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# VISUOMOTOR AND AUDIOMOTOR REACTION TIME IN ELITE AND NON-ELITE BADMINTON PLAYERS

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**Abstract:**
The ability to quickly perceive appropriate motor response is essential in the badminton sport under the critical time pressure. This study aimed to evaluate the visual and auditory reaction time, speed, anaerobic power and vertical jump between elite and non-elite badminton athletes. With this purpose, various anthropometric measurements, hexagonal obstacle test, vertical jump test, anaerobic power measurement and auditory and visual reaction time tests were performed to the elite and non-elite athletes. When auditory reaction time, vertical jump and anaerobic power measurements were evaluated, there was no significant difference between the elite and non-elite groups, but it was noticed that there was a significant differences in quickness and visual reaction time in favor of elite athletes. It is also seen that speed and visual reaction time have a positive effect on badminton athletes are able to get to the high performance level in other literature information. For this reason, it has been thought that training programs designed for badminton athletes by considering these physiological parameters and training systems designed to increase the reaction time may be beneficial.

**Keywords:** visuomotor reaction, audiomotor reaction, badminton athletes

## 1. Introduction

The ability to rapidly perceive visual cues and to initiate a targeted motor response is essential in many sports when athletes have to perform visuomotor tasks under critical

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time pressure as with the badminton sport. Badminton is one of the most popular sports in the world with 200 million fans (Kwan and Rasmussen, 2010). Badminton that was born in China has the final shape in England and is now the national sport of various Asian countries (Phomsoupha and Laffaye, 2015). This game, which can be played by everyone regardless of age or experience, is characterized by short repetitive motor activity at high speed and intensity within an 80 $m^2$ court (Lees, 2003). During competitions, athletes have to move quickly by changing direction suddenly (Tiwari et al., 2011), and also elite athletes have to fulfill the maximum limits of speed, agility, flexibility, durability and power (Raman and Nageswaran, 2013). Badminton is a combination of high intensity short runs (anaerobic system) (Jeyaraman et al., 2012) and longer, medium or high intensity runs (aerobic system) (Majumdar et al., 1997). The atypical and surprising flight trajectory of the shuttlecock (badminton ball), considered that the reaction time may be more important in badminton. Therefore, badminton athletes need a good balance, short reaction time and speed throughout the competition. Many studies have shown that the reaction time for athletes is much shorter than non-athletes (Bhabhor et al., 2013; Nakamoto and Mori, 2008). In a study which brain functions were measured instantaneously by means of a functional magnetic resonance imaging (fMRI) device on badminton athletes, while various images were presented to the athletes of the badminton they reported that the athletes had acted on many brain networks and the elite athletes had much more fMRI activation in their parts of the brain that were analyzed by the visual attention and body kinematics than the beginner athletes (Wright et al., 2011). It has been shown that badminton athletes have higher visuomotor skills than non-racquetball athletes (Di et al., 2012). This study was planned to examine the time of visual and auditory reaction in terms of being an elite among badminton athletes. In addition, in this study, the athlete's response time to auditory and visual stimuli as well as other physiological parameters such as vertical jump, anaerobic power, quickness and anthropometric measurements of the athletes has been investigated in relation to the elite qualities of the athletes.

## 2. Method

Twenty athletes that have intercollegiate badminton league (non-elite) (male = 11, female = 9) and twenty badminton national team athletes (elite) (male =11, female = 9) participated in this study voluntarily. None of the volunteers had a lower extremity or vertebral pathology. Also, they did not have any surgery operation until 6 months before the measurements were made. This study was carried out with the approval of the Gaziantep University Clinical Research Ethics Committee with decision code 2015/235.

### 2.1 Anthropometric Measurements

The height of the athletes was measured by rule with 0.01m accuracy measuring the distance between vertex and foot. The body weight was measured with an electronic scale with accuracy of 0.1 kg without shoes (Polat et al., 2011). The age of the athletes was record by asking them (Doğan et al., 2016).

