PSYCHOMOTOR EVALUATION OF ATHLETE AND NON-ATHLETE CHILDREN

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Abstract. Throughout the centuries, the humankind has been driven towards knowledge. Therefore, people have taken interest in how the human mind interacts with the body. Nowadays, this relation is better understood than any time before. Child development must work as a symbiosis between the psychic and physical aspects. Latency of one of these elements may lead to serious problems in other periods of life. This study included 26 children, boys and girls, all having roughly the same age. They provided us with important data about their psychomotor development with the help of two tests. The aim of the research was to investigate how these children would perform the tests, to reflect their psychomotor ability and ultimately to build up their profiles. The research methods used in this investigation were the Matorin Test and the Space Perception and Dynamic Balance Test. The results of the research have shown that the level of psychomotor ability of the tested subjects is insufficient due to deviations from the Space Perception and Dynamic Balance Test. The conclusions have highlighted that assessing the psychomotor development of the 6th-grade students, girls and boys, through the Matorin Test and the Space Perception and Dynamic Balance Test can determine the level of psychomotor and health development.

Keywords: space perception, dynamic balance, body movement, psychomotor assessment.

Introduction

There are studies that present the association between a low psychomotor and neuronal level such as epilepsy in both children and adults. Cognitive delay and delay in psychomotor development are a less researched field of epilepsy complications, but these two delays seem to be present in adults with chronic epilepsy (Garcia-Ramos, 2018). Psychomotor education is a vital component of the general education process, not only in physical and sporting education. As a result of investigations and scientific papers (Costa et al., 2015; Fisher et al., 2005; Gallahue & Ozmun, 2002) about educational establishments, we have found that the time spent on psychomotor activities is low.

Many studies (Lubans et al., 2010; Epuran, 2011; Guralnik et al., 2010) have shown that, in the age period between 13 and 14 years, the acquired motor skills have exacerbated stability, new movements being retained very easily in the “motor memory”. If an appropriate environment is provided, children in this age range learn, absorb and store a vast amount of information of any type in a very short time. This plasticity must be capitalized on by well-structured principles and methods.

Motor ability, in general, is made up of three hierarchical components, depending on their complexity.

Motor acts are the simplest expression of the individual's adaptive responses to concrete situations, from the need for dialogue with nature, with others or with oneself (Epuran, 2011). In other words, the motor act is the basis of motor actions or the element of which motor actions are built.

Motor acts can also be found as motor gestures. Motor actions are the syntax of motor actions that respond to the solving of an immediate task (Epuran, 2011). They form the content of motor activities. It should be emphasized that motor actions have a specific character that is detailed in terms of the conditions in which they take place.

Psychomotricity clearly means combining motor functions with psychic functions, which are mediated by the development of the nervous system. This term "psychomotor" was first introduced by Leonardo Landois in 1872. In its sphere of influence, it encompasses a multitude of particular elements such as the psyche, human body, spatial and temporal coordinates, memory, etc.

To perform movements, an individual needs a set of information according to the environment in which they are. This information is acquired through three different analyzers: the visual analyzer, the auditory analyzer, and the mechanoreceptors found at the muscle and tendon levels. The perception of space starts from the location of everything in the environment through the visual, kinesthetic and auditory analyzers (Radu & Ulici, 2003). Of these, the visual analyzer is the most important one, providing the largest amount of information. Psychomotricity, as part of applied psychology, tends to study the motor functions integrated in and coordinated by psychic functions. It is recognized the idea that good body control is the first condition of good behavioral control.

Psychomotricity is a compound term that divides human movement into two fundamental components, the psychic and the motor ones. The literature often suggests the idea that psychomotricity emphasizes the important part of consciousness, placing first the perceptual process and the unity between perception and movement (Epuran, 2011).

Social interaction plays an important role in forming independent social skills and early social relationships. It also affects other developmental fields such as language and communication (Guralnick et al., 2010; Guralnick et al., 2006; Kim et al., 2017). Studies on psychomotor training for social skills or social interaction are ongoing (Cioni & Sgandura, 2013). Psychomotor training enables children to change play through communication and interaction with other children, develops roles and rules for the self, develops an understanding of self and others, improves their communication ability and socialization skills through the process of finding pleasure, and develops self-control. It also helps to form a healthy personality through personal character-oriented behavioral experience by breaking away from a merit system that operates on fault orientation and focuses on the weakness, abnormal behavior and shortcomings of children (Cioni & Sgandura, 2013; Kim et al., 2017).

