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Original scientific paper

SOME INDICATORS OF MORPHOLOGICAL AND MOTOR DIMENSIONS OF BLIND AND VISUALLY IMPAIRED STUDENTS

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Abstract*:* Regular physical activity is an important factor in health prevention and is one of the postulates for a child's optimal growth and development. Physical activity is often the crucial tool when working with children with disabilities and those who are developmentally impaired. Despite all the known benefits of physical activities and programmed exercises for visually impaired children, these kind of activities are still undervalued and limited. Fear of injury is one of the key reasons for blind and visually impaired children's lack of movement and exercise. They are often scared of new activities and therefore do not accordingly develop and acquire motor behaviors and skills. The development of motor skills is realized through different sport activities and physical education program in schools. In order to detect and monitor changes in biological growth and development as well as motor skills development, it is crucial to identify the basic indicators of morphological and motor dimensions. Therefore, the aim of this paper is to determine the stage of biological growth and development in blind and visually impaired students and their motor skills development, based on their morphological and motor skills indicators, and in relation to their visual impairment level.

Key words: *morphological characteristics, motor skills, blind and visually impaired students*

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INTRODUCTION

One of the basic aims of physical education is to demonstrate responsible personal and social behavior in physical activity settings. Morphological and motor characteristics represent the objective indicators of students' physical growth and development and overall health. On the other hand, physical education teachers are committed, while evaluating students' progress, to assess the morphological and motor characteristics of each student and the differences between genders (Primary Education Book of Regulations, Official Gazette, Republic of Serbia, nos. 72/09, 52/11 and 53/13). Morphological indicators are directly linked to changes in student body constitution and composition and nutrition control (Bjelanović et al., 2017). Apart from monitoring quantitative growth and development indicators, another basic aim of physical education is student motor skills improvement. Adequate motor skills are essential for a successful acquiring of complex motor tasks, competences, and healthy habit development (Milovanović, Radisavljević & Pašić, 2010; Kerić & Ujsasi, 2014).

The vast majority of papers that study and monitor student physical growth and development mention many complex endogenous and exogenous factors. The endogenous factors are biological inheritance, hormonal state, and gender, while exogenous factors are diet, social and economic status, chronic diseases, and physical activity (exercise, sport) (Šegregur, Kuhar & Paradžik, 2010). However, when talking about blind and visually impaired students, we can notice that studies that deal with the topic, however scarce and deficient, tend to include both endogenous and exogenous factors, especially physical activity. It has to be noted that vision impairment and its many levels certainly influence motor abilities and skills, however much this statement may stir controversy (Juodžbaliene & Muckus, 2006; Houwen et al., 2009). One of the possible categorizations of visually impaired students is the medical-based Paralympic classification, B1, B2 and B3.

Regular physical activity improves muscle tone, flexibility, joint structure and function, including overall body functionality. The adequate level of muscle strength and stamina has a positive impact on healthy bone structure, fall injury prevention and improving everyday activities (Murphy & Carbone, 2008). On the other hand, an inadequate level of muscle strength can cause many health issues, including poor circulation, low cardiovascular endurance, low bone mass, and development of low self-esteem.

Body functionality and its work capacity influence the everyday activities of all children with disabilities, including those blind and visually impaired. Despite all benefits, children with disabilities are more restricted in their participation, have lower level of fitness and have higher levels of obesity than their peers without disabilities (Houwen et al., 2010). The omnipresent fear of injury is one of the key reasons for blind and visually impaired children's lack of movement and exercise. Often they are scared of new activities and unfamiliar space and therefore do not accordingly develop and acquire motor behavior and skills (Kabel, 1972). Sometimes the potential risks overpower all positive aspects of physical exercise for blind and visually impaired children. Often they are overprotected by their parents, they tend to shelter their children more than necessary, and therefore acquire lower results in jumping and throwing exercises (Buell, 1950a; Buell, 1950b). Sermejev states that a lack of fitness exercise has the direct impact not only on lower nerve and muscle functionality, but also on the visual perception function (acc: Grbović, 2005). Semenov (acc: Grbović, 2005), explains this theory and says that the activation of cardiovascular and respiratory systems significantly improves blood circulation, visual organs interchange as well as trophic processes, ciliary muscle work ability, and the strength of eye sclera.

