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The Effect of Warming on Visual Response Time in Dominant and Non-Dominant Lower and Upper Extremities

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Abstract

The aim of this study was to investigate the effect of warm-up on the visual response time of the dominant and non-dominant hand and foot in basketball players. A total of 13 male basketball athletes with an age of 14.38 ± .506 years, height 180.15 ± 8.07 cm, body weight 66.54 ± 13.73 kg and sports experience 4.69 ± 13.73 years were voluntarily included in the study. Visual response time of the dominant and non-dominant hands and feet were measured before and after the warm-up protocol. The warm-up protocol consisted of a 20-minute warm-up including basketball-specific movements and 5-minute stretching movements. Visual response time of the athletes were measured with the Blazepod system. There was no significant difference in the group main effect and time x group interaction of the athletes' hand visual response times after warm-up ($F=2.403$; $p>0.05$; $F=0.170$; $p>0.05$). There was a statistically significant difference in the time effect ($F=22.943$; $p<0.05$). In the comparison of visual response times of both dominant hand ($p=0.001$) and non-dominant hand ($p=0.005$), a significant decrease was found in visual response times after warm-up compared to before warm-up. There was no significant difference between the visual response time of the dominant and non-dominant foot after warm-up ($U=60.50$; $p=0.506$). No significant difference was detected in the comparison of the visual response times of the dominant foot before warm-up with those after warm-up ($Z=-1.804$; $p=0.071$). Similarly, no significant difference was found after warming up in the non-dominant hand ($t=2.150$; $p=0.055$). It can be said that the warm-up protocol applied to basketball players increased the visual response times of the dominant and non-dominant hand and this increase was more significant in the dominant hand. However, the warm-up protocol did not affect visual response time in both dominant and non-dominant feet.

Keywords: Basketball, dominant leg, hand dominance, response time.

Özet

Baskın ve Baskın Olmayan Alt ve Üst Ekstremitelerde Isınmanın Görsel Tepki Süresine Etkisi

Bu çalışmanın amacı basketbolculara uygulanan ısınma aktivitesinin baskın ve baskın olmayan el ile ayağın görsel tepki süresine etkisini incelemektir. Araştırmaya yaşları 14,38 ± ,506 yıl, boy uzunlukları 180,15 ± 8,07 cm, vücut ağırlığı 66,54 ± 13,73 ve spor deneyimleri 4,69 ± 13,73 yıl olan toplam 13 erkek basketbol sporcusu gönüllü olarak dahil edildi. Araştırma grubu ısınma protokolü öncesi ve sonrası baskın ve baskın olmayan el ile ayağın görsel tepki süreleri ölçüldü. Isınma protokolü basketbola özgü hareketleri içeren 20 dakikalık bir ısınma aktivitesi ve 5 dakikalık germe hareketleri şeklinde uygulandı. Sporcuların görsel tepki süreleri, Blazepod sistemi ile gerçekleştirildi. Çalışmaya katılan sporcuların ısınma sonrası el görsel tepki süreleri grup ana etki ve zaman x grup etkileşimi skorlarında anlamlı farklılık tespit edilmedi (F=2,403; p>0,05; F= 0,170; p>0,05). Zaman etkisinde ise istatistiksel olarak anlamlı farklılık belirlendi (F=22,943; p<0,05). Isınma öncesine kıyasla hem baskın el (p=0,001) hem de baskın olmayan el (p=0,005) görsel tepki sürelerinin karşılaştırılmasında ısınma sonrası görsel tepki sürelerinde anlamlı derecede azalma saptandı. Baskın ve baskın olmayan ayağın ısınma sonrası görsel tepki sürelerinin karşılaştırılmasında anlamlı farklılık tespit edilmedi (U=60,50; p=0,506). Isınma öncesi baskın ayak görsel tepki sürelerinin ısınma sonrası ile karşılaştırılmasında anlamlı farklılık belirlenmedi (Z=-1,804; p=0,071). Benzer şekilde baskın olmayan ayakta ısınma sonrasında anlamlı farklılık olmadığı saptandı (t=2,150; p=0,055). Basketbolculara uygulanan ısınma protokolünün baskın ve baskın olmayan el görsel tepki sürelerinde artış görüldüğü ve bu artışının baskın el de daha anlamlı olduğu söylenebilir. Fakat ısınma protokolünün hem baskın hem de baskın olmayan ayakta görsel tepki süresini etkilemediği belirlenmiştir.