Spatial orientation is essential for maintaining proper posture for locomotion and for most motor activities. Three different systems, namely the vestibular, visual and somatosensory ones are distinguished, which together govern these complex behaviors (Barra et al., 2010; Joassin et al., 2010).

Kinesthesia is a "muscular feel", a way to accept your own movements and positions. In another perspective, it is described as "a sense mediated by nerve endings localized in the muscles, tendons, and joints being stimulated by body movement and tensions" (Paterson,

2012). Reaction time provides an indirect index of the processing capability of the central nervous system and a simple means of determining sensorimotor performance (Namita et al., 2010). Reaction time is the interval between the onset of a signal (stimulus) and the initiation of a movement response (Senel & Oroglu, 2006). Movement time is the interval between the initiation and completion of the movement. Response time is the cumulative effect of reaction time as well as movement time (Mannie, 2011).

Wilson et al. (2016) demanded a stronger consideration of psychomotor factors for talent research and acknowledged that players with good psychomotor factors (e.g., technical skills) are highly coveted players.

Psychomotor performance is an important determinant of performance in sports, specifically in those requiring fast decision-making and execution skills (Tulppo et al., 2014). Also, particularly in professional sports, high strain due to the extremely busy competition schedule may result in decreased cognitive performance as an early marker of overreaching (Nederhof et al., 2006; Hynynen et al., 2008). Overreaching is a condition when “immediately after the period of overload training, performance will usually be impaired” and recovery to the normal performance level lasts days to weeks (Nederhof et al., 2007). The suggested marker of overreaching is psychomotor slowness, measured with motor time and reaction time tests (Nederhof et al., 2006; Tulppo et al., 2014).

Motor qualities are considered important for the physical, mental and social evolution of children (Gallahue & Ozmun, 2002) and may even be the foundation of an active and healthy lifestyle as many studies have shown. For example, it has been revealed that a good index of the level of motor qualities has a positive impact on health, influencing effectively the improvement of the cardiorespiratory capacity, the maintenance of optimal body weight, the improvement of the level of practice and the daily activities, the development of the executive function of the body, etc. (Lubans et al., 2010; Fisher et al., 2005; Williams et al., 2008; Krombholz, 2013).

The *purpose* of the research is to provide reference values for the participating subjects, boys and girls, about their psychomotor development at the time the tests were conducted, using discriminatory criteria such as gender and level of sports activity.

A first reason for choosing this theme was the desire to understand to what extent psychomotor education is present in the instructive-educational process that takes place during physical education classes. The main objectives were to identify, using the Matorin Test and the Space Perception and Dynamic Balance Test, the psychomotor profile of the 6th graders, girls and boys, athlete or non-athlete children.

Methodology

Participants

In the study, we investigated 26 students in the 6th grade A. The subjects were divided into four subcategories according to two criteria of discrimination, namely gender and the practice of a particular sport in an organized environment.

Instruments

The tests applied were the following: Matorin Test and Spatial Perception and Dynamic Balance Test.

Matorin Test - the purpose of this test was to highlight the general coordination of the subjects. The test consists of a jump around one's own longitudinal axis. The subject aims to achieve the broadest rotation. The rotation was measured in degrees. The subject was asked to perform two jumps to the right and two to the left, eventually getting the best for each side. Also, a jump was not validated in case of losing one's balance or landing outside the landing area. The meaning of the first jump to the right or to the left was at the discretion of each subject. Four thin cardboard plates were used to perform this test, but they were bonded together. The size of a board was 100 cm x 70 cm. The surface was graded to measure as accurately as possible the amplitude of the jump. In order not to imprint a rotational movement after the jump, the cardboard surface was stabilized by means of a resistant adhesive tape.

Spatial Perception and Dynamic Balance Test - this test was applied to investigate proprioception and spatial orientation but also to determine coordination skills and dynamic balance. The equipment needed for the test was minimal, consisting of an adhesive tape roll and a measuring object, and a roulette. The subjects had the task of moving in a straight line over a distance of 12 meters, stopping at the moment they felt they had arrived at their destination. The starting and ending points were clearly and distinctly marked, being joined by a straight line of adhesive tape traced on the floor of the hall. The subjects had to travel without support from the visual analyzer; they wore ski glasses that had been modified by applying a black foil on the viewfinder to prevent light from penetrating through the glasses and thus altering the test results. Positioned at the starting point, the subjects were asked, before putting their glasses, to visualize the route, focusing on the final point. There was no start order, the subjects starting the test at a specific time they chose. For greater accuracy of the test, the subjects were not disturbed by other sounds or other factors. The test was carried out in a sports hall measuring 38 meters in length, 18 meters in width and 7.5 meters in height. When the subject stopped, he or she was asked to stay in place to make the measurements using the roulette. Two parameters, "+", "-" "12 meters", and right and left side deviations were recorded. All values obtained in this test were expressed in centimeters.