Experience in working with blind and visually impaired students suggests that they often avoid participation in fitness activity programs. Generally, the only physical program the children of this population are regularly included in are physical education class in the educational institution, in accordance with the plan and program for blind and visually impaired children. The plan and program is in correspondence with inclusive education principles recommendations. Still, visually impaired students, due to their objective restrictions, face numerous obstacles in observing and executing physical exercises (Eškirović et al., 2001). It is important that the educator develops a high level of engagement and specific knowledge, especially when it comes to understanding the space perception of the blind and visually impaired student. She/he has to achieve the aim of improving growth and development, and acquiring and perfecting their motor abilities, which will result in the improvement of their work capacities and overall health. Therefore, the aim of this work is to determine the stage of biological growth and development of blind and visually impaired students and their motor skills development, based on their morphological and motor skills indicators, and in relation to their visual impairment level.

METHOD

Sample

The study sample of 31 blind and visually impaired included young adolescent elementary students attending the Veljko Ramadanović School for the visually impaired. The sample was stratified into 2 subsamples, in accordance with the level of impairment (B1 and B2). B1 represents the group of blind students, while B2 is the group of children with low vision (Ćosić et al., 2014). 18 students were male (M), while 13 were female (F), their average age 12.97 (±2.03).

Variables

Body height (BH) and body mass (BM) were 2 variables applied for morphological range assessment. The result was the individual body mass index (BMI). Motor function was tested by 2 variables: **strength** - standing long jump (SLJ) and bent arm hang (BAH), and **endurance** – curl up exercises (CU) and static balance (SB).

Data Processing Method

The measuring results were analyzed by descriptive and comparative statistics procedures. Each applied variable was measured by their basic and central dispersive parameters: arithmetic mean, standard deviation, minimal and maximal results, all for each subsample (gender). The differences of morphological and motor space variables were analyzed by T-test for small independent samples, in relation to gender and the degree of visual impairment students. In the domain of comparative statistics, the Spearman correlation coefficient was applied, in order to establish a correlation between certain morphological and motor space variables, both in relation to gender and the degree of visual impairment.

RESULTS

The obtained results were systematized in relation to indicators of morphological and motor space. All the results are interpreted textually and tabularly. The interpreted results of descriptive analysis show, in every allocated space, a hypothetical predictor of gender and degree of visual impairment.

Results pertaining to the morphological characteristics of the respondents included height as an exemplary of longitudinal dimensionality of the skeleton and body mass as an examplary of the voluminosity on the basis of which the calculation of body mass index, as an indicator of nourishment status, was conducted (tables 1 and 2). Descriptive indicators of motor space variables are also given in Tables 1 and 2, for the assessment of strength, endurance and balance.

Table 1. *Descriptive indicators of morphological and motor parameters according to gender for the B1 degree of visual impairment*.

Degree of visual impairment (DVI)		Variables	N	Min.	Max.	AS	St.Dev.
B1	Gender F	BH	8	1.42	1.65	1.56	0.081
		BM	8	37.65	65.00	49.11	8.886
		BMI	8	17.04	25.71	**19.96**	2.79
		SLJ	8	12.00	100.00	50.97	33.520
		CU	8	7.00	19.00	13.87	4.734
		BAH	8	0.00	49.16	11.57	17.033
		SB	8	0.00	0.00	0.00	0.000
	Gender M	BH	8	1.40	1.88	1.61	0.150
		BM	8	29.85	68.10	49.53	13.019
		BMI	8	12.89	23.24	**18.69**	3.226
		SLJ	8	26.00	158.00	84.65	51.868
		CU	8	0.00	29.00	14.00	9.196
		BAH	8	0.00	73.00	15.43	26.082
		SB	8	0.00	0.00	0.00	0.000

Table 2. *Descriptive indicators of morphological and motor parameters according to gender for the B2 degree of impairment*.