### 2.2 Vertical Jump and Anaerobic Power Measurement

Vertical jump values were measured using a vertical jump pan. During the test, the feet were contiguous and the body was in a vertical position, the last point of contact of the fingertips was marked. Athletes were asked to touch the board by jumping up as far as possible. The athletes did not take a step when jumping and twisted their knees 90 degrees. The athletes repeated this process three times and recorded the difference between the two distances using the best results (Bilgiç et al., 2016a, 2016b; Yıkılmaz et al., 2016; Akcan and Biçer, 2015; Yıldız et al., 2016; Biçer and Akkuş, 2005; Akbal, 1998). By the following formula, the anaerobic power, body weight and vertical jump values of the experiment group were determined by using Lewis method.

$P = \sqrt{4.9}(\text{Weight})\sqrt{D^n}$

$P$ = Power, $D^n$= Vertical jump distance

### 2.3 Hexagonal Obstacle Test Measurements

Hexagonal obstacle test measures quickness, coordination and anaerobic stability. A hexagon with a border of 66 cm was drawn on a flat surface in test. Each side of the hexagon was identified by letters A, B, C, D, E and F respectively. The athletes were asked to jump out of each line then back into the hexagon with a double foot by stay in the middle of the hexagon. When the athletes arrived the first letter, it was applied in three rounds to complete a turn. The athletes were allowed to do a round test before the test started and wanted to do it as fast as possible. The duration of the test was measured with a chronometer. Those who step or missed the lines were tested again after rest (Köktaş, 2013; McKenzie, 2005).

### 2.4 Visual and Auditory Reaction Time Measurements

Visual and auditory reaction time was measured using computerized online software programs (www.humanbenchmark.com, www.cognitivefun.net) developed for reaction time measurement, after the appropriate environment and environmental conditions were ensured, at which the athlete was able to experience the least possible stimulation (Cuthbertson et al., 2015; Pancar et al., 2016).

### 2.5 Data Analysis

SPSS 20.0 package program was used for the analysis of the obtained data (IBM SPSS Software 20.0, United States). Independent sample t test, in which two independent variables were compared, was used, considering the suitability of parametric distribution, and $p < 0.05$ was considered statistically significant.

## 3. Results

There was no significant difference between anthropometric measurements since attention to the selection of individuals as close as possible (Table 1).

**Table 1:** Anthropometric measurements of athletes

| Variable | Group | N | Mean | Std. Deviation(±) | p |
|---|---|---|---|---|---|
| **Age (year)** | Elite Athletes | 20 | 20.20 | 1.77 | 0.432 |
| | Non- Elite Athletes | 20 | 20.65 | 1.81 | |
| **Height (cm)** | Elite Athletes | 20 | 170.75 | 8.26 | 0.879 |
| | Non- Elite Athletes | 20 | 171.20 | 10.26 | |
| **Weight (kg)** | Elite Athletes | 20 | 64.45 | 12.08 | 0.565 |
| | Non- Elite Athletes | 20 | 66.65 | 11.90 | |

P <0.05 was considered significant by evaluating with independent sample t test.

When auditory reaction time, vertical jump and anaerobic power measurements were evaluated, there was no significant difference between elite and non-elite groups, but in hexagonal quickness and visual reaction time there was a significant difference in favor of elite athletes (Table 2).

**Table 2**: Measurements obtained from the research parameters

| Variable | Group | N | Mean | Std. Dev.(±) | p |
|---|---|---|---|---|---|
| **Vertical Jump (cm)** | Elite Athletes | 20 | 41.45 | 12.39 | 0.560 |
| | Non- Elite Athletes | 20 | 39.45 | 8.85 | |
| **Anaerobik Power (kg.m/sn)** | Elite Athletes | 20 | 92.41 | 28.01 | 0.938 |
| | Non- Elite Athletes | 20 | 93.06 | 23.78 | |
| **Speed (sc)** | Elite Athletes | 20 | 11.86 | 2.69 | **<0.001*** |
| | Non- Elite Athletes | 20 | 13.67 | 1.31 | |
| **Auditory Reaction (ms)** | Elite Athletes | 20 | 204.03 | 33.47 | 0.613 |
| | Non- Elite Athletes | 20 | 209.40 | 33.61 | |
| **Visual Reaction (ms)** | Elite Athletes | 20 | 257.70 | 34.35 | **0.035*** |
| | Non- Elite Athletes | 20 | 279.25 | 28.00 | |

P <0.05 was considered significant by evaluating with independent sample t test.

