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STEREOSKOPICKÉ VIDĚNÍ U HÁZENKÁŘŮ A PLAVCŮ V OBDOBÍ MLADŠÍHO ŠKOLNÍHO VĚKU

SPATIAL VISION OF SWIMMERS AND HANDBALL PLAYERS AT A YOUNGER SCHOOL AGE

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Abstract

The aim of this study is to assess the quality of stereoscopic vision in children of younger school age ($n = 60$) with regard to sports activities (handball, swimming), regularly performed by these children.

In order to determine the level of stereopsis, the standardized test “Titmus stereo test” was used. At the same time, the initial history of sports-physical activities was carried out to receive more objective interpretation of the results. For the statistical processing of the gained data (Statistica 8.0), the non-parametric method - Mann-Whitney U test - was used. Other parameters were expressed by means of frequency, averages, and percentage representation in charts.

The data were processed using the Mann-Whitney U test. The following values were calculated: $Z = -1.97$; $p = 0.05$. The observed data support our hypothesis that physical activity connected with a strong activation of visual and brain functions could affect the quality of individual elements of visual space depth perception, such as stereopsis or myopia. The median values of stereoscopic vision levels in handball players (9) and swimmers (7) are demonstrably given in favour of handball players. Handball players clearly dominate also in the frequency of excellent results achieved in the test of stereoscopic vision (values 9 and 10).

On the basis of the statistical results, we can accept the determined hypothesis validated by the “Titmus stereo test” test of stereopsis, and we can state that the quality of stereopsis in handball players is higher than in swimmers.

Keywords: stereopsis; younger school age; handball; swimming

Souhrn

Cílem této studie je posouzení kvality stereoskopického vidění u dětí mladšího školního věku ($n = 60$) s ohledem na pravidelné sportovně-pohybové aktivity (házenou, plavání). Pro stanovení úrovně stereopse byl použit standardizovaný test „Titmus stereo test“. Současně byla provedena anamnéza sportovně-pohybových aktivit za účelem objektivnější interpretace výsledků. Pro statistické zpracování získaných dat (Statistica 8.0) byla použita neparametrická metoda Mann-Whitney U test. Ostatní parametry byly vyjádřeny pomocí četností, průměrů a procentního zastoupení v grafech.

Statistickým zpracováním byly stanoveny následující hodnoty: $Z = -1,97$; $p = 0,05$. Výsledky podporují naši hypotézu, že pohybová aktivita spojená se silnou aktivací vizuálních a mozkových funkcí může ovlivnit kvalitu jednotlivých prvků vnímání hloubky vizuálního prostoru, jako je stereopse nebo krátkozrakost. Průměrné hodnoty úrovně stereoskopického vidění u házenkářů (9) a plavců (7) vyznívají dle naší studie ve prospěch házenkářů. Házenkáři jednoznačně dominují také ve frekvenci vynikajících výsledků dosažených v testu stereoskopického vidění (hodnoty 9 a 10).

Na základě statistických výsledků můžeme přijmout stanovenou hypotézu ověřenou testem stereopse „Titmus stereo test“ a můžeme konstatovat, že kvalita stereopse je u házenkářů vyšší než u plavců.

Klíčová slova: stereopse; mladší školní věk; házená; plavání

Introduction

Visual functions have a significant effect on almost every daily human activity. The level of visual functions is very important with regard to the quality of life (Valach et al., 2016) and is closely associated with the degree of success in performing or learning the selected motor activity. With regard to high-performance or peak sports, the low level of stereoscopic vision is perceived as a limiting factor of sporting performance, or as a significant restriction when practising selected skills.

Vision, as a primary source of information, provides about 80% of stimuli from the external environment. For this reason, it may be assumed that the quality of visual functions, stereoscopic vision in our particular case, plays a primary role in activities related to spatial orientation, distance estimation, motor learning, motor docility levels, or abilities to perform any motor activity. Assuming that if a person has a high level of stereoscopic vision, there are primarily ideal conditions for successful execution or learning of locomotor tasks in terms of afferentation.

With regard to the topic of our study, we also assume that the quality of stereoscopic vision is affected by the kind of sport performed by a particular individual. As a matter of fact, handball generally requires a continuous visual contact, good estimation of distances, and spatial orientation. In this case, both the visual functions of the eyes, and the processes running in the brain, are activated intensively, and for a long time. Swimming, on the contrary, requires no increased activation of the above-mentioned functions, and, in addition, it takes place in an aquatic environment, which is often “distorted” by swimming goggles worn by swimmers.

