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12-14 Yaş Arası Erkek Taekwondocularda El-Göz Koordinasyon Antrenmanlarının Görsel Tepki Sürelerine Etkisi

Berkay Löklüoğlu Sedat Özcan

ORİJİNAL ARAŞTIRMA

Özet

Görsel tepki süresi, taekwondo gibi dövüş sporlarında rakibin hareketine tepki verme ve tekniklerin kısa sürede yeterli güçle uygulanması bakımından önemlidir. Rutin antrenmanlara ek koordinasyon çalışmalarının Taekwondocularda görsel tepki süresini nasıl etkilediğinin belirlenmesi gereklidir. Bu bilgilerden hareketle çalışmamızın amacı; 12-14 yaş arası erkek taekwondocularda sekiz haftalık el-göz koordinasyon antrenmanlarının görsel reaksiyon sürelerine etkisinin incelenmesidir. Araştırmaya 12-14 yaş arası 32 erkek taekwondo sporcusu gönüllü olarak katılmıştır. Katılımcılar antrenman grubu (n:16) ve kontrol grubu (n:16) olmak üzere iki gruba ayrılmıştır. Antrenman grubu sekiz hafta boyunca haftada iki gün rutin taekwondo antrenmanlarına ek olarak el-göz koordinasyon çalışmaları uygulamışlardır. Kontrol grubu ise herhangi bir koordinasyon çalışması olmadan rutin taekwondo antrenmanlarına devam etmişlerdir. El-göz koordinasyon antrenmanları öncesi ve sonrasında görsel reaksiyon süreleri Blazepod Sistemi kullanılarak belirlenmiştir. Ön-test ve son-test ölçümlerini karşılaştırmak için 2*2 Tekrarlı Ölçümler ANOVA kullanılmıştır. Veriler SPSS 25.0 (SPSS Inc., Chicago, IL, ABD) programında analiz edilmiş ve anlamlılık düzeyi $p<0.05$ olarak belirlenmiştir. Dominant el, dominant olmayan el ve çift el reaksiyon süreleri antrenman programı sonunda istatistiksel olarak anlamlı düzeyde azalmıştır sırasıyla %5,12, %4,24 ve %3,74. Ayrıca tekrarlayan ölçümlerin ANOVA sonuçlarına göre grup, zaman ve grup-zaman etkileşimlerinde istatistiksel olarak anlamlı sonuçlar bulunmuştur ($p<0.05$). 12-14 yaş arası erkek taekwondocularda sekiz haftalık el-göz koordinasyon antrenmanları görsel reaksiyon sürelerini önemli derecede azaltmıştır. Dolayısıyla el-göz koordinasyon çalışmalarıyla taekwondo performansı için önemli olan görsel reaksiyonun geliştirildiği söylenebilir. Çalıştırıcıların antrenman programlarına koordinasyon çalışmaları eklemeleri görsel reaksiyon gelişimi için önerilebilir.

Anahtar kelimeler: Taekwondo, el-göz koordinasyonu, görsel tepki süresi

Berkay Löklüoğlu, Hatay Mustafa Kemal Üniversitesi, Hatay, Türkiye, berkayl@hotmail.com

The Effect of Hand-Eye Coordination Training on Visual Response Times 12-14 Ages Male Taekwondo Players

Abstract

Visual response time is essential in combat sports such as taekwondo, as it allows players to react to the opponent's movement and quickly apply techniques with sufficient power. Therefore, it is necessary to determine how coordination exercises and routine training affect visual response time in Taekwondo players. Based on this information, our study aimed to investigate the effect of eight-week hand-eye coordination training on visual response time in 12-14-year-old male taekwondo players. Thirty-two male taekwondo athletes aged 12-14 participated in the study voluntarily. The participants were divided into a training group (n:16) and a control group (n:16). The training group practiced hand-eye coordination exercises and routine taekwondo training twice a week for eight weeks. The control group continued their routine taekwondo training without any coordination training. Visual response times before and after the hand-eye coordination training were determined using the Blazepod System. 2*2 Repeated Measures ANOVA was used to compare pre-test and post-test measures. The data were analyzed in SPSS 25.0 (SPSS Inc., Chicago, IL, USA), and the significance level was set as $p<0.05$. Dominant hand, non-dominant hand, and double hand response times decreased statistically significantly at the end of the training program by 5.12%, 4.24%, and 3.74%, respectively. In addition, according to the results of repeated measures ANOVA, statistically significant results were found in group, time, and group-time interactions ($p<0.05$). Eight weeks of hand-eye coordination training significantly decreased visual response times in 12-14-year-old male taekwondo players. Therefore, it can be said that hand-eye coordination training improves visual response time, which is essential for taekwondo performance. It may be recommended that trainers add coordination exercises to their training programs for visual response time development.

