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Visual Skills of the Female Athletes in Team and Individual Sports

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ABSTRACT

Visual has always been recognized as one of the most important sensory systems involved in the implementation of many athletic skills because of the close and necessary relationship with performing the movements, and it is considered particularly important by specialists in learning and motor control. Today, in addition to assessing the key indices in athletic performance (physical, medical, psychological and nutritional evaluations), visual skills assessment is also held in great importance. In this regard, the present study aims to answer the question of whether the difference between the visual skills of athletes (team and individual) and non-athletes is significant. For this purpose, 85 subjects (44 non-athletes, 22 athletes in team sports, and 19 athletes in individual sports) participated in this study and were selected using purposive sampling. The research instrument was "sports vision tests of Wilson and Falkel (2004)". The psychometric properties of this test were studied and confirmed through the correlation between the referees and retest method. The results of the statistical analyses showed that there were significant differences between focusing ($P=0.001$), tracking ($P=0.0001$), sequencing ($p=0.009$), eye-hand coordination ($P=0.0001$), and vergence ($P=0.015$) of all-girl teams and individual sports athletes with non-athletes. Just as female individual and team sports athletes were better in focusing and tracking than non-athletes, individual sports athletes were better in sequencing than team sports athletes and non-athletes, and non-athletes were better in eye-hand coordination and vergence. However, in regards to visualization, no significant difference was observed between the three groups. According to the results, participation in sports activities, regardless of the type of activity, helps an individual to obtain better abilities in the visual system and its skills. Additionally, the role of visual skills in individual and team fields is different; therefore, due to the importance of vision, it is recommended that coaches consider special planning along with other motor capabilities.

KEY WORDS: *Visual Skills, Athletes, Focusing, Tracking, Sequencing, Eye-Hand Coordination, Vergence.*

INTRODUCTION

A major challenge in the studies of motor learning is reaching a certain level of expertise and passing through the process of learning a skill in the optimum way. It seems that the implementation of skills is always dependent on learning; therefore, the use of appropriate exercises, based on principles of motor learning,

leads to the storage and retrieval of information in the memory. Thus, motor skills are produced based on the previous learned actions (1). "Skill", in terms of Guthrie (1952), is a functionality that reaches the desired result through determined confidence and spending the least energy or time (2). This ability represents a

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level of expertise and it comprises a division of the physical, technical, tactical and mental skills (3).

Recently, another collection of skills, known as "vision skills", has attracted the attention of motor behavior specialists. Due to the growing interest in the role of this type of skill on performance, a relatively new interdisciplinary field has been formed. The area that is known as "athlete's vision" was invented in the early 1960s in America by Optometrists and Ophthalmologists (4, 5).

Vision plays an important role in our daily activities and, those who are deprived of vision have problems in their performance in the visionary world. Undoubtedly, therefore, the role of this information is very important in motor control (3, 6). Many experts believe that the vision system is the richest source of information about the world in which we live (7).

Therefore, the issue of learning, implementation of motor skills, and the visual system are very important. Accordingly, it is not surprising that researchers have tried to find a relationship between visual performance and motor behavior because of the obvious importance of vision in motor tasks; so far, however, few studies have been carried out on the visual and eye socket in terms of health, caring and analytical components (6). According to those studies carried out, it appears that the function of skills in the visual function is different from other senses (7).

Visual has two performance categories, which include visual-motor skills and visual perception. "Visual-motor skills" are intimately related to athletic performance. In the visual-motor system, four main motor skills are related to the eyes. These skills include: Eye-hand coordination, Tracking, Accommodation (focusing) and vergence. Another aspect of the visual system is "the process of visual perception". Visual-perceptual skills include visual memory, visualization, and figure-ground Perception (8). Another important aspect of vision is the interaction between visual-motor and visual-perceptual skills, which enable the athlete to pass her teammates without looking at them. In most sports skills and daily tasks, these skills are used; for example, being able to hit a ball is a skill that is highly dependent on the

ability to track. It can be said that athletes who do not have this action have few tracking skills (6). There are evidences that support this belief (there is a strong correlation between performance and visual). For example, Hudak and Spaniol (2012) found that athlete students had better visual skills than non-athletes (9). Halder and Saha (2013) reported that athletes had significantly better performance in eye-hand coordination than non-athletes (10).