Degree of impairment		Variables	N	Min.	Max.	AS	St.Dev.
B2	Gender F	BH	5	1.47	1.66	1.59	0.075
		BM	5	36.00	63.20	51.65	9.976
		BMI	5	16.66	23.71	**20.04**	2.516
		SLJ	5	92.50	177.00	146.60	34.657
		CU	5	10.00	24.00	18.20	5.263
		BAH	5	1.12	59.04	25.87	26.787
		SB	5	0.00	19.00	8.00	9.670
	Gender M	BH	10	1.44	1.78	1.60	0.131
		BM	10	32.85	80.15	50.58	15.787
		BMI	10	14.81	25.25	**19.20**	3.535
		SLJ	10	40.00	201.70	149.87	51.523
		CU	10	14.00	31.00	22.30	4.715
		BAH	10	2.35	58.10	29.21	20.166
		SB	10	0.00	26.00	14.00	10.477

Based on the results of the calculated body mass index, in relation to the degree of visual impairment and gender, it can be discerned that the respondents have an optimal body mass and normal nourishment status because the values range from 5-85 percentile (B1/F=19.96; B1/M=18.69; B2/F=20.04; B2/M=19.20) (Barlow & Expert Committee, 2007).

Table 3 presents the results of discriminant analyzes of morphological and motor space parameters reckoned for the subsamples according to gedner and degree of visual impairment.

Table 3. *The descriptive parameters of the morphological and motor space variables, calculated for the subsample according to gender and the degree of vision impairment with the results of the discriminant analysis*.

Variables	Degree of impairment	Pupils (F)			Pupils (M)		
		Mean	Std. Dev.	Mean	Std. Dev.	Std. Dev.	Std. Error Mean
ATV	B1	1,56	,08	,02	1,61	,15	,05
	B2	1,59	,07	,03	1,60	,13	,04
	T-test	***t** = -,827*	*Sig. = ,813*	***t** = ,139*	*Sig. = ,776*		
ATM	B1	49,11	8,88	3,14	49,53	13,01	4,60
	1B2	51,65	9,97	4,46	50,58	15,78	4,99
	T-test	***t** = -,479*	*Sig. = ,979*	***t** = -,151*	*Sig. =,422*		
ITM	B1	19,96	2,79	,98	18,69	3,22	1,14
	B2	20,04	2,51	1,12	19,20	3,53	1,11
	T-test	***t** = ,048*	*Sig. = ,715*	***t** = -,318*	*Sig. =,658*		
MSD	B1	50,97	33,52	11,85	84,65	51,86	18,33
	B2	146,60	34,65	15,49	149,87	51,52	16,29
	T-test	***t** = -4,901*	*Sig. = ,718*	***t** = -2,661*	*Sig. = ,649*		
MPT	B1	13,87	4,73	1,67	14,00	9,19	3,25
	B2	18,20	5,26	2,35	22,30	4,71	1,49
	T-test	***t** = -1,498*	*Sig. = ,923*	***t** = -2,487*	*Sig. = ,106*		
MIV	B1	11,57	17,03	6,02	15,43	26,08	9,22
	B2	25,87	26,78	11,97	29,20	20,16	6,37
	T-test	***t** = -1,066*	*Sig. = ,095*	***t** = -1,266*	*Sig. = ,701*		
	B1	,00	,00	,00	,00	,000	,000

MBT	B2	8,00	9,67	4,32	14,00	10,47	3,31
	T-test	***t** = -2,407***	*Sig. =* ***,000***		***t** = -3,756***	*Sig. =* ***,001***	

**- significance level 0.01

Based on the results of the discriminant analysis (Table 3) for the morphological space of the variables tested, it can be discerned that there is no statistically significant difference in relation to gender or degree of impairment. However, in the motor space, based on the analyzed results of the subsamples and according to the degree of impairment, there is a statistically significant difference in the variable for assessing balance in respondents of both genders, in favor of the B2 degree of visual impairment subsample.

Tables 4 and 5 show the results of the correlation of the morphological and motor space indicators tested in relation to the degree of impairment and gender.