Keywords: Taekwondo, hand-eye coordination, visual response time

Introduction

In all speed-based sports, athletes must apply their knowledge correctly to perform at their best (Laby et al., 2011). Developing motor skills does not mean that sportive performance will be successful. The continuity of success also depends on an important level of perceptual skills. In highly competitive sports, the athlete may be subjected to spatial and temporal constraints by the opponent. In such constraints, the athlete's ability to perceive quickly and accurately is essential in preparing and using motor skills and facilitating decision-making (Mori et al., 2002). The stimulus to the muscles passes to the central nervous system through the nerve, and the response of the muscles according to the decision made by the individual is called a response (Okkesim & Coşkun, 2015). The evaluation of reactive skills in sports depends on two neuromotor variables: response and movement time (El-Gizawy & Akl, 2014). Response time refers to the time from the onset of stimulation at the receptor to activation in the muscle (Paśko et al., 2021). At the same time, the central nervous system and neuromuscular system are the most reliable indicators of sensory stimuli. The response speed is characterized by the athlete's quick decision-making and accurate and fast reactions to the stimulus in competition. Response speed is a part of movement speed (Sevim, 2010). The response time to a visual response between athletes is related to how quickly an athlete reacts to a visual stimulus as soon as possible. An extended response time indicates that the athlete does not pay the necessary attention to the stimulus and uses information slowly. Movement time refers to the time between the beginning and the end of the motor movement (El-Gizawy & Akl, 2014). Studies have indicated that individual characteristics determine response time and are not affected by training. In contrast, motor units' movement time is affected by neuromuscular coordination, which can be shaped primarily with appropriate training. Response and movement time are considered classic measures of the efficiency and effectiveness of an individual's capacity to process information and perform sporting skills (Paterson, 2010).

People use their hands in daily tasks and physical activities. Response times are affected by many factors and can vary from person to person and from trial to trial (Pavelka et al., 2020; Ertavukçu et al., 2021). These factors are perception, focus, stimulus size, arousal level, age, gender, and fatigue (Tatlıcı & Özer, 2022). Response time is an inherited trait (Güler & Yıldırım, 2022). The brain needs a minimum response time of 60-70 ms for the organism to recognize, process, and react to the stimulus (Soto-Rey et al., 2014). Response time typically decreases until the thirties, reaches its optimal level, and then continues to increase in the sixties and seventies. Studies show men have shorter response times than women (Luchies et al., 2002).

It is known that response time is an essential skill for high performance in many sports branches. In other words, response time is one of the critical performance indicators. Especially in taekwondo, visual response time is significant for performance, and for this purpose, coaches carry out various studies to develop visual response time. There are also studies on this subject in the literature, but the number of studies needs to be increased. There is a need for more studies in different age groups and with different methods. The 12-14 age group is a critical developmental stage as children transition into adolescence. During this period, significant changes occur in both cognitive and motor skills. Skills such as hand-eye coordination, visual perception, attention, reflex speed, and motor planning develop rapidly, leading to improved responses to external stimuli. This age group is particularly suitable for assessing the impact of hand-eye coordination exercises on both physiological and cognitive development. Interventions during this stage can result in measurable and significant improvements in basic cognitive-motor skills, such as visual response time. This prompts questions about how hand-eye coordination exercises specifically affect visual response time in children during their developmental years. Therefore, this study aimed to investigate the effects of an eight-week hand-eye coordination training program on the visual response time of male taekwondo players aged 12-14.

Materials and Methods

Participants

The study was conducted using a pre-post-test model, a type of experimental design. The sample size was determined using power analysis (G*Power 3.1). Thirty-two male taekwondo athletes aged between 12-14 years participated voluntarily in the study. The participants were randomly assigned to the training group (TG, n=16) and the control group (CG, n=16). The participants were given a detailed explanation of the study's content and the associated risks. They were asked to sign a consent form confirming their participation as volunteers.

Research Procedure

Before the pre-test measurements, adaptation practices were performed to familiarize participants with the device and the method. The training group practiced hand-eye coordination exercises in addition to routine taekwondo training twice a week for eight weeks (at least 72 hours between two training days), while the control group continued their routine taekwondo training without any additional training program. Demographic data, including participants' age, height, and body weight, were collected. In addition, visual response time measurements were performed using the Blazepod (Israel) system before and after the training program.