Other researchers, including Du Toit *et al.* (2012), assessed the visual skills of non-active students and active military personnel using the vision test of Wilson and Falkel (2004) (8). The results demonstrated that eye-hand coordination and tracking skills were stronger in the military personnel, while sequencing and visualization skills in the students were superior. Meanwhile, in the focusing, there were significant differences between the military personnel and the students (8). In general, due to the research, it is concluded that physical activity can influence the visual performance skills; the diversity of findings may be related to the use of laboratory tools, gender, sample size, measuring some skills, vision skills, and different age ranges (8-13). However, despite the fundamental role of physical activity, it is considered less.

In addition to the foregoing, it is worth mentioning that visual-perceptual and visual-motor skills in all athletes (whether in a team or an individual) are not the same (14). Also, as many aspects of the athlete's abilities can be improved by specific exercises, visual-perceptual and visual-motor abilities can be changed significantly by sports vision training (15); the changes need identification of the visual skills that greatly depend on the particular type of sport (16). To date, no research has been found in which the visual skills of sports athletes have been studied.

In total, according to the presented theory and literature principles of research, most of the researches that have been conducted in the area of sports have assessed the physiological and psychological characteristics involved in different sports. However, very few studies have been conducted on the visual skills, and most of these focused on athletes, non-athletes, and soldiers, and used laboratory analysis tools. It is worth noting that field methods are very

important when it comes to measuring visual skills, especially when we allow the assessments to occur in the community places such as schools, sports halls.

In this regard, the importance of visual skills in people's lives and its central role has been observed as one of the strongest predictors of future physical activities that comprise the missing part in training programs. So far, no study has been conducted in this field. Considering the noted cases, the present study is conducted in order to answer the following questions:

1. Do athletes (team and individual) have a better visual function compared to non-athletes?

2. Are there differences between individuals and team sports athletes in regards their vision skills?

Answering these questions can help coaches, athletes, and other members of the community to enhance visual skills, which could have an important effect on the explanation and determination of the visual skills. Answers to these questions can be used in scouting players. Additionally, recognition of visual skills can also be used to identify weaknesses in athletic performance. On the other hand, this data may be a reference for educators to provide training interventions in order to improve visual function and motion, so that the athletes can show better performance in all competitive areas.

MATERIALS AND METHODS

This study is causal-comparative study. The present study is applicable due to the time length, the cross type and in terms of the obtained results. It is noteworthy that all stages of the study were approved by the Ethics Committee of Shiraz University.

Participants. Participants in this study consisted of 85 students (44 non-athletes, 22 athletes of team sports and 19 athletes of individual sports) who were selected from all the female student athletes of Shiraz University who were enrolled in the academic year 2013-2014 through the purposive sampling method, and according to the inclusion and exclusion criteria of the study. The most important criteria included those with a sports history, lack of eye diseases, or diseases of the inner eye. It is noteworthy that athletes were active in team

sports (basketball, volleyball and futsal) and individual sports (swimming, badminton, table tennis, and running). In the beginning, a summary of the research project was explained to everyone. Then, after obtaining consent from the participants, these people were recruited to the medical history study and checked for any eye diseases, dizziness or eye surgery.

Research Tools. In order to assess the visual skills of the test subjects, the sports vision test of Wilson and Falkel (2004) was carried out on the participants (6). This test has been used in several studies, such as Mohammadi, Rostami and Alborzi (2015), Rostami, Mohammadi, and Alborzi (2015), Fourie (2013), Du Toit *et al.* (2012, 2012)(8, 12, 17-19). It should be noted that, for the psychometric properties of this test, three methods were used, namely content validity, correlation between the referees, and the test-retest method. It is approved as follows (18):

Table1. Information on methods of correlation between the experimenters and test-retest

Visual Skills	Test-retest		Methods of correlation between the experimenters	
	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>
Focusing	0.001	0.93	0.001	0.75
Tracking	0.001	0.92	0.001	0.77
Vergence	0.001	0.93	0.001	0.89
Sequencing	0.001	0.88	0.001	0.81
Eye-hand Coordination	0.001	0.94	0.001	0.83
Visualization	0.001	0.91	0.001	0.81

The test has been considered for reliability as well as for low cost, compared to other similar tests which are available for clinical optometry centers and have been used for the assessment of some visual skills. The test includes six subtests (Accommodation or Focusing, Tracking, Vergence, Sequencing, Visualization, Eye-hand coordination), which were performed by the participants sequentially with a rest period of one minute after the execution of each sub-test. It should be noted that the subjects repeated each test twice and the average performance was

recorded. In this study, the duration of the implementation of this test was reported as 15 to 20 minutes for each participant (6).

