TÜBİTAK

ORIGINAL ARTICLE

Turk J Med Sci
2009; 39 (6): 871-874
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E-mail: medsci@tubitak.gov.tr
doi:10.3906/sag-0809-44

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Athletes have faster eye-hand visual reaction times and higher scores on visuospatial intelligence than nonathletes

Aim: To compare sports-related visual abilities such as hand-eye reaction time and visuospatial intelligence of athletes to nonathletes.

Materials and methods: Differences in sports-related visual abilities such as hand-eye reaction time and visuospatial intelligence between athletes and nonathletes were studied in 157 male (M age = 13.9 years, SD = 1.8) and 126 female (M age = 13.9 years, SD = 1.7) high school students. Visuospatial intelligence was assessed with Cattel's Culture Fair Intelligence Test. A software package of random stimulus presentation and response recording was used for eye-hand reaction time.

Results: Athletes had lower eye-hand visual reaction time (the faster) ($P < .001$) and higher visuospatial intelligence ($P < 0.01$) compared to nonathletes. There were no sex differences. There was a negative correlation between the number of years of doing sports and eye-hand visual reaction time ($r = 0.3$, $P < 0.001$) and a positive correlation with visuospatial intelligence ($r = 0.3$, $P < 0.001$).

Conclusion: These results support the view that sport activities are beneficial to both eye-hand reaction time and visuospatial intelligence. In light of the results of the present study, we can recommend more sport activities for higher academic success in primary, middle, and high school students.

Key words: Reaction time, visuospatial intelligence, athletes

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Sporcular sporcu olmayanlara göre el-göz reaksiyon zamanında daha hızlılar ve daha yüksek uzaysal zeka puanlarına sahipler

Amaç: Sporcuların sporla ilgili görsel kabiliyetler olan el-göz reaksiyon zamanı ve uzaysal zeka puanlarını sporcu olmayanlarla kıyaslamayı amaçladık.

Yöntem ve gereç: Sporla ilgili görsel kabiliyetler olan el-göz reaksiyon zamanı ve uzaysal zeka puanlarındaki sporcular ve sporcu olmayanlar arasındaki farklar 157 erkek (M age = 13,9, SD = 1,8) ve 126 kız (M age = 13,9 , SD = 1,7) orta öğrenim öğrencisinde çalışıldı. Uzaysal zeka Cattel's Culture Fair Intelligence Test ile ölçüldü. El-göz reaksiyon zamanı için random görsel uyaran ve deneğin uyarana cevap süresini kaydeden bir paket bilgisayar programı kullanıldı.

Bulgular: Sporcular sporcu olmayanlara kıyasla daha düşük el-göz reaksiyon zamanına ($P < 0,001$), yani daha hızlı reaksiyona, ve daha yüksek uzaysal zeka puanlarına ($P < 0,01$) sahiptiler. Cinsiyet farkı yoktu. Sporcularda sporla ilgilenme yaşı ile reaksiyon zamanı arasında negatif ($r = 0,30$) ve uzaysal zeka arasında pozitif ($r = 0,30$) korelasyon vardı.

Sonuç: Bu sonuçlar sportif aktivitelerinin reaksiyon zamanı ve uzaysal zeka açısından faydalı olduğu görüşünü desteklemektedir. Sunlan çalışmanın sonuçları ışığında ilköğretim ve lise öğrencilerinde daha yüksek okul başarısı için daha fazla sportif aktivite yapmayı tavsiye edebiliriz.

Anahtar sözcükler: Reaksiyon zamanı, uzaysal zeka, sporcular

Received: September 23, 2008
Accepted: October 26, 2009

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Introduction

Visual performances were found to be significantly better in the athletic population compared to nonathletes for certain visual skills: vergence facility, saccades, visual reaction time, peripheral awareness, and near point of convergence using a clinical battery of vision tests (1).

It has been reported that the dynamic visual acuity of athletes was superior to that of nonathletes (2) and athletes were faster than non-athletes (3). It has also been shown that exercise shortened motor time but failed to affect pre-motor time (4).

In a recent study, differences between athletes and the sedentary subjects in terms of visual evoked potentials (VEP) were noted; acute and habitual exercise affected the VEP responses independently of the body temperature and other physiological parameters (5). They suggested that small sized pre-exercise P100 amplitudes in the athletes can be attributed to the effect of rapid visual-activity-demanding sports on the central nervous system.

Eysenck (6) has re-emphasized the intelligence concept and pointed out the importance of reaction time as an elementary measure of intelligence: the speed of information processing is a fundamental property of biological intelligence (the "speed hypothesis of intelligence"). Accordingly, the nonverbal IQ has been found to be directly correlated with hand speed in right- and left-handed subjects (7,8).

We aimed to compare sports-related visual abilities such as hand-eye reaction time and visuospatial intelligence of athletes to those of nonathletes.