Figure 1. Representation of the Spatial Perception and Dynamic Balance Test path

Figure 2. Representation of the lateral deviation in the Spatial Perception and Dynamic Balance Test

Procedure

The study was conducted at the “Mihai Viteazu” Middle School located in Targu Mures. The subjects were examined in a series of tests to assess the psychomotor level of each one. Prior to the test, we had provided all the necessary safety conditions. Thus, the physical education and sports teacher of the classroom where we carried out the study provided the required documentation (medical certificate), stating that the subjects involved were physically fit. The tests ensured safe conditions to perform them. This investigation was done in accordance with the Declaration of Helsinki (Harris & Atkinson, 2013) and approved by the Ethics Committee of the “Lucian Blaga” University in Sibiu, before the commencement of the study. It also met the ethical standards for Sport and Exercise Science Research. Due to the fact that the General data protection regulation had entered into force on 25 May 2018 (Regulation (EU) 2016/679), imposing a single set of rules on the protection of personal data, the tutors of the investigated subjects were provided with an agreement for the recording and use of personal data. This agreement was signed in two copies by all tutors and allowed the recording and use of some motor parameters. Confidentiality was ensured by protecting the identity of all participants.

For the Matorin Test, the cardboard construction was placed at the center of half of the hall, away from any harsh or bumpy object (wall, gym, radiator) to avoid injuries in the event of a fall after the jump. For the Self-Impulse and Dynamic Balance Test, it was assured that the path traveled by the subject (blindfold) was free.

Results

All values recorded after the tests are shown in the table below.

Table 1. *Values for the two tests*

“Mihai Viteazu” Middle School					Tests					
Subjects					Matorin Test (UM = Degrees)		Spatial Perception and Dynamic Balance Test (UM = Cm)			
No.	Subject no.	Age	Gender	Sport	Right	Left	Dev. Left	Dev. Right	Deviation +	Deviation -
1	Subject 1	13	F	Basketball	355	330	64	0	70	0
2	Subject 2	13	M	Football	295	365	23	0	55	0

3	Subject 3	13	F		315	310	197	0	0	5
4	Subject 4	13	M		360	355	74	0	0	3
5	Subject 5	12	M	Football	270	315	0	0	0	2
6	Subject 6	14	M		310	405	38	0	200	0
7	Subject 7	12	F	Volleyball	365	390	0	306	108	0
8	Subject 8	13	F		240	205	0	290	100	0
9	Subject 9	13	M	Handball	370	350	0	0	0	50
10	Subject 10	13	M		345	320	304	0	0	100
11	Subject 11	13	F		325	320	50	0	0	45
12	Subject 12	13	M		340	400	0	40	50	0
13	Subject 13	13	F		315	320	108	0	80	0
14	Subject 14	13	F	Gymnastics	355	325	200	0	0	30
15	Subject 15	13	F	Volleyball	320	255	0	253	200	0
16	Subject 16	13	M		270	320	25	0	175	0
17	Subject 17	13	M		270	295	0	238	205	0
18	Subject 18	13	F		260	280	0	325	0	290
19	Subject 19	13	M		305	275	0	318	0	25
20	Subject 20	13	M	Football	340	320	0	110	0	3
21	Subject 21	13	F		240	290	0	188	0	40
22	Subject 22	13	F	Gymnastics	360	340	0	206	0	35
23	Subject 23	13	F		340	315	60	0	80	0
24	Subject 24	13	M	Swimming	380	345	0	25	60	0
25	Subject 25	12	F		365	370	0	55	47	0
26	Subject 26	13	F	Handball	300	310	0	105	38	0

The statistical analysis comprised descriptive statistics (average, median, standard deviation) and inferential statistics. For the comparison of medians, the non-parametric Mann-Whitney Test was applied. The chosen significance threshold for p was 0.05. The statistical analysis was performed using the GraphPad Prism software.

Table 2. *Statistical results of the Matorin Test for right and left jumps according to gender criteria*

Matorin right	Female gender	Male gender	Matorin left	Female gender	Male gender
Number of values	14	12	Number of values	14	12
Mean	318.2	321.3	Mean	311.4	338.8
Std. Deviation	44.14	39.95	Std. Deviation	45.63	39.15
P value	0.856		P-value	0.117	

The Mann-Whitney Test has revealed that there is no statistically significant difference between Matorin degrees left and right in female gender and male gender.