The visuo-motor co-ordination at the neurological and psychological level is reported by Zago, McIntyre, Senot, & Lacquaniti (2009) in their publication. Relationships between the quality of visual functions and co-ordination processes are also described by Hirtz (2003). Jendrusch (1995) analyses importance of the quality of visual functions in relation to specific sporting performance. The input and analysis of visual information in the course of sporting performance have already been described in great detail by other authors, such as Voss (1982). Issues related to the perception of space on a neurobiological basis are specified in more detail by Hubel (1989) in his studies. The topics of visuo-motor co-ordination are also discussed by other authors (Rychtecký & Fialová, 1995; Benešová, 2012; Schmidt & Wrisberg, 2000; Zwierko, 2007; Munzert, 2004; Kirschen, Laby, Kirschen, Applegate, & Thibos, 2009; Meinel & Schnabel, 2007; Mechling & Munzert, 2003; Birklbauer, 2006 and others).

By studying scientific literature, and after consultations with the specialists at the Department of Ophthalmology of University Hospital in Pilsen, we have logically reached the hypothetical considerations of how the ability to perform a sporting activity, which “stimulates” visual and related brain functions, can affect the quality of visual functions, stereoscopic vision in our particular case.

The goal of our investigation is to determine whether handball players, in comparison with swimmers, have a higher quality of selected visual functions. The points in questions addressed in this paper are based on the assumption that handball players, in comparison with swimmers, have a higher quality of stereoscopic vision. Examination of the level of stereopsis using the field test called the “Titmus stereo test”. It is a standardised ophthalmological procedure, which provides specific data about the quality of stereoscopic vision.

Methodology

The research sample, which was tested in our research, consisted of handball players and swimmers from selected Pilsen sports clubs. The research sample consisted of 60 probands (boys and girls of younger school age), and every sports branch was always represented by a group of 30 probands. 92% of the probands were at the age of 7 to 10 years, and have been involved in swimming (an average of nine hours per week), or handball (an average of five hours per week) activities for more than 3 years. The research sample tested by us can be characterised as a set of two groups, already specialising in one kind of sport, but also involved in other sporting activities in their spare time. The probands were selected on the basis of voluntariness, availability, and convenience (Hendl, 2004).

For the purposes of our research, the standardised “Titmus stereo test” was used (Figure 1). The author of the test is a US company Stereo Optical Co., Inc., (Chicago, IL, USA), and test validity and reliability were verified, for example, by Ancona et al. (2014). This is a board with pictures that, after putting 3D glasses, creates the perception of a space depth. Our measurements were carried out with the means of vision correction (glasses, lenses). Each of the tested probands had an unlimited

amount of time to resolve the test tasks. The average time of one test was about two minutes. The probands could tilt, zoom in, or zoom out the “fly” in any direction. In our research, we used the test with diamonds. One point was given for each correctly detected circle in the diamond. It was possible to achieve 10 points as a maximum. (Vision Assessment Corporation, 2012). The achieved number of points was recorded in a simple table.



Obrázek 1./ Figure 1.

Test stereopse (Zdroj: <http://oic2020.com/index.php/categories/stereo-tests>)./ Stereopsis test (Source: <http://oic2020.com/index.php/categories/stereo-tests>).

The collected data were analysed on a ratio scale. For the purposes of statistic diagnostics, the Statistica 8 program was used. Two mutually independent files were compared. The results, divided according to the criteria given by the relation to the set objectives and hypothesis, were expressed in the form of histograms and graphs. For the expression, the non-parametric method, MANN-WHITNEY U TEST was used, and other parameters were expressed in the form of frequencies, mean values, medians, or percentage representation in graphs.

Hypothesis: The quality of stereoscopic vision in handball players at the younger school age is higher than in swimmers of the same age.