Data Analysis. The raw data obtained from the measurement of variables using statistical software SPSS version 22 were analyzed using descriptive and inferential statistics. The findings show that the Kolmogorov-Smirnov test was used to check the normality of the data distribution. The Levine test was used for the evaluation of homogeneity of variance and variance analysis. This study analyzed whether the athletes (team and individual) have a better visual function compared to non-athletes. Whether there is any difference between team and individual athletes in visual skills. An one way analysis of variance (ANOVA) was also

used. Finally, Tukey's range test was applied to compare the visual skills of groups at a significance level ($p < 0.05$).

RESULTS

The descriptive data suggests the homogeneity of three groups in terms of age, height and weight (Table 2).

The results of the ANOVA test showed that there was a significant difference between focus on visual skills ($F=7.67$, $df=2$, $p=0.001$), tracking ($F=8.93$, $df=2$, $p=0.0001$), sequence ($F=5.05$, $df=2$, $p=0.009$), eye-hand coordination ($F=14.64$, $df=2$, $p=0.0001$), and vergence ($F=4.4$, $df=2$, $p=0.015$) between the groups (Table3).

Table2. Descriptive information of demographic variables (Mean±SD)

Groups	N	Weight (Kg)	Height (cm)	Age (year)
Team sports athletes	22	60.87±3.91	163±4.46	21.82±2.70
Individual sports athletes	19	57.43±4.42	160±4.12	21.68±2.96
Non-athletes	44	61.72±4.79	162±3.63	21.80±2.66

Table 3. Results of the ANOVA test in Visual Skills

		Sum of Squares	df	Mean Square	F	p
Focusing	Between Groups	824.933	2	412.466	7.668	0.001
	Within Groups	4410.879	82	53.791		
	Total	5235.812	84			
Tracking	Between Groups	1213.144	2	606.572	8.926	0.0001
	Within Groups	5572.103	82	67.952		
	Total	6785.247	84			
Vergence	Between Groups	152.897	2	76.449	4.398	0.015
	Within Groups	1425.526	82	17.384		
	Total	1578.424	84			
Sequencing	Between Groups	276.176	2	138.088	5.048	0.009
	Within Groups	2243.071	82	27.355		
	Total	2519.247	84			
Eye-hand Coordination	Between Groups	4785.319	2	2392.659	14.645	0.0001
	Within Groups	13397.181	82	163.380		
	Total	18182.499	84			
Visualization	Between Groups	394.130	2	197.065	2.582	0.082
	Within Groups	6258.782	82	76.327		
	Total	6652.912	84			

The results showed a significant difference in visual skills including focusing, tracking, sequencing, eye-hand coordination, and vergence of female athletes (individual and team

sports) with non-athletes. In the other words, females athletes (individual and team sports) were superior in focusing and tracking than non-athletes. Females of individual athletes were

superior in sequencing than non-athletes and females of team athletes. Non-athletes were superior in eye-hand coordination than females

athletes. Non-athletes were superior in vergence than females of team athletes. The results are presented in Table 4.

