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Journal of Anthropology of Sport and Physical Education

ORIGINAL SCIENTIFIC PAPER

Differences in Postural Status of the Spine of Swimmers of the Juvenile and Adolescent Age

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Abstract

The aim of this study was to determine the condition and the difference in postural status of spine in a frontal and sagittal plane in swimmers of juvenile and adolescent age. The sample of respondents, in total, comprised of 53 swimmers of both sexes having at least three-year-long swimming experience, i.e. divided by age: 28 respondents, swimmers of juvenile age, and 25 respondents of adolescent age. `Spinal mouse` was used to assess a postural status of a spine. Based on the obtained results, it may be concluded that there is no statistically significant difference in the number of swimmers of different age groups with postural spinal disorder in the frontal (sig=1.000) and sagittal plane in the thoracic (sig=0.108) and lumbar part (sig=0.237). Statistically significant differences, within each age group of swimmers, have been noticed between the number of children with and without postural disorder: juvenile age frontal plane (sig=0.000), sagittal plane of the thoracic part (sig=0.705), lumbar part (sig=0.001), while with the same statistical analysis, in respondents of adolescent age, was determined: in frontal plane (sig=0.001) and in sagittal plane of the thoracic part (sig=0.028), lumbar part (sig=0.162). Based on the results, it may be concluded that the level of postural disorders of the spine in swimmers of juvenile and adolescent age is high, but that the level of the prevalence of postural disorders is statistically insignificant among the respondents of juvenile and adolescent age.

Keywords: *Scoliosis, Kyphosis, Lordosis, Flat back, Kypholordosis*

Introduction

The modern conditions of living that surround us today represent a highly technologically advanced period due to which there is the development of numerous benefits that affect the facilitation of everyday activities from the earliest age. The benefits, caused by the intense technological development, represent a possibility of a faster and simpler solution to everyday activities at home, school, and work. However, as a side effect of a modern technological development, hectic lifestyle, the phenomenon of hypokinesia, i.e. reduced movement, is increasingly present (Bubanj, Živković, Živković, Milenković, Bubanj, et, al., 2012). Hypokinesia represents a phenomenon that is increasingly present in children of the earliest age, which represents many risk factors. Risk factors of insufficient movement, i.e. physical activity, are reflected primarily in the appearance of the increasingly frequent impaired postural status of children of juvenile and adolescent age. The impaired postural status of children of this age is most noticeable through the appearance of postural disorders on the spinal column as a result of muscle imbalance (Đokić, Međedović, & Smiljanić, 2011).

Postural disorders of the spine can be located in a frontal and sagittal plane. In a frontal plane, scoliosis poor postures of the body can be diagnosed most often due to muscular imbalance of the left and right side of the trunk muscles of the thoracic and lumbar parts, but this imbalance can also occur in a sagittal plane of the spine and then we talk about kyfotically bad posture of the body, i.e. an increased angle of convexity of kyfotic curve and lordotically poor posture of the body, which represents an increase in the concavity of the lordotic curve in a lumbar part of the spine of the sagittal plane (Jorgic, Milenković, Ždrale, Milenković, & Stanković, et al., 2015). Also, due to the appearance of reduced movement, there may be insufficiently formed spinal physiological curves in the sagittal plane, i.e. the appearance of

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flat back in both thoracic and lumbar part (Milenković, 2007, 160). In accordance with the knowledge of insufficient movement of the children of the earliest ages and on the other hand of the high percentage of the postural disorders on the spine in both the sagittal and frontal plane, swimming as a basic sport based on its specificity of movement has the ability to provide the activation of the musculature of the whole body. By activating the musculature of the whole body, and before all muscles of the trunk, both antero-posterior and medially lateral, that represents a possibility to reduce the frequency of the spinal disorders on the spine in relation to the conducted researches whose subjects have not engaged in physical activity.

Accordingly, the aim of this research is to determine the condition and the difference of the postural status of the spine in the frontal and sagittal plane in swimmers of juvenile and adolescent age.

Methods

Sample of respondents

The sample consisted of 25 juvenile swimmers, i.e. aged 6 to 10 years having minimum of 3-year-long experience in swimming and of 25 adolescent swimmers, i.e. aged 11 to 14 years having also minimum of 3-year-long experience in swimming. The participants were the members of the swimming club `Nis 2005` and `Saint Nikola` from Nis.

Because the participants were under the age of 18, the consent for their participation in this study was signed by their coaches.