Results

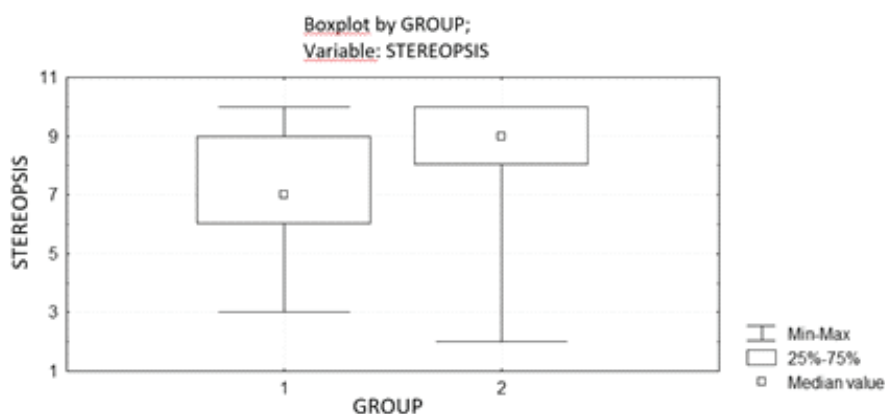
To compare the quality level of stereopsis in the two independent groups of swimmers (Group 1) and handball players (Group 2), the Mann-Whitney U test was used (Tab. 1).

Tabulka 1./ Table 1.

Mann-Whitney U Test. Srovnání stereopse házenkářů a plavců. (Zdroj: Statistica 8.0)./ Mann-Whitney U Test. Comparison of stereopsis in handball players and swimmers. (Source: Statistica 8.0).

Mann-Whitney U Test (comparison.sta)								
Variable: GROUP								
Group 1: 1			Group 2: 2					
	Position total	Position total				Valid N	Valid N	
	Group 1 Swimmers	Group 2 Handball players	U	Z	p-level	Group 1 Swimmers	Group 2 Handball players	p
STEREOPSIS	185	280	65	-1.97	0.05	30	30	0.05

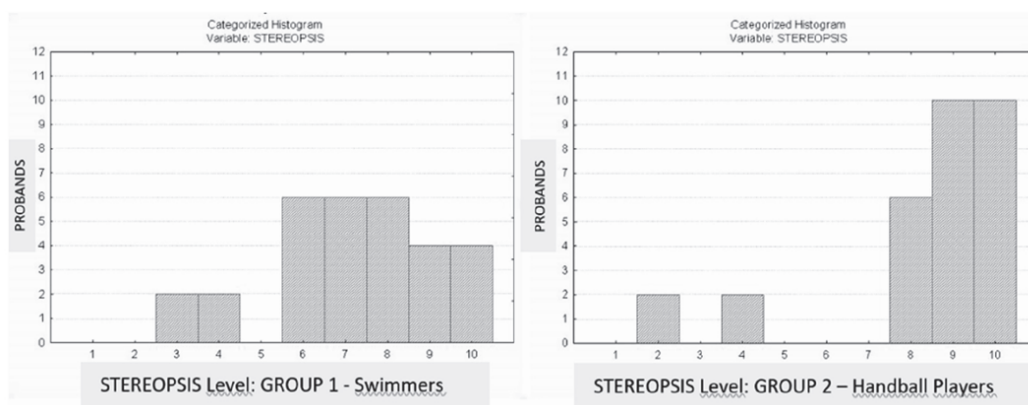
The median values of the level of stereoscopic vision in handball players and swimmers are shown in Figure 2 (Boxplot).



Obrázek 2./ Figure 2.

Porovnání úrovně stereopse u plavců (skupina 1) a házenkářů (skupina 2) (Zdroj: Statistica 8.0)./ Graphical representation of the levels of stereopsis in swimmers (Group 1) and handball players (Group 2). (Source: Statistica 8.0).

The frequency distribution of stereoscopic vision in the group of handball players and swimmers is shown in Figure 3. Handball players, in comparison with swimmers, achieve excellent values of stereoscopic vision more often.



Obrázek 3./ Figure 3.

Četnosti rozložení úrovně stereoskopického vidění plavců (skupina 1) a házenkářů (skupina 2) (Zdroj: Statistica 8.0)./ Frequency distribution of stereoscopic vision in swimmers (Group 1) and handball players (Group 2) (Source: Statistica 8.0).