Table 4. Results of the Tukey's range test in visual skills between the groups

Dependent Variable	(I) group	(J) group	Mean Difference (I-J)	SE	p
Focusing	Individual sports athletes	Team sports athletes	3.62919	2.29699	0.118
		Non-athlete	7.65191*	2.01337	0.0001
	Team sports athletes	Individual sports athletes	-3.62919	2.29699	0.118
		Non-athlete	4.02273*	1.91509	0.039
	Non-athlete	Individual sports athletes	-7.65191*	2.01337	0.0001
		Team sports athletes	-4.02273*	1.91509	0.039
Tracking	Individual sports athletes	Team sports athletes	-.68660	2.58170	0.791
		Non-athlete	7.17703*	2.26292	0.002
	Team sports athletes	Individual sports athletes	.68660	2.58170	0.791
		Non-athlete	7.86364*	2.15247	0.0001
	Non-athlete	Individual sports athletes	-7.17703*	2.26292	0.002
		Team sports athletes	-7.86364*	2.15247	0.0001
Vergence	Individual sports athletes	Team sports athletes	2.24880	1.30582	0.089
		Non-athlete	-.97847	1.14458	0.395
	Team sports athletes	Individual sports athletes	-2.24880	1.30582	0.089
		Non-athlete	3.22727*	1.08872	0.004
	Non-athlete	Individual sports athletes	.97847	1.14458	0.395
		Team sports athletes	-3.22727*	1.08872	0.004
Sequencing	Individual sports athletes	Team sports athletes	4.21770*	1.63802	0.012
		Non-athlete	4.37679*	1.43576	0.003
	Team sports athletes	Individual sports athletes	-4.21770*	1.63802	0.012
		Non-athlete	.15909	1.36568	0.908
	Non-athlete	Individual sports athletes	-4.37679*	1.43576	0.003
		Team sports athletes	-.15909	1.36568	0.908
Eye-hand Coordination	Individual sports athletes	Team sports athletes	-2.55895	4.00317	0.524
		Non-athlete	-16.28372*	3.50887	0.0001
	Team sports athletes	Individual sports athletes	2.55895	4.00317	0.524
		Non-athlete	-13.72477*	3.33760	0.0001
	Non-athlete	Individual sports athletes	16.28372*	3.50887	0.0001
		Team sports athletes	13.72477*	3.33760	0.0001
Visualization	Individual sports athletes	Team sports athletes	.22787	2.73616	0.934
		Non-athlete	-4.18417	2.39831	0.085
	Team sports athletes	Individual sports athletes	-.22787	2.73616	0.934
		Non-athlete	-4.41205	2.28125	0.057
	Non-athlete	Individual sports athletes	4.18417	2.39831	0.085
		Team sports athletes	4.41205	2.28125	0.057

*. The mean difference is significant at the 0.05 level.

DISCUSSION

The results showed a significant difference in visual skills including focusing, tracking,

sequencing, eye-hand coordination, and vergence of female athletes with non-athletes in individual and team sports. In the other words,

females of team athletes were superior in individual and team skills in Focusing and Tracking than non-athletes. In this regard, the results of the present research are consistent with some findings of studies (8-12, 20-27), while they were inconsistent with other findings (12). It seems that the results could be related to the kind of training, tools and different subjects and different age ranges (8).

Results showed that female individual and team sports athletes were better in focusing and tracking than non-athletes, individual sports athletes were better in sequencing than team sports athletes and non-athletes, and non-athletes were better in eye-hand coordination and vergence. However, in regards to visualization, no significant difference was observed between the three groups.

In this context, for an explanation of these findings that align with previous studies in relation to lead groups in matching skills (Focusing), the theory of integration of the visual attention, which has been suggested by Treisman (1980), could be used (28). This theory suggests that the visual search process takes more time that an individual focus on the desired area of his/her spotlights. Therefore, individual can more quickly determine targets and its location (2, 28).

In terms of motor learning, the differences in skills related to the effect of the transfer of learning can be understood due to the visual tracking. This can be due to increased processed simulations by the brain as a result of training and experience. This leads to an increase in speed of tracking motions, as well as a reduction of transfer time of vision stabilization, from one point to another in athletes (29). This difference can also be examined from the perspective of Optometry. During the tracking movements, saccade repression occurs and visual system tracking only processes movements from the first and last points effectively (25). As the tracking movements become faster, the duration of information suppression is dropped and more time is given for people to learn and process information. As a result, this helps to improve performance and tracking skills (30).

The results of this study revealed superiority in girls in individual athletic group when comparing the visual skills of vergence. The better performance of individual athletes in vergence skills, on the one hand, is because of their training (convergent and divergent eyes for following the

ball of the opponents' moves). Their skills are quite improved during practicing these skills; on the other hand, it seems that visual-motor skills are more involved in individual sports.

When explaining the differences in vergence of skills, these can also be examined from the perspective of motor development. The muscles of the eye lens play an important role in the control of eye movement and are the basis for binocular vision (vergence), particularly since binocular vision is one of the visual traits that is important for the motor function of athletes. Additionally, given that individual athletes in this study are constantly repeating and practicing these conditions, this leads to improved speed, coordination, endurance muscles of the eye lens and improvement of the vergence of the athletes in the individual athletes group (6, 31).