Training Protocol

Hand-eye coordination movements that establish a connection between both brain hemispheres were preferred. To adapt to the training, games in which coordination, attention, and response features were effective were applied. Attention, concentration, perception, and decision-making skills were examined with attention-enhancing exercises. Moving the fingers in different directions coordinated, throwing and catching different types of balls, and rolling a ball on a rope were practiced. In addition, sequential movements combining several movements were also included. The levels were made difficult by throwing and holding the ball straight, throwing and holding the ball high in one hand and low in the other, changing the low-high ball, repeating the movement with visual command, throwing straight and holding with crossed hands. Each training session lasted about 45 minutes and included a 10-minute warm-up, a 25-minute main phase, and a 10-minute cool-down. During the main phase, all exercises were performed for equal durations. The compliance rate for the training was assessed, and all participants attended every session (Orhan, 2015).

Visual Response Time

Participants' visual response times were measured using the Blazepod system, which consists of wireless light disks that turn off the light when the disk is touched (Figure 1). Blazepod is a speed and cognitive system that measures the athlete's training and performance level. It is a modern, reliable, and easy-to-maintain tool for measuring visual reactions. It provides long-lasting and effective performance with proper use and regular maintenance. This system, used to improve the athlete's performance, also helps improve the connection between mind and body, reaction, and response. The system has eight different lights. The device, connected to smart devices via Bluetooth, also records the data obtained. The random protocol in the Blazepod system was utilized for the test application. Five pots were used in the application. At 30-cm intervals, the distance between the two ends of the pots arranged in a crescent shape on the floor was set to 100 cm. Participants stood with both feet on the ground, facing the disks at a distance, allowing them to touch the disks based on their arm's length quickly. The participants were asked to touch the lighted disk with the hand they used for the test as soon as possible and to turn off the disk's light for 30 seconds consecutively and randomly. Measurements were taken three times for each hand: dominant, non-dominant, and double-handed. The best time recorded was considered the participant's response time (milliseconds, ms).

Figure 1. Blazepod System

Statistical Analysis

The data's normality was assessed statistically (Shapiro-Wilk, skewness, kurtosis) and graphically (Histogram, Q-Q graph). 2*2 Repeated Measures ANOVA was used to compare the pre-post test values of the variables according to the groups. Pre-test and post-test change percentages of the groups were calculated. Group, time, and Group*Time interaction values, as well as effect size values, were determined. The data were analyzed using SPSS version 25.0 (SPSS Inc., Chicago, IL, USA), with a significance level set at $p<0.05$.

Findings

Table 1 shows descriptive results for the groups, including age, height, and body weight.

Table 1. Descriptive results of groups

Variables	Group	*N*	$\bar{x}$	SD
Age (year)	**TG**	16	13,00	0,97
	CG	16	12,94	0,85
Height (cm)	**TG**	16	157,31	12,36
	CG	16	155,31	6,66
Body Weight (kg)	**TG**	16	48,34	2,87
	CG	16	49,00	3,97

TG: Training Group; CG: Control Group; $\bar{x}$: Mean, SD: Standard deviation.

Table 2 shows the pre-test and post-test visual response time values and change percentages for the participants' study groups.

Table 2. Visual response times pre/post-test values by groups

Variables	Group	N	Pre-Test	Post-Test	% Change
			$\bar{x} \pm$ SD	$\bar{x} \pm$ SD	
Dominant hand (ms)	**TG**	16	476,875 ± 66,59	452,438 ± 60,52	% 5,12
	CG	16	569,563 ± 39,36	565,875 ± 33,86	% 0,65
Non-dominant hand (ms)	**TG**	16	495,625 ± 55,18	474,625 ± 56,23	% 4,24
	CG	16	584,812 ± 33,34	583,000 ± 23,60	% 0,31
Double-hand (ms)	**TG**	16	454,625 ± 72,77	437,625 ± 69,90	% 3,74
	CG	16	548,938 ± 33,43	546,000 ± 32,88	% 0,53

TG: Training Group; CG: Control Group; $\bar{x}$: Mean, SD: Standard deviation.

In the training group, the dominant hand, non-dominant hand, and double-hand visual response times decreased by 5.12%, 4.24%, and 3.74%, respectively, due to the training. In the control group, all variables had no significant changes (Table 2).

Table 3. ANOVA results of repeated measures for visual response times

Variables	Interaction	F	p	Effect Size
Dominant hand (ms)	**G**	32,107	0,000*	0,517
	T	30,633	0,000*	0,505
	G*T	16,674	0,000*	0,357
Non-dominant hand (ms)	**G**	43,443	0,000*	0,592
	T	6,056	0,020*	0,168
	G*T	4,284	0,047*	0,125
Double-hand (ms)	**G**	27,244	0,000*	0,476
	T	10,012	0,004*	0,250
	G*T	4,981	0,033*	0,142

G: Group; T: Time; G*T: Group-Time interaction; *p<0,05.