Figure 3. Matorin Test results for left jump (right side of the figure) and right jump (left side of the figure) - red color for female and blue color for male

Table 3. Statistical results of the Matorin Test for left and right jumps according to athlete/non-athlete criteria

Matorin left	Athlete	Non-athlete	Matorin right	Athlete	Non-athlete
Number of values	11	15	Number of values	11	15
Mean	331.4	318.7	Mean	337.3	306.7
Std. Deviation	34.50	50.58	Std. Deviation	35.80	41.56
P value	0.480		P value	0.061	

The Mann-Whitney Test has shown that there is no statistically significant difference between Matorin degrees left and right in athletes and non-athletes. The category of athletes included both female gender and male gender, but also non-athletes.

Figure 4. Matorin Test results for left jump (left side of the figure) and right jump - red color for athletes and blue color for non-athletes

Table 4. Statistical results of the Space Perception and Dynamic Balance Test, right and left side deviations according to gender criteria

Space Perception Test and Dynamic Deviation Right and Left	Female gender	Male gender
Number of values	14	12
Mean	171.9	99.58
Std. Deviation	98.46	118.2
P value	0.101	

The Mann-Whitney Test has emphasized that there is no statistically significant difference between right and left deviation mean values in the Space Perception and Dynamic Balance Test performed by the female and male genders.

Figure 5. Space Perception and Dynamic Balance Test results, right and left side deviations according to gender criteria (red color for female, blue color for male)

Table 5. *Statistical results of the Space Perception and Dynamic Balance Test, back and forth (+/-) deviations according to gender criteria*

Spatial Perception and Dynamic Balance Test, back and forth deviation	Female gender	Male gender
Number of values	14	12
Median	58.50	52.50
Mean	83.43	77.33
Std. Deviation	76.18	75.77
P value	0.738	

The Mann-Whitney test has indicated that there is no statistically significant difference between the values of back and forth deviations in the Spatial Perceptions and Dynamic Balance Test performed by the male and female genders.

Figure 6. Spatial Perception and Dynamic Balance Test results, back and forth (+/-) deviations according to gender criteria (red color for female, blue color for male)

Table 6. Statistical results of the Space Perception and Dynamic Balance Test, right and left side deviations according to athlete/non-athlete criteria

Space Perception and Dynamic Balance Test, deviation to the right	Athlete	Non-athlete	Space Perception and Dynamic Balance Test, deviation to the left	Athlete	Non-athlete
Number of values	11	15	Number of values	11	15
Median	105.0	108.0	Median	50.00	80.00
Mean	117.5	154.0	Mean	59.18	96.33
Std. Deviation	108.0	116.0	Std. Deviation	55.45	84.24
P value	0.391		P value	0.264	

The Mann-Whitney Test has highlighted that there is no statistically significant difference between the right and left mean deviation and back and forth mean deviation in the Space Perception and Dynamic Balance Test performed by athletes and non-athletes.

Figure 7. Statistical results of the Space Perception and Dynamic Balance Test, right side (left side of the figure) and left side deviations (red color for athletes, blue color for non-athletes)

Discussion

Mental/physical duality has been found in the scientists' works and reflections from antiquity and the Middle Ages to the present. There are studies that highlight the importance of psychomotor development for students, considering that it ensures optimal development of the components of fine motricity, such as writing (Costa et al., 2015; Gallahue & Ozmun, 2002; Krombholz, 2013). The process of writing requires complex skills and abilities that are difficult to learn and repeat in a correct form.

The results of the investigation highlighted that, in the Matorin Test to the right, the average was 318.2 degrees for female gender and 321.3 degrees for male gender. In the same test with jump to the left, the average was 311.3 degrees for female gender and 338.8 degrees for male gender. The Mann-Whitney Test has shown that there is no statistically significant difference between degrees left and right in female gender and male gender.

The Space Perception and Dynamic Balance Test revealed an average right and left deviation from the path of 171.9 cm in female gender compared to male gender, who recorded a better result, only 99.58 cm left or right deviation. The Mann-Whitney Test has indicated that there is no statistically significant difference between the right and left deviation mean values in the Space Perception and Dynamic Balance Test performed by the female and male genders.

In the same Dynamic Balance Test, the back and forth average deviation from the path was 83.43 cm for female gender compared to a better result of 77.33 cm for male gender. No statistically significant difference was found between the average value of the back and forth deviations from the Space Perception and Dynamic Balance Test performed by the female and male genders.