Additionally, the improvement of team athletes in sequence skills also seems to be due to focusing on the visual-perceptual skills, as well as repetition and practice and active visual memory in the total hours of training. This helps to remind the athlete of the learned techniques and tactics and to use them in emergencies, leading to improved sequence skills in these athletes than individual athletes. In general, this kind of exercise can also have positive effects on the two types of skills which result in a significant difference in the groups. On the other hand, the difference in the athlete's visual skills can be explained according to the theory of information processing. This theory considers the brain as a computer; therefore, it is said that it considers humans as the chains of processing calculating machines.

Central factors such as attention, memory, and visual, as well as environmental factors such as speed of nerve impulses, have significant effects on the speed of information processing and memory functions. In general, this is one of the reasons for the differences between high-speed memory functions and information processing functions in athletes than non-athletes. Because athletes, when remembering the numbers, categorize them at first and then organize them, this is why they act better in the call data memory. Since athletes regularly train, they can maintain their memory functions better. For one thing, exercise and sports activate the production and function of neurotransmitters in the brain. Exercise also increases the levels of

tissue oxidation, while oxygen plays an important role in the metabolism and energy system of the central nervous system (2, 6, 31).

The difference between groups in hand-eye coordination of visual skills can be due to the issue of freedom degrees that Bernstein had raised (1930, 1950). The theory is that less experienced people (non-athletes) tend to freeze non-essential parts of the body by reducing the number of freedom degrees, so that they can focus on the main aspects. However, experienced people (athletes) want to find the desired degree of freedom in accordance with their task performance (2).

On the other hand, statistical differences observed among athletes of team sports and individual sports and non-athletes in eye-hand coordination skills may, in part, be related to brain hemispheres. Studies have shown that exercise and physical activity can also cause changes in the brain in the field of sports. Brain MRIs of athletes have also shown that they have a peak performance of their brain in the left hemisphere and use the left hemisphere of their brains more. The left hemisphere includes features such as the performance information process and, while the right hemisphere is of a visual-spatial, three-dimensional orientation and coordination (32), these findings correspond with the results.

The lack of a significant difference in the visualization skills can be explained due to the nature of visual skills. Ferreira (2003) believes that visual skills comprise two categories of software skills that are acquired by practicing, and hardware skills that are genetic and are not affected by skills training (33). These skills are different, even among athletes. This means that some of these skills are improved due to performing sports skills (33, 34), while others are the same between athletes and non-athletes (35).

CONCLUSION

According to the results of previous research and the results of this study, it could be concluded that participation in sports is important for everyone. In addition to increasing physical capacity, it improves body control and social communication; it also has positive effects on visual information processing (perception, integrity and response). This indicates that changes in brain structure and neural communication leads to more

effective and faster motor responses and provides a foundation for optimum health (4). It is worth recalling that visual skills are influenced by several factors such as physical fitness, intensity, and duration of exercise, the type of test, and testing time (21, 27, 36, 37).

The results of this study with respect to the objectives of talent identification, and the selection of players in different sports due to the nature of the field, are unique. Therefore, it is recommended that athletic trainers and training planners identify athletes with visual skills; also, due to the nature of the field, visual exercises related to these skills should be involved in the training programs, which can lead to better business vision system capabilities, skills and improved motor performance. However, in order to expand the research findings, more research is needed. It is suggested that future researches focus on a comprehensive knowledge of the factors that are involved in improving visual skills, as well as in order to compare the visual skills in athletes of individual and team sports and various posts in different fields. Unfortunately, applicable studies have not been conducted that confirm or exclude the research, which shows the importance and necessity of such research. However, more research is needed to clarify the results in this area and could examine the findings in the different samples and by further control of variables.

In conclusion, it should be noted that, in this study, with regard to control of the study variables such as fatigue, nutrition, stress at the time of the test, and the mental states of the participants, the rest of the participants had a direct influence on the performance that couldn't be controlled by the researchers. The problem in interpreting the results and a comparison with other studies could also provide constraint.

APPLICABLE REMARKS

- Holding different courses and workshops to promote awareness of visual skills and their impact on performance and daily activities.
- The use of coaches and athletes from this test in conjunction with other clinical vision tests and the prevention of excessive costs.

- Conducting a similar research for better and more accurate route selection to provide services to athletes and coaches. Unfortunately, applied research has not been implemented to confirm or exclude this issue, which shows the importance and necessity of such research.

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