Materials and methods

Subjects

The subjects were 157 boys and 126 girls attending a high school in Erzurum. They ranged in age from 15 to 19 years. Of 157 boys, 37 were soccer players, 20 were basketball players, 17 were volleyball players, 12 were runners, 9 were skiers, and 62 were nonathletes. Fifteen of 126 girls were basketball players, 14 were volleyball players, 8 were runners, 6 were skiers, and 83 were nonathletes. They were members of school teams playing various sports. Athletes who played for less than 3 years in any sport branch were not included the study. All subjects participated in the study voluntarily.

Experimental design

All of them were right-handed as assessed by the modified version of the Edinburgh Handedness Inventory (9). Left-handed subjects were not recruited because they might have an advantage in reaction time (10). For the assessment of eye-hand visual reaction time, a computer monitor was placed 50 cm away from the subject's eyes. The subject's jaw was fixed on the jaw support; the subject was asked to focus both eyes on the central fixation point on the screen. A software package (Davis & Frank, 1990) was used for random stimulus presentation and response recording. A central flash as a visual stimulus was presented and the subject was asked to press a key (A) on the keyboard. Reaction times shorter than 150 ms were considered anticipatory responses and those longer than 500 ms were considered attention errors. Both were removed from the analyses. Subjects with strabismus, refraction errors, and visual field defects were not included in the study.

The visuo-spatial intelligence (nonverbal intelligence) was established by Cattel's Culture Fair Intelligence Test. The raw scores were converted into IQs using the table for converting raw scores directly into intelligence quotients (IQ).

Statistical analysis

For statistical analysis, the unpaired Student's t test and Pearson correlation in the statistical software SPSS 10.0 for Windows were used.

Results

In ANOVA, there was not any difference for eye-hand visual reaction time and visuo-spatial intelligence among different sports.

In this study, there were differences in terms of eye-hand visual reaction time and visuo-spatial intelligence between athletes and nonathletes. Eye-hand visual reaction time was higher in non-athletes and visuo-spatial intelligence was higher in athletes. These differences were not affected by sex (Table).

Table. Means of eye-hand visual reaction time and nonverbal intelligence in young athletes and nonathletes.

	Athletes			Nonathletes			P
	N	M	SD	N	M	SD	
Eye-Hand Visual Reaction Time							
Total Sample	138	318.1	48.8	145	369.4	60.1	0.001
Boys	95	317.1	49.9	62	366.8	58.5	0.001
Girls	43	320.3	46.5	83	371.3	63.0	0.001
Nonverbal Intelligence							
Total Sample	138	77.4	23.6	145	70.3	18.6	0.01
Boys	95	75.8	21.2	62	69.2	17.7	0.05
Girls	43	81.0	28.1	83	71.2	19.4	0.05

In the total sample, there was a negative correlation between the sporting age (total duration of playing sports) and eye-hand visual reaction time ($r = 0.3$, $P < 0.001$) and a positive correlation with visuo-spatial intelligence ($r = 0.3$, $P < 0.001$).

Discussion

It has been well documented that exercise is beneficial to mental health (11-13). Researchers have also established that exercise results in a mild enhancement of cognitive function (14-18).

According to a recently suggested theory, the "psychomotor theory", there is an association between exercise and mind health, and dance is the aesthetic expression of mind in bodily movement (19). Dance originates in a discrete bodily-kinesthetic "intelligence" (20); skilled movement is a form of thinking (21); movement is predominant in all forms of human intellectual activity (22,23). Moreover, exercise has been reported to have tranquilizing and antidepressant effects on participants (24). Tan (19) suggested that movement may occupy a central position in cognitive actions.

Accordingly, Tan (25) reported that there is an inverse correlation between the latency of the Hoffman reflex recorded from the thenar muscles of the right and left hands and nonverbal IQ: high IQ was associated with higher motoneuronal excitability and vice versa. Concerning the more peripheral nervous system, Tan (26) found that the sensory and motor median-nerve conduction velocity was positively linearly correlated with the IQ in men. IQ is closely related to spinal-motor activity, assessed by Hoffmann reflex in humans (27), and to the hand skill in right- and left-handed subjects (7,8,28).

In this study, eye-hand visual reaction time was higher in non-athletes ($P < 0.001$) and visuospatial intelligence was higher in athletes ($P < 0.01$). Sex did not significantly affect these differences. Two possible explanations for the athlete's advantages in both eye-hand visual reaction time and visuospatial intelligence are that subjects with intrinsic neurological advantages such as eye-hand reaction time and visuo-spatial intelligence can readily participate in sports, and that exercise is beneficial to eye-hand reaction time and visuo-spatial intelligence.

In the total sample, there was a negative correlation between the sporting age (total duration of making sports) and eye-hand visual reaction time ($P < 0.001$) and a positive correlation with visuospatial intelligence ($P < 0.001$).

These results support the view that exercise is beneficial to eye-hand reaction time and visuo-spatial intelligence. It can be stated that sport activities can be recommended for success in other lessons such as mathematics and science in primary, middle, and high school students. Moreover, it can be stated that all sports are beneficial for the enhancement of cognitive function (14-18), because there was not any difference among different sports mentioned in this study such as soccer, basketball, volleyball, running, and skiing.

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