Discussion

Development in the tested age period is very individual, uneven development occurs in children, and biological age may differ from the calendar age in many cases. The development of the eyes is finalised at the age of the school maturity period, therefore, the measured values, primarily in younger children, may not be entirely valid. Based on the comparison of the results between swimmers and handball players, resulting from the provided graphs, we can confirm our assumption that the quality of stereopsis has a higher level in the tested handball players than in children who are involved in swimming at the same age. On the basis of statistical results, we can therefore accept hypothesis H1 ($p = 0.05$). The median values of the level of stereoscopic vision in handball players (9) and swimmers (7) are demonstrably given in favour of handball players. This trend also prevails with regard to the frequency of excellent results in the stereoscopic vision test (values 9 and 10), where handball players clearly dominate. The values of stereoscopic parallax equivalent to 30"-15" can be considered excellent (Cybersight, 2016), and in our testing, it was equivalent to levels of 8, 9 and 10.

It can be assumed that physical activity connected with handball playing activates visual and brain functions more, therefore, their utilisation in the “civilian” life will be, compared to swimmers, at the higher level. We suppose that the level of cognitive functions is associated with the active spatial perception of athlete’s own movement, as well as movement of other objects, such as balls, playmates, adversaries, and the like.

Limiting factors, which could adversely affect the results of stereopsis measurement, are, for example: hyperactivity, a lack of concentration at the time of testing, or other health problems (pain, cold, etc.). The lack of concentration could influence mainly younger children, who are not able to concentrate fully for a longer time. Transfer from other sports activities could have a quite significant effect on the stereopsis test results, especially in older probands. This positive transfer is anticipated mainly in the group of swimmers.

It should also be taken into consideration that the research sample was not made up of a representative sample. The probands were selected on the basis of voluntariness, availability, and convenience (Hendl, 2004). This fact could partially affect the test results.

Conclusions

Kurt Meinel (Meinel & Schnabel, 2007), who is the founder of the methodology of physical culture in Germany, says that the successful physical development is indispensably related to knowledge of the structure and patterns of human development with regard to motor functions of the human body.

From the viewpoint of contribution to theory, it is still necessary to be actively engaged in cognitive and motor functions, not only as a whole, but with individual segments of these complicated systems. Revelation of regularities between these segments, diagnostics of individual factors using the most state-of-the-art techniques, and their exact description in accordance with the current paradigm, can be considered a direction that will have influence on the methodology within the whole spectrum of sports and physical activities.

Within the framework of this study, our hypothesis has been confirmed. The stereopsis test results were compared at two different kinds of sports. In handball, the quality of visual functions is the fundamental prerequisite for the successful engagement in handball, while in swimming, on the contrary, visual functions are less important with respect to performance. In both sports, special eyeglasses are available, and athletes may get the best advantages from them. Eye defects in handball players can be compensated with lenses, but this option is not feasible in swimmers.

Based on the data ascertained, it can be presumed that the physical activity requiring strong activation of visual and brain functions can affect the quality of the individual components of visual perception of space, such as stereopsis or myopia. This factor should not be underestimated and physical activity of children and adults, no matter whether recreational or sports-oriented, should contain the dynamic motion elements. Living in the open air with natural daylight is another important factor in connection with the activation of visual functions, and, from the evolutionary viewpoint, it has a fundamental impact upon the promotion and development of visual functions in human beings.

Diagnostics of the quality of visual functions and subsequent prevention of the eye apparatus, resp. visual functions, are the secondary goals of our research. Visual defects result in the information deficit that cannot be completely substituted by the remaining sense organs. We are of the opinion that the transfer of research results into practice is very important as the children with impaired stereoscopic vision logically have the narrowed selection of sports and physical activities. We recommended to the probands with the low levels of measured stereopsis to undergo the repeated measurement, and if the results of this measurement are unsatisfactory for the second time too (the number of achieved points is less than 7 out of 10), we propose them, after consultation with their parents, visiting an ophthalmologist.

From the viewpoint of contribution to the practical life, we would like to outline some measures which could improve both the quality of everyday life and sports performance at the peak and recreational levels. In order to find out the exact current status of visual functions, we recommend a complete ophthalmologic examination, including diagnostics of visual acuity, single binocular vision, refraction, colour perception, and screening. Regarding the appropriateness of vision correction, consultation with an ophthalmologist is necessary.

With regard to the further research, long-term testing is recommended. We propose enlarging the research sample of probands, and extending testing by other sports activities where different activation of visual functions can be assumed. In this way, it will be possible to better verify the connection between sports and physical activity, and the quality of visual functions.¹

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