduction, and conduct more studies to measure the velocity of nerve conduction of nerves that was not covered in the current study to identify the extent of the impact of practicing badminton on these nerves.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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