Table 4. *The correlation between morphological and motor parameters in female pupils of different degrees of vision impairment*.

Degree of impairment	Morphological indicator		Motor indicator			
			SLJ	CU	BAH	SB
B1 (N=8)	**BH**		-0.048	-0.431	0.024	a
		Sig.	0.911	0.286	0.955	.
	BM		-0.762*	-0.240	-0.571	a
		Sig.	**0.028**	0.568	0.139	.
	BMI		-0.738*	-0.383	-0.810*	a
		Sig.	**0.037**	0.349	**0.015**	.
B2 (N=5)	**BH**		0.600	0.600	0.800	0.359
		Sig.	0.285	0.285	0.104	0.553
	BM		0.000	0.200	0.400	-0.359
		Sig.	1.000	0.747	0.505	0.553
	BMI		-0.100	-0.100	0.300	-0.718
		Sig.	0.873	0.873	0.624	0.172

*- correlation significance level 0.05
a- inability of calculation due to a constant in one of the variables

Based on the analyzed results of the B1 degree of visual impairment in the female pupils subsample, the correlation between the indicators of morphological characteristics and motor abilities can be discerned at the level of statistical significance of 0.05. The correlation coefficient has a negative sign, thus reducing the body mass and body mass index would impact the increase in standing long jump results (BH/SLJ r = -0.762, sig. = 0.018; BMI/SLJ r = -0.738, sig. = 0.037), and bent arm hang (BMI/BAH r = -0.810 sig. = 0.015). For the subsample of B2 visual impairment in female pupils, based on the analysis, no statistically significant correlation between morphological characteristics and motor abilities was discerned.

Table 5. *The correlation between morphological and motor parameters in male pupils of different degrees of vision impairment.*

Degree of impairment	Morphological indicators		Motor indicators			
			SLJ	CU	BAH	SB
B1 (N=8)	BH		0.429	0.643	0.317	a
		Sig.	0.289	0.086	0.444	.
	BM		0.310	0.333	0.195	a
		Sig.	0.456	0.420	0.643	.
	BMI		-0.095	0.071	-0.024	a
		Sig.	0.823	0.867	0.954	.
B2 (N=10)	BH		-0.671*	-0.148	-0.802**	-0.523
		Sig.	**0.034**	0.683	0.**005**	0.121
	BM		-0.809**	0.068	-0.782**	-0.337
		Sig.	**0.005**	0.853	0.**008**	0.340
	BMI		-0.632*	0.394	0.624	-0.215
		Sig.	**0.050**	0.260	0.054	0.551

**- correlation significance level 0.01
* - correlation significance level 0.05
a- inability of calculation due to a constant in one of the variables

In the B1 degree of visual impairment in the male pupils subsample, a statistically significant correlation between variables of morphological and motor space is not identified. While in the B2 degree of visual impairment in the male pupils subsample, a statistically significant correlation between all the morphological space variables tested and variables for estimating power (SLJ, BAH) can be discerned at the significance level 0.01 and 0.05. At the significance level of 0.01, the correlation coefficient indicates that an increase in body height and body weight can significantly decrease the results for the endurance in bent arm hang variable (BH/BAH r = 0.802 sig. = 0.005; BM/BAH r = 0.782, sig. = 0.008). It was also discerned that the increase in body weight may significantly decrease the results for the standing long jump variable (BM/SLJ r = -0.809, sig. =0.005). Somewhat smaller impact, in terms of increasing body height and body mass index, can be brought in connection with the realization of weaker results for the standing long jump variable (BH/SLJ r = -0.671, sig. = 0.034; BMI/SLJ r = -0.632, sig. = 0.050).

DISCUSSION

One of the main objectives of physical education is support and development of the physical components of the body, the monitoring of morphological characteristics and motor characteristics of pupils are just some of the objective indicators of the overall growth and development of the body but also the health status of pupils. This research identified certain morphological characteristics of blind and visually impaired students which may be associated with their nourishment status. Also, the morphological characteristics observed are correlated with certain motor skills, strength, endurance and balance, all in relation to the degree of visual impairment and sex. The obtained results were compared with similar scientific papers (a small number of mostly foreign authors) that are aimed at assessing morphological characteristics and motor abilities of blind and visually impaired children, as well as papers in which the typical population of older elementary school age (from 11 to 15 years of age) was studied.