Anahtar Kelimeler: Basketbol, baskın ekstremite, el baskınlığı, tepki süresi.

INTRODUCTION

Basketball is one of the sports branches where motoric characteristics must be at the highest level. Mainly anaerobic energy systems are used and therefore factors such as strength, quickness and timing must be realized in harmony. The athlete's ability to perform technical movements correctly and easily is related to factors such as strength, jumping, balance, speed and rhythm (13). Among these factors, response time, which is a component of speed, is an important parameter for performance (7). Response time and reaction time are often used interchangeably (25) but there is a semantic difference between these two terms (19, 14). Reaction time is defined as the rate at which the organism responds to external stimuli. Response time refers to the time between the occurrence of the stimulus and the completion of the movement (20).

Being able to react quickly to these stimuli is also shown among the important performance parameters in terms of athletes reaching high performance (6). Response time is affected by some factors, both good and bad. Among these factors, factors such as gender, age, fatigue and readiness for stimulation are mentioned (2, 26, 34). One of these variables, readiness for stimulation, is related to warm-up exercises to become ready both physically and mentally before practicing a sport branch (3). Warm-up is the optimization of psychological and physiological conditions passively or actively with general and special movements before competition and training (33). In other words, warming up is making the body ready for a physical performance before it is performed (17). The aim of warming up is to increase body and intramuscular temperature and to meet physiological responses in the most effective way by increasing the blood flow rate in the vessels (15). The fact that warming up increases intramuscular temperature and makes it ready for performance has provided some researchers with the opportunity to investigate the effect of cerebral lateralization on performance (9, 21, 28). The fact that the dominant and non-dominant part of our body is more prone to one side is called lateralization. In other words, the difference between right and left or the occurrence of a structure or function more on one side is called lateralization (23). The best indicator of brain-related functional asymmetry is hand preference. Since one hand is dominant over the non-preferred hand in undertaking a task, it is referred to as the dominant hand (18). This situation has led to some studies and studies on the effects of dominant and non-dominant limbs on performance have been carried out (9, 11, 28). Chouamo et al. (2021) In a study, it was investigated whether there was a difference in dominant and non-dominant hand response times. Found that the dominant

hand response time s of male and female participants were faster than the non-dominant hand. Paillard et al. (2018) In a study, the effect of warm-up on postural control in the dominant and non-dominant foot was investigated and it was reported that there was no difference in both feet before and after warm-up. However, Brighenti et al. (2022) Hemphasized that warm-up is effective on the dominant leg and that this effect is more than athletes in asymmetrical sports branches. Based on the findings of these studies, we wanted to find out whether warm-up has different effects on the visual response time of dominant and non-dominant hand and/or foot. Therefore, the aim of this study was to examine the effect of warm-up on the visual response time of dominant and non-dominant hand and foot in basketball players.

METHOD

Participants

A total of 13 male basketball athletes with an age of 14.38 ± 0.506 years, a height of 180.15 ± 8.07 cm, a body weight of 66.54 ± 13.73 kg, and a sports experience of 4.69 ± 13.73 years were voluntarily included in the study. Before the study, the purpose of the study and the tests to be performed were explained to all participants verbally in detail. In addition, the Voluntary Consent Form, which included information about the study, was read to the athletes and their parents and their written consent was obtained.

Procedure

Hand-eye response time and foot-eye response time measurements were performed on 2 separate days with 3-day intervals. Hand-eye response time was measured on the first measurement day and foot-eye response time was measured on the second measurement day. The same measurement procedure was applied on both measurement days (Figure 1). Response time measurements were performed as pre-test and post-test. After the pre-test measurements, the participants performed the warm-up protocol and then took the post-test measurements. The dominant hand was determined by asking "which hand do you actively use when writing?" and the dominant foot was determined by asking "which foot do you primarily use to kick a ball?". Before the tests, the participants were randomly divided into 2 groups. The first group was pre-tested first with the dominant limb and then with the non-dominant limb, while the second group was pre-tested with the non-dominant limb and then with the dominant limb. In the post-test response time measurements, the first group was taken first with the non-dominant limb and then with the dominant limb, while the second group was taken first with the dominant limb and then with the non-dominant limb. This was done to minimize the learning/practice effect in response time tests.