The last comparison analyzed sought to find out whether there was any statistically significant difference between athletes and non-athletes in the Space Perception and Dynamic Balance Test, left or right deviation. Regarding the deviation to the right, the average was 117.5 cm for the athlete category compared to the weaker result of non-athletes, 154 cm. Concerning the deviation to the left, the average was 59.18 cm for the athlete category and 96.33 cm for non-athletes. For both results (left or right deviation), no statistically significant difference was found between athletes and non-athletes in the Space Perception and Dynamic Balance Test.

The learning and execution of these skills require a high level of symbolic and abstract thinking, intellectual activity and a high level of psychomotor development (Stănescu, 2002). Studies have highlighted the need for proper psychomotor development to prevent diseases such as epilepsy, but also to combat neurological irregularities (Piazzini, 2006). Therefore, it can be discussed not a duality in the end, but a mind/brain/body triad. Studies suggest the idea that “the psyche is intimately linked to motricity; motor and psychic phenomena divide the same neural substrate, the brain being a binder between the psychic and the body (Uner, 2007). Psychophysiological research has also substantiated the relationship between psychomotor efficiency and physiological activity (Bezanova & Shtark, 2007).

The importance of building motor qualities is an increasingly common topic in research studies, demonstrating each time the positive effects that result from their education.

The motor ability of an individual adds up to a series of motor manifestations (skills), which, depending on their level of growth, influence the level of efficiency existing in performing a series of motor acts or actions.

In a recent study (Litwic-Kaminska, Miciej, & Sobieralska-Michalak, 2016) researchers have discovered significant statistical differences between athlete and non-athlete children for the indicators of attention and the parameters of psychomotor reactions. In the same research, significant correlations were obtained between visual-motor coordination testing device (individuals obtained higher perceptiveness results) and the ability to focus manifested through better reaction times and fewer mistakes.

The results of earlier research indicate that sports activity has a beneficial impact on visual-motor coordination and reaction times at all ages, including adolescence (Akarsu et al., 2009; Gallota et al., 2015; Syvaioja et al., 2014; Verburch et al., 2014).

Psychomotricity emphasizes child development. Viscione et al. (2017) believe that psychomotor education will always be an important component for achieving some progressive autonomy of the children related to the environment.

Psychomotricity has been explained and debated, from theoretical and practical points of view, as a technique that aims to form and consolidate the temper and personality, and ensure proper social integration (Shingjergji, 2014).

The educational potential of the motor activities is topical and is interesting to be studied in future educational activities. The physical exercise has passed from a performance means

to a superior, inclusive and integrative status. At the same time, it is an educational means, a knowledge means, a recovery means, a therapeutic means, a recreational and social integration means. These multiple valences can also be found in psychomotor aspects (Talaghir & Iconomescu, 2019).

Conclusion

The results of the investigation have shown that a profile of Matorin Test values for children aged 12.92 ± 0.39 years corresponding to the 6th graders has an average of 318.2 degrees in female gender and 321.3 degrees in male gender for the jump to the right, and 311.3 degrees in female gender and 338.8 degrees in male gender for the jump to the left. Other scientific research found similar results of 319.04 degrees in male gender and 318.20 degrees in female gender for the right side and 306.17 degrees in male gender and 304.07 degrees in female gender for the left side (Păcuraru, Preda, & Ciocoiu, 2010) or an average value of 315 degrees to the right and 305 degrees to the left (Gavojdea, 2015). In other studies regarding performance sports activities, for example in volleyball players aged between 9 and 12 years, the average result was 270.98 degrees to the left and right in the Matorin Test (Wesselly, Răchită, & Grigoriu-Norocel, 2015). Other research reached similar final results in a basketball sample, with 300.42 to the right and 277.7 to the left (Moldovan & Enoiu, 2011). In a study regarding football players with ages between 10 and 12 years, the final result was 311 degrees to the left and 311.5 degrees to the right in the Matorin Test (Monea et al., 2017).

In conclusion, the main objectives of our research were fulfilled by establishing the psychomotor profile of the 6th-grade students, girls and boys, through the Matorin Test and the Space Perception and Dynamic Balance Test.

A second conclusion is that, after interpreting the results obtained, we can state that the science of psychomotricity is a fundamental and indispensable component of the instructive-educational process. At the age of the middle-school, it must be implemented so as to ensure proper development, providing the younger student with the motor strength behind it. Based on the study, we can conclude that the level of psychomotor ability of the tested subjects is insufficient due to deviations from the Space Perception and Dynamic Balance Test.

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