Sample of measuring instruments

"Spinal Mouse"(Idiag, Fehraltdorf, Switzerland, www.idiag.ch) was a measuring instrument for assessing the state of the postural status of the spine in the frontal and sagittal plane of juvenile and adolescent swimmers. This instrument belongs to a group of non-invasive methods of diagnosing the postural status of the spine. Validity and reliability of the instrument was determined by the research conducted by the authors (Mannion, Knecht, Balaban, Dvorak & Grob, 2004; Post & Leferink 2004). "Spinal Mouse" was used earlier with the respondents of the same age (Jorgic, Milenković, Ždrale, Milenković, Stanković et al., 2015; Jorgić, Milenković, Milenković, Stanković, & Bubanj, 2015; Božić, Đorđević, & Nurkić, 2019).

Description of variables

Variables for assessing the state of the postural status of the spine in the frontal plane are represented in Table no. 1. The method of determining of the state of postural status of spine in the frontal plane on the basis of the obtained angles expressed in degrees is taken from the literature (Devedžić, Ćuković, Luković, Luković, Milošević, et al., 2016; Milenković, Stanković, & Đorđević, 2018).

Table no.1. Presentation of variables for assessment of the state of postural status of the spine and their description.

No.	Variable name	Variable description	Abbreviation
1	Normal posture of the body in the frontal plane	Angle with convexities up to 5 degrees in the thoracic ilumbar part of the frontal plane of the spine.	NPBFP
2	Left thoracic scoliotic	Angle with convexity in the thoracic part on the left side greater than five degrees.	LTS
3	Right thoracic scoliotic	Angle with convexity in the thoracic part on the right side greater than five degrees.	RTS
4	Left lumbar scoliotic	Angle with convexity in the lumbar part on the left side greater than five degrees.	LLS
5	Right lumbar scoliotic	Angle with convexity in the lumbar part on the right side greater than five degrees.	RLS
6	Left thoracic and left lumbar scoliotic poor posture, total left scoliotic	Angle with convexity in the thoracic part on the left side greater than five degrees and lumbar left side also greater than five degrees.	LTLLS
7	Right thoracic and right lumbar scoliotic poor posture, total right scoliotic	Angle with convexity in the thoracic part on the right side greater than five degrees and on the lumbar right side also greater than five degrees.	RTRLS
8	Left thoracic and right lumbar scoliotic poor posture, duplex-right scoliotic	Angle with convexity in the thoracic part on the left side greater than five degrees and the lumbar right side also greater than five degrees.	LTRLS
9	Right thoracic and left lumbar scoliotic poor posture, duplex right-left scoliotic	Angle with convexity in the thoracic part on the right side greater than five degrees and the lumbar left side also greater than five degrees.	RTLLS
10	Normal body posture in the sagittal plane of the spine	Represents the angle of the kyphotic curve in the range from 30 º to 45 º in the thoracic part and from 20 º to 40 º in the lumbar part of the sagittal plane of the spine	NPSP
11	Kyphotic	It represents an angle in the thoracic part of the spine greater than 45 º	KIF
12	Flat back in the thoracic part of the sagittal plane of the spine	Represents an angle in the thoracic part of the spine less than 30 º	FBTSP
13	Lordotic	It represents an angle in the lumbar part of the spine greater than 40 º	LOR
14	Flat back in the lumbar part of the sagittal plane of the spine	It represents an angle in the lumbar part of the spine less than 20 º	FBLSP
15	Kifolordotic poor posture	Represents an angle in the thoracic region greater than 45 º and in the lumbar spine greater than 40 º	KIFLOR
16	Flat back in the thoracic and lumbar part of the sagittal plane of the spine	Represents the angle of the kyphotic curve less than 30 º in the thoracic part and less than 20 º in the lumbar part of the sagittal plane of the spine	FBTLSP

Variables for assessing the state of the postural status of the spine in the sagittal plane are represented in Table no. 1. The method of determining of the state of postural status of spine in the sagittal plane on the basis of the obtained angles expressed in degrees is taken from the literature (Mannion, Knecht, Balaban, Dvorak & Grob, 2004; Post & Leferink 2004; (Milenković, Stanković, & Đorđević, 2018).

Measurement organization

The measurements planned for this research were carried out at the SC `Cair` swimming pool in Nis from 6 till 8 pm. The respondents were minimally dressed; more precisely, they only had on themselves their bathing suits. The diagnosis of the postural status was carried out by graduate professors of sport and physical education with prior education of Professor Sasa Milenkovic.

The measurements included in this research conducted in accordance with the ethical principles of human research according to the Helsinki Declaration of 2008 (World Medical Association, 2011).

Statistical data processing

The data obtained were processed in the programme for statistical data processing SPSS `version 20` after the measurement.

The state of postural status in the frontal and sagittal plane in juvenile and adolescent swimmers is presented through the parametres of the descriptive statistics: frequency and percentages.

To determine differences in the prevalence of deformities and normal body posture within each individual group of respondents, the Hi quality test was used to determine the quality of matching, while for determining the differences in the prevalence of deformities between juvenile and adolescent swimmers, Hi square test was used to test independence.