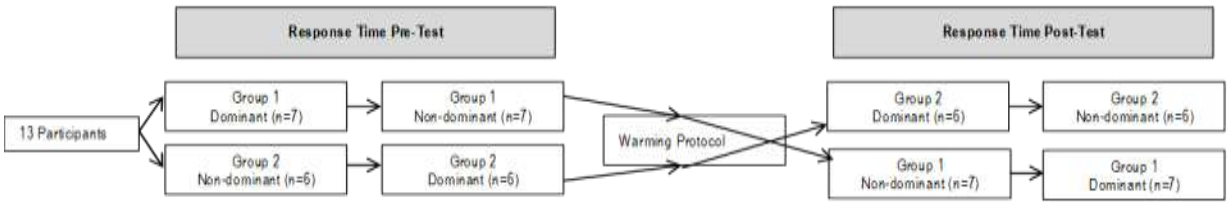

Figure 1. Experimental process for dominant and non-dominant limbs.

Dynamic Warm-Up Protocol

Participants performed a 10-min warm-up protocol adapted from Romaratezabala et al. (2018) and Chen et al. (2022). The protocol started with 5 minutes of jogging with a heart rate of approximately 140 beats/min. It was followed by 5 minutes of static stretching exercises. These exercises included immobilization at the end of the range of motion for the hip, shoulder, calf and thigh muscles. This was followed by 5 minutes of dynamic joint mobility exercises. These exercises were performed for all joints and up to the limits of range of motion. Exercises included: Arm movements up and down, back and forth, diagonal, open and close, lateral and circular movements of the hip, heel striking the hip with a two-foot jump, right and left backward swing of the torso with shoulders, side running with knee pulling and cross-stepping, vertical and lateral jumps, running with gradually increasing acceleration. Then, basketball-specific full-court lay-ups were applied for 10 minutes, followed by hand-over-hand, leg-to-leg, back-to-back, two- and three-point free throws, and stretching exercises. The warm-up lasted a total of 25 minutes and was performed with the coach of the team.

Hand-Eye and Foot-Eye Response Time

Response time measurements were performed with the BlazePodtm system, which consists of wireless light disks controlled by a smartphone and works on the basis of extinguishing the light by touching the lighted disk. Tests were taken 3 times each for dominant and non-dominant sides and the best time was recorded as the participant's response time (milliseconds, ms).

Hand-Eye Response Time

Hand-eye response time test was measured separately for dominant and non-dominant hand. For the test, the "Formula Reactions" protocol in the BlazePodtm system was applied. Five discs were fixed to a flat wall with vacuum apparatus as shown in Figure 2 (4), with 4 discs spaced 1.5 m apart from each other in a square shape with the 5th disc in the center of this square. Participants stood with both feet on the floor, facing the disks and at a distance where they could easily touch the disks according to their arm length. The participants were instructed to turn off the light of the disk by touching the illuminated disk with the hand they used for the test as soon as possible for 30 s consecutively and in random order. The test was started when the first disk was illuminated after the "Ready" command and was automatically terminated at the end of the test period.

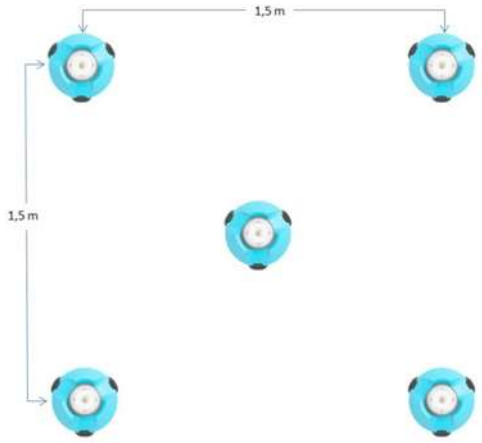

Figure 2. Layout of BlazePod illuminated disks (4).