## 4. Discussion and Conclusion

This study is a research which evaluating of visual and auditory reaction time, speed, anaerobic power and vertical jumping between elite and non-elite badminton athletes. It has been aimed to give information about which physiological parameters of elite badminton athletes are more advanced and information about which visuomotor and audiomotor skills which are neuropsychological processes are examined and which training programs are more beneficial in this area. When badminton athletes are examined in terms of anthropometric measurements, the difference between the performances of the athletes and these measurements is not very important within the general situations. However, Poliszczuk et al. , the most successful 13 male athletes in the world rankings in 2008 are generally about 5 cm longer (mean height 179 cm, mean weight 70 kg) and they has remarked that they are an advantage of being tall even if contradictory to some literature information (Poliszczuk and Mosakowska, 2010). In another study of badminton athletes according to 13 best athletes in their countries, It has been showed that the average length of Turkish, Indonesian, Nigerian and Spanish athletes were shorter than average (mean 171 cm), while German, Czech, South African and Danish athletes had longer (mean 182 cm). Values such as body weight and body mass index also have contradictory sources. The anthropometric measurements of elite and other athletes in this research are lower than the top 13 athletes mentioned before (mean height 170 cm, mean weight 65 kg). It is necessary to work with a wide range of athletes with different measures for anthropometric measurements and for examining the success in badminton.

The mean values of vertical jump values were found as 65.72 ± 9.85 cm, 54.37 ± 6.72 cm and 53.80 ± 9.07 cm respectively in male volleyball, soccer and handball athletes (Albay et al., 2008), this value was found about 37cm in tennis athletes who are closer to badminton (Girard et al., 2014). In another study that performed on elite badminton athletes, vertical jump values were shown to be statistically significant in favor of male athletes (mean 40 cm) and female athletes (mean 29 cm) (Abian-Vicen et al., 2012). In our study, although female athletes were found, this value was found as 41.45 cm in elite athletes and 39.45 cm in non-elite athletes. No other study has come out that comparing the vertical jump values of elite and non-elite badminton athletes in the literature. This study shows that there was no difference between the vertical jump values of elite and other badminton athletes.

In the study of the evaluating the anaerobic powers (Wingate test) of elite and non-elite male and female athletes (Bencke et al., 2002) in handball, tennis, gymnastics, and swimming sports, although in many sport anaerobic powers have significantly difference, the researchers argued that the muscle mass of the athlete more concerned with the anaerobic power rather than sport or the type of training. Despite the fact that elite and non-elite badminton athletes have not been come across comparing in terms of anaerobic power, it has been shown that only elite and non-elite swimmers are different in terms of anaerobic power compared to sports such as tennis, handball, gymnastics and swimming (Bencke et al., 2002). In our work, there were no differences in the anaerobic power between the athletes as well as in many sport fields. In a study that evaluating of a new quickness test badminton-specific between elite and elite badminton athletes, researchers reported that the duration of the quickness in elite athletes was much shorter Loureiro and Freitas, 2016). In the Malaysian elite and non-elite badminton athletes, the values of quickness were found to be in conflict with other literature. There was no difference in the quickness tests performed on the elite and non-elite athletes in the study. However, researchers have argued that the elite athletes are longer and heavier than others (Ooi et al., 2009). According to the results obtained from this research, a significant difference was found in favor of elite athletes about quickness between elite and non-elite badminton athletes.

In earlier studies, the visual and auditory reaction time was found to be shorter in badminton athletes than in non-athletic but healthy persons (Bankosz et al., 2013; Hulsdunker et al., 2016). Likewise, elite badminton athletes who performed a goal-setting test that closely related to visual reaction time were found to be more successful than non-elite athletes (Loureiro and Freitas, 2012). In a study which comparison with elite and non-elite badminton athletes performed by Kim et al., it has found that elite athletes had shorter reaction times (Kim et al., 2007). In our study, similarly, elite athletes were found to have shorter visuomotor response, and other literature findings were supported, but audiomotor response was found to be similar in both athlete groups. When both this study data and the literature information are taken into account, it is obvious that the speed and speed of visual reaction have a positive effect in achieving high performance level of badminton athletes. For this reason it was thought that it would be beneficial for the badminton athletes to practice their training programs by considering these physiological parameters. For this purpose, it is suggested that a computer based educational system (Huynh and Bedford, 2011) designed to increase the reaction time to be included in badminton training planning.

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