The repeated measures ANOVA results for the participants' visual response times are presented in Table 3. Statistically significant results were found in group, time, and group-time interactions for the dominant hand, non-dominant hand, and double-hand visual response time values ($p<0.05$).

Discussion and Conclusion

Our study investigated the effect of eight-week hand-eye coordination training on visual response times in 12-14-year-old male taekwondo players. The main finding of our study was that eight weeks of hand-eye coordination training significantly decreased visual response times in male taekwondo players. In other words, it was determined that taekwondo players' visual response skills improved with hand-eye coordination training.

Recently, with the development of technology, systems that send visual stimuli to athletes and report responses with feedback at the time of stimulation have started to be used. The use of these systems has shed light on recent studies in many sports branches (Ergin & Kartal, 2021). In our study, the Blazepod system, one of these systems, was used to determine visual response times. The number of studies using this system is increasing in the literature. Ergin et al. (2021) evaluated the visual response times of soccer players across positions using the Blazepod system. Song et al. (2020) used the Blazepod system to measure visual response speed in a study investigating the effect of a ten-week body stability exercise program on balance in volleyball players. Oliveira et al. (2021) investigated the reliability of evaluating the Blazepod™ device to measure response time by recording Blazepod results of 24 athletes during a single-leg stand activity. These results indicated that practitioners could utilize Blazepod™ technology to monitor performance changes during cognitive training and assess training effects. A study of thirty-one male soccer players using the Blazepod device to assess agility performance concluded that the Blazepod response device is a reliable measurement method for performance assessment (Hoffman, 2020).

Visual response time, the duration of a person's response to a stimulus, is a critical performance measure in most sports. It affects athletes' perceptual skills (Salthouse, 2007). Response time and hand-eye coordination are necessary for success in many sports, including judgment games, team, racket, combat, and individual sports (Menevşe, 2011). Many sports demand that athletes respond quickly to changing visual information using hand movements (Erickson, 2022). In the relevant literature, studies compare visual response performance, an essential performance element. These studies were conducted to compare different sports branches (Çimen Polat et al., 2018; Mülhim & Akcan, 2021), to compare athletes and non-athletes (Asia & Warkar, 2013), to compare elite athletes and amateur athletes (Vieten et al., 2007), and to compare according to positions in the sports branch (Ergin & Kartal, 2021). However, all these studies focused on acute effects.

Studies focusing on chronic effects have been conducted in the literature to determine the development of visual response with different methods and training, and their effects. However, these studies are few. Altuncu (2023) reported that oculomotor exercises with gaze stabilization positively affected hand-eye coordination and visual reaction in table tennis players aged 15-25. Patel and Rathi (2019) reported that two coordination exercises performed for four weeks improved visual reaction time positively. However, this improvement was not significant; the reason may be due to the insufficient number and frequency of exercises. Merdan and Aktop (2021) examined the effects of eight-week attention and coordination training on reaction time performance under anaerobic fatigue in university students. However, they did not find any change in reaction time—the reason may be physiological changes, especially in the brain, during anaerobic fatigue. Our study found that eight weeks of hand-eye coordination training significantly decreased visual response times in 12-14-year-old taekwondo players. The results of the studies above and our study differ. The differences in the results may be due to the sample group selected and the different exercises applied in the training.

The effect of cup stacking exercises applied for 5 weeks on reaction time and hand-eye coordination performance in children aged 8-10 years was examined. It was concluded that the exercises positively affected reaction time and hand-eye coordination performance (Udermann et al., 2004). In a 2006 study, the effect of a movement training program on attention, concentration, hand-eye coordination, and reaction time was examined, and it was concluded that a 6-month movement training program had a positive effect on hand-eye coordination in children aged 5-7 years (Özbar et al., 2006). The results of these two studies are similar to those of our study. However, the small number of studies on the effects of coordination exercises on visual response makes it difficult to compare and interpret the results. Therefore, more studies are needed to evaluate this subject more reasonably.

In conclusion, it was found that eight-week hand-eye coordination training significantly decreased visual response times in 12-14-year-old male taekwondo players. Therefore, it can be said that hand-eye coordination exercises improve visual response time, which is essential for taekwondo performance. Coaches should incorporate hand-eye coordination exercises into their training programs to develop visual response time. However, further research is necessary due to the limited studies available and the requirement for randomized controlled trials.

Ethics Committee Permission Information

The ethics committee permission for this research was obtained from the Süleyman Demirel University Health Sciences Clinical Research Ethics Committee with the decision numbered 2024/17 dated 03.01.2024.

Declaration of Contribution Rates of Researchers

Both the authors have equal contributions.

Conflict of Interest Statement

There is no conflict of interest in this study.

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