Foot-Eye Response Time

To determine foot-eye response time s, the "Fast Feet" protocol, which is available in the BlazePodTM system and can be controlled with a smartphone, was applied. On a flat surface, 4 disks were placed side by side at 30 cm intervals and fixed to the ground with a vacuum apparatus (Figure 3). Participants stood with both feet on the floor, facing the disks and just in front of the center disks. The distance to the disks was adjusted according to the length of each participant's foot that could most easily touch the disks. Before each test, participants were instructed which foot would turn off the light of the illuminated disk. During the test, the other foot was instructed to touch the ground continuously. The test was automatically started after the "get ready" and the participant was asked to extinguish the lighted disk in random order for 30 s by touching the lighted disk with the test foot as soon as possible. At the end of the time, the test was automatically terminated.

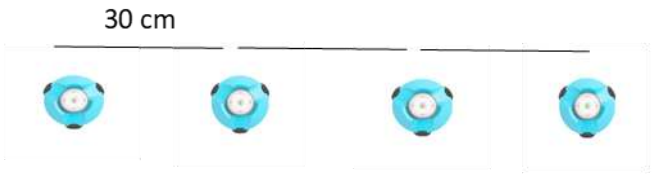

Figure 3. Layout of BlazePod light disks.

Ethical approval and institutional permission

Selcuk University Faculty of Sports Sciences Non-Interventional Clinical Research Ethics Committee approval was obtained for this study (Date: 04.10.2022; Decision no: /133).

Data Analysis

Research data were summarized as mean and standard deviation. Normality analysis was tested with Shapiro Wilk test. Two-factor ANOVA, paired t-test for dependent groups in the pre-test and post-test comparisons, and t-test for independent samples in the comparison of two independent groups were applied in the analysis of normally distributed data. Mann Whitney U and Wilcoxon tests were used to analyze non-normally distributed data. The significance level was accepted as 0.05. SPSS 26 statistical package program was used in all analyses.

FINDINGS

Table 1. Descriptive characteristics of the study group (n=13).

Group	Mean	Std. Deviation	Minimum	Maximum
Age (year)	14.38	0.506	14	15
Height (cm)	180.15	8.07	175.0	184.00
Body weight (kg)	66.54	13.73	48.00	104.00
Sports experience (year)	4.69	2.29	2.00	8.00