Lee et al. (1985) in their research indicate that blind children are lower and lighter (in terms of height and weight) than the typical population (without visual impairments). This conclusion is in accordance with the results obtained in this study. Comparing the results with the results published by the Regional Institute of Sport (Doder, 2010), male and female pupils with impaired vision are lighter and lower than their typical peer population. This may be due to the fact that blind and visually impaired children are often born prematurely. It has been found that the blind and visually impaired children have a lower body weight of lower extremities than the typical population (Wyatt, 1997); while the group of authors (Blessing et al., 1993; Hopkins, et al., 1987; Jankowski & Evans, 1981) indicates that the population of the visually impaired expresses a high body mass index. However, excessive body weight (body mass index) in the population of blind and visually impaired children, most frequently associated with a reduced level of physical activity, is not the case in respondents in this study.

Regarding the results of this study and other studies that are associated with the motor abilities of blind and visually impaired children, compared to children of the same age of the typical population, the results are in favor of the typical population (Alibegović & Jablan, 2009). In some studies that assessed the power (explosive strength of the lower extremities) certain results can be identified in favor of the blind and visually impaired children in relation to the typical population, but only at the level of numerical values in individuals (Garunović, 2015). In this study, based on the numerical values of descriptive analysis, a better result for the evaluation of power in relation to the degree of visual impairment was recorded in visually impaired pupils. In support of this are the results of previous studies which confirm that the visually impaired have better abilities than the blind, as well as better coordination (Grbović, 2005), which is essential in the standing long jump performance. If the results obtained in this study are compared with the recommendations for a typical population of children 11 to 15 years of age (Ahmetović et al., 2015) we discern that the respondents in this study have achieved results that are considerably below average. The same can be concluded when it comes to the variables on the basis of which strength of the upper extremities (BAH) and durability (CU) was estimated. Grbović (2007) states that the overall performance of visually impaired students compared to typical children population are significantly reduced, regardless of age and sex.

On the basis of these research results, in relation to balance testing (SB), it can be discerned that there are no statistically significant differences between the sexes, but there is a statistically significant difference corresponding with the degree of visual impairment. Compared to blind students (B1), students who are visually impaired (B2) have achieved a significantly better result. On the other hand, the results of the balance test in pupils who have no visual impairment show that the typical population achieves better results than the population of blind and visually impaired children. Blind and visually impaired demonstrate exceptional difficulties in maintaining the equilibrium position (Bouchard & Tetreault, 2000). The blind develop balance with the help of motor, tactile and vestibular analyzers. Further, the maturation of the central nervous system, enhances the integration of received information from different sensory modalities, however, visually impaired children have difficulties in responding to this information (Grbović, 2006). Results of the correlation tested in this study indicate the relation of body height, body mass and strength. As the respondents of this study are in the sensitive period (the second rapid period of growth and development), a negative sign of the correlation of body height, body mass and strength of the lower extremities, may be interpreted through biological growth and development, where the muscular system does not follow the growth and development of the skeletal system. The identified correlation between body height, body mass and strength of the upper extremities (static strength), can be clarified by confronting fatigue on the basis of personal characteristics, i.e., delaying of the interruption of the test with the desire to achieve better results.

CONCLUSION

On the basis of the analyzed data of this study, it can be concluded that there were no statistically significant differences in relation to the degree of visual impairment among the respondents in the evaluated morphological space variables. However, compared to the typical population, the respondents of this study have lower values for body height and body weight. The increased body mass index values that usually occur in the population of the blind and visually impaired children, and which are often associated with a reduced level of physical activity have not been identified in respondents of this study. For the assessed motor space variables, a significant difference was identified for the evaluation of the balance, which is in favor of visually impaired pupils, as well as for the correlation between body height, weight and power (explosive strength of the lower extremities/relative strength and endurance of the upper extremities).

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