Results

Based on the table no.2, that is, the presentation of basic parametres of the descriptive statistics on the numerical and percentage prevalence of deformities in the frontal plane of the spine in juvenile and adolescent swimmers, indicate that normal body posture in the frontal plane is present in 8 respondents (15,1%), while right thoracic scoliosis poor body posture diagnosed in 4 respondents (7,5%), left lumbar scoliosis poor body posture diagnosed in 2 respondents (3,8%), total right scoliosis poor body posture diagnosed in 33 respondents (62,3%) and duplex right-left scoliosis poor body posture diagnosed in 6 respondents (11,3%).

Based on the presentation of the results in the Table no.2, on the numerical and percentage prevalence of deformities in the sagittal plane of the spine in juvenile and adolescent swimmers indicate that the normal body posture in the sagittal plane is present in 22 respondents (41,5%), kyfotic poor body posture diagnosed in 4 respondents (7,5), while flat back in a thoracic part of the sagittal plane present in 13 respondents (24,5%), lordosis poor body posture diagnosed in 8 respondents (15,1). Only 1 respondent (1,9%) was diagnosed with the postural disorder of flat back in lumbar part of the sagittal plane. Diagnosed postural disorder in the sagittal plane in thoracic and lumbar part in terms of increased convexity or concavity of physiological curves was diagnosed in 4 respondents (7,5%) and in only 1 respondent the lack of physiological curves in thoracic and lumbar part of the sagittal plane of the spine was diagnosed.

Based on the presentation of the results in the Table no. 2, on the numerical and percentage prevalence of deformities in the frontal plane of the spine in juvenile swimmers indicate that the normal body posture in the frontal plane is present in 4 respondents (14,3%), kyfotic poor body posture diagnosed in 4 respondents (7,5), left lumbar scoliosis bad posture diagnosed in 2 respondents (7,1%), total right scoliosis poor posture diagnosed

Table no. 2. Postural status of the spine in juvenile and adolescent swimmers

Postural status of the spinal column in the frontal and sagittal plane of juvenile and adolescent swimmers									
Fontal plane									
	Juvenile and adolescent swimmers			Juvenile swimmers			Adolescent swimmers		
	F	P	CP	F	P	CP	F	P	CP
NPBFP	8	15.1	15.1	4	14.3	14.3	4	16.0	16.0
RTS	4	7.5	22.6				4	16.0	32.0
LLS	2	3.8	26.4	2	7.1	21.4			
RTRLS	33	62.3	88.7	18	64.3	85.7	15	60.0	92.0
RTLLS	6	11.3	100.0	4	14.3	100.0	2	8.0	100.0
In total	53	100.0		28	100.0		25	100.0	
Sagittal plane									
NPSP	22	41.5	41.5	10	35.7	35.7	12	48.0	48.0
KIF	4	7.5	49.1	1	3.6	39.3	3	12.0	60.0
FBTSP	13	24.5	73.6	12	42.9	82.1	1	4.0	64.0
LOR	8	15.1	88.7	2	7.1	89.3	6	24.0	88.0
FBLSP	1	1.9	90.6	1	3.6	92.9			
KIFLOR	4	7.5	98.1	2	7.1	100.0	2	8.0	96.0
FBTLSP	1	1.9	100.0				1	4.0	100.0
In total	53	100.0		28	100.0		25	100.0	

F-Frequency; P-Percentage; CP-Cumulative percentage; NPBFP - Normal posture of the body in the frontal plane; RTS - Right thoracic scoliotic; LLS - Left lumbar scoliotic; RTRLS - Right thoracic and right lumbar scoliotic, total right scoliotic; RTLLS - Right thoracic and left lumbar scoliotic, duplex right-left scoliotic; NPSP - Normal body posture in the sagittal plane of the spine; KIF - Kyphotic; FBTSP - Flat back in the thoracic part of the sagittal plane of the spine; LOR - Lordotic; FBLSP - Flat back in the lumbar part of the sagittal plane of the spine; KIFLOR - Kifolordotic; FBTLSP - Flat back in the thoracic and lumbar part of the sagittal plane of the spine.

in 18 respondents (64,3%) and duplex right-left scoliosis poor posture diagnosed in 4 respondents (14,3%).

Based on the presentation of the results in the Table no. 2, on the numerical and percentage prevalence of deformities in the sagittal plane of the spine in juvenile swimmers indicate that the normal body posture in the sagittal plane diagnosed in 10 respondents (35,7%), kyfotic poor body posture was diagnosed in 1 respondent (3,6%), while flat back in a thoracic part of the sagittal plane present in 12 respondents (42,9%), lordosis poor body posture diagnosed in 2 respondents (7,1%). Only 1 respondent (1,9%) was diagnosed with the postural disorder of flat back in lumbar part of the sagittal plane. Diagnosed postural disorder in the sagittal plane in thoracic and lumbar part in terms of increased convexity or concavity of physiological curves was diagnosed in 2 respondents (7,1%).

Based on the presentation of the results in the Table no. 2, on the numerical and percentage prevalence of deformities in the frontal plane of the spine in adolescent swimmers indicate that the normal body posture in the frontal plane is present in 4 respondents (16 %), right thoracic scoliosis poor posture diagnosed in 4 respondents (16 %), total right scoliosis poor posture diagnosed in 15 respondents (60%) and duplex right-left scoliosis poor posture diagnosed in 2 respondents (8 %).

Based on the presentation of the results in the Table no. 2, on the numerical and percentage prevalence of deformities in the sagittal plane of the spine in adolescent swimmers indicate that the normal body posture in the sagittal plane was diagnosed in 12 respondents (48%), kyfotic poor body posture diagnosed in 3 respondents (12%), while flat back in a thoracic part of the sagittal plane present in 1 respondent (4%), lordosis poor body posture diagnosed in 6 respondents (24,4%). Only 1 respondent (1,9%) was diagnosed with the lack of physiological curves in thoracic and lumbar part of the sagittal plane of the spine. Diagnosed postural disorder in the sagittal plane in thoracic and lumbar part in terms of increased convexity or concavity of physiological curves was diagnosed in 2 respondents (8%).

Table no. 3. Difference in state of the postural status of the spine in juvenile swimmers

Difference in state of the postural status of the spine in juvenile swimmers			
Difference in the state of postural status of the spinal column in the frontal plane in juvenile swimmers			
	Frequency	Hi square test	
NPBFP	4	Chi-Square	14.286a
DFP	24	df	1
In total	28	Asymp. Sig.	.000
NPBFP - Normal body posture in the frontal plane of the spine; DFP - Deviation from normal posture in the frontal plane of the spine.		a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 14.0.	
Difference in the state of postural status of the spine in the sagittal plane in juvenile swimmers			
Difference in the state of postural status of the spine in the thoracis part of the sagittal plane in juvenile swimmers		**Test Statistics**	
	Frequency	Hi square test	
NPTPSP	13	Chi-Square	.143a
DPTPSP	15	df	1
In total	28	Asymp. Sig.	.705
NPTPSP - Normal body posture in the thoracic part of the sagittal plane of the spine; DPTPSP - Deviation from normal posture in the thoracic part of the sagittal plane of the spine		a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 14.0.	
Difference in the state of postural status of the spine in the lumbal part of the sagittal plane in juvenile swimmers		**Test Statistics**	
	Frequency	Hi square test	
NPLPSP	23	Chi-Square	11.571a
DPLPSP	5	df	1
In total	28	Asymp. Sig.	.001
NPLPSP - Normal body posture in the lumbal part of the sagittal plane of the spine; DPLPSP - Deviation from normal posture in the lumbal part of the sagittal plane of the spine.		a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 14.0.	

Results presented in the table no.3 indicate that there is a statistically significant difference (sig=0.000) in number of juvenile swimmers with and without postural disorders of the spine in the frontal plane.

Results presented in the table no.3 indicate that there is no statistically significant difference (sig=0.705) in number of juvenile swimmers with and without postural disorders of the spine in thoracic part of the sagittal plane. In lumbar part of the sagittal plane of the spine in juvenile swimmers, statistically significant difference between the number of respondents with normal posture and with diagnosed disorder was noticed.

Results presented in the table no.4 indicate that there is a statistically significant difference (sig=0.001) in number of adolescent swimmers with and without postural disorders of the spine in the frontal plane. Results presented in the table no.4 indicate that there is statistically significant difference (sig=0.028) in number of adolescent swimmers with and without postural disorders of the spine in thoracic part of the sagittal plane. In lumbar part of the sagittal plane of the spine in adolescent swimmers, statistically significant difference (sig=0.162) between the number of respondents with

Table no 4. Difference in state of the postural status of the spine in adolescent swimmers

Difference in state of the postural status of the spine in adolescent swimmers			
Difference in the state of postural status of the spinal column in the frontal plane in adolescent swimmers			
	Frequency	Hi square test	
NPBFP	4	Chi-Square	11.560a
DFP	21	df	1
In total	25	Asymp. Sig.	.001
NPBFP - Normal body posture in the frontal plane of the spine; DFP - Deviation from normal posture in the frontal plane of the spine.		a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 12.5.	
Difference in the state of postural status of the spine in the sagittal plane in adolescent swimmers			
Difference in the state of postural status of the spine in the thoracis part of the sagittal plane in adolescent swimmers		**Test Statistics**	
	Frequency	Hi square test	
NPTPSP	18	Chi-