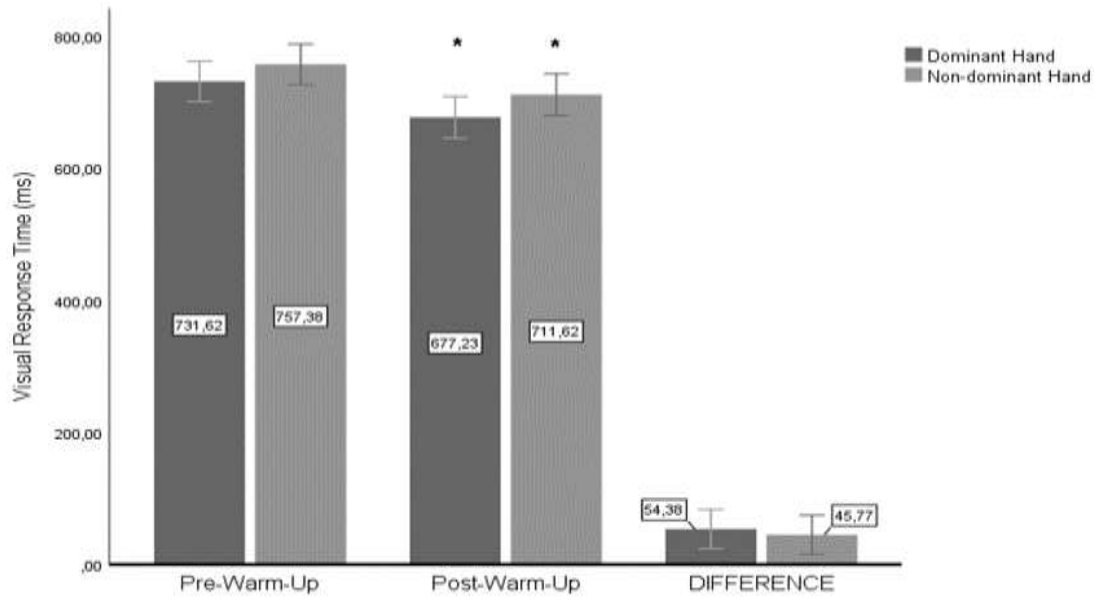

Figure 4. Dominant and non-dominant hand visual response times before and after warm-up. Error bars are presented as ± 2 standard errors. *p<0.05

No significant difference was found in the group main effect and time x group interaction scores of the athletes' hand visual response time after warm-up (F=2.403; p>0.05; F=0,170; p>0.05). There was a statistically significant difference in the time effect (F=22.943; p<0.05). Visual response time of dominant hand (p=0.001) and non-dominant hand (p=0.005) improved after warm-up. No statistically significant difference was found in the comparison of the differences (t=0.412; p= 0.684) (Figure 1).

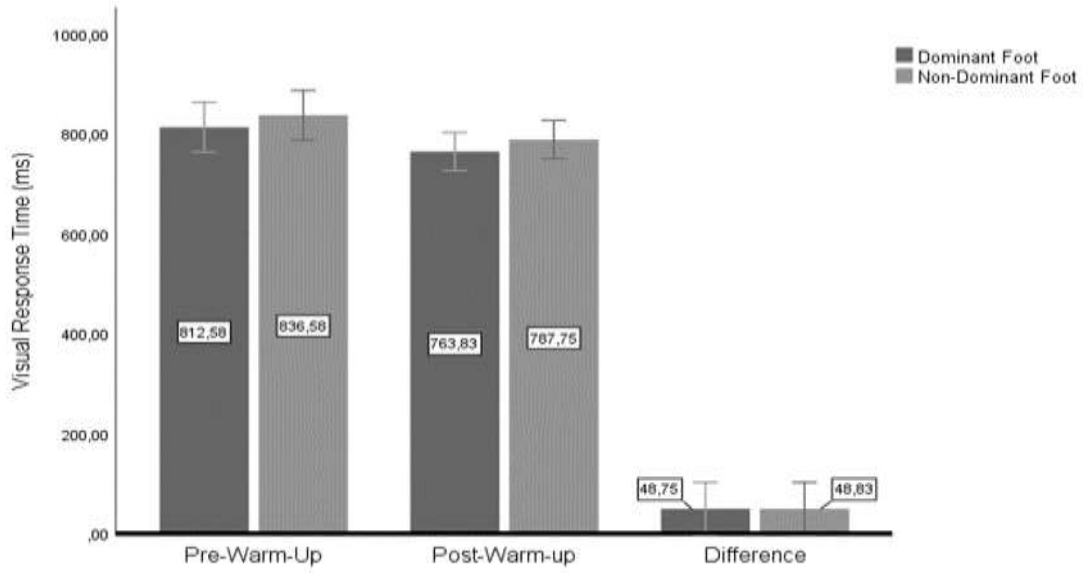

Figure 5. Dominant and non-dominant foot visual response time before and after warm-up. Error bars are presented as ± 2 standard errors.

DISCUSSION AND CONCLUSION

This study has a unique value in terms of investigating the dominant and non-dominant hand and foot visual response time of warm-up. The study was conducted to determine whether there was a difference between dominant and non-dominant limbs in hand and foot visual response time before and after warm-up.

In studies on hemispheric asymmetry, it was aimed to determine the hand, foot and eye preference of individuals in order to provide a basis for research on cerebral lateralization. Cerebral lateralization is the anatomical and functional differentiation between the right and left hemispheres of the brain. Hemispheres have different tasks within themselves and the dominant hemisphere can perform its task better than the non-dominant hemisphere (8). Therefore, there is a significant difference in the hand dominance of most people, and this difference suggests that there may be a difference in sensory-motor tasks such as response time and performance tasks performed with the dominant and non-dominant hand (11).

Basketball is one of the sports where both dominant and non-dominant hands are used in training and competition. The success of basketball players during the game usually depends on their ability to perform different skills equally well with the dominant and non-dominant hand (32). In this study, it was found that after the warm-up protocol applied to basketball players, an increase was observed in the visual response time of the dominant and non-dominant hand and this increase was more significant in the dominant hand.

Doğan and Şen (2019), Chouamo et al. (2021) and Aslan et al. (2023), who reported results compatible with this study, investigated whether there was a difference in dominant and non-dominant hand response time. Doğan and Şen (2019) examined the hand response time of participants with different hand preferences. The researchers reported that the response time of the dominant hand of the participants was shorter than the non-dominant hand. Chouamo et al. (2021) examined 15 male and 14 female participants with computer-assisted reaction test. Twenty-seven participants were reported to have right dominant hand while 2 participants had left dominant hand. The findings of the study indicated that the dominant hand of both male and female participants had shorter response times than the non-dominant hand. Arslan et al. (2023) examined the hand-eye response times of boys and girls. The "Formula Reactions" protocol in the BlazePodtm system was used to determine the hand-eye response times of the participants. In the study conducted in two different task conditions (classical music and preferred music), they reported that the dominant hand had better visual response time than the non-dominant hand in the preferred music condition.

There are also findings in the literature that are not in parallel with the results of this study. These findings were reported by Gignac & Vernom (2004), Badau et al. (2018), and Gignac & Vernom (2004) reported

that there was no significant difference between dominant hand and non-dominant hand preferences in simple response time in a study conducted on a total of 81 participants (53 women and 28 men). Badu et al. (2018) Examined the response times of athletes from individual branches (gymnastics, boxing, judo, taekwondo, wrestling and karate) using computer games. In the study, they stated that the left hand performed significantly better than the right hand according to the results of the Benchmark test, regardless of which of the participants with dominant right and left hand.

Visual response time, which is among the performance parameters that affect success in sports, is very important. In high-level competitions where success is affected by very small performance parameters, it should be ensured that the athlete reaches the highest efficiency from the pre-competition warm-up (30). Therefore, in sports branches such as basketball, it is important for success that the foot reacts as quickly to a stimulus as the hand.

However, in the comparison of the dominant and non-dominant foot times of basketball players before and after warm-up, it was found that there was no significant difference in both feet after warm-up. This research supports the studies conducted by Karadağ & Kutlu (2006) and Açak et al. (2012). Karadağ and Kutlu (2006) examined the effect of visual and auditory stimuli on dominant and non-dominant foot response times in a study on soccer players. As a result of the study, it was reported that there was no significant difference in the response times of dominant and non-dominant feet of soccer players. Açak et al. (2012) found that there was no difference in the dominant and non-dominant foot response times of hearing impaired national athletes. In the literature, the number of studies on dominant and non-dominant foot visual response times of warm-up is limited. Therefore, the findings of Karadağ & Kutlu (2006) and Açak et al. (2012) were discussed. However, Brighenti et al. (2022) reported that the improvement in balance control after warm-up in participants from symmetrical and asymmetrical sports branches was greater in the dominant leg compared to the non-dominant leg. In the study conducted with 12 participants (8 boys and 4 girls) who were actively practicing sports, asymmetry athletes were reported as 5 in total, with gender and branch differences among the participants. This caused the sample of the study to be limited. In this study, in determining the dominant and non-dominant standing visual response times of warm-up, it was tried to ensure that the sample group was larger and homogeneous by including only male participants from the basketball branch, which is an asymmetric sport.

As a result; the warm-up caused an improvement in the dominant and non-dominant hand response times of basketball players. This improvement was more pronounced in the dominant hand. However, there was no difference in feet response times after warm-up compared to before warm-up. Since this study only included team sports, it is recommended that team and individual athletes should be compared in studies that will examine the effect of warm-up on dominant and non-dominant limbs. In addition, examining the effect of warm-up on visual response time in both limbs in physically active and inactive athletes may also reveal the chronic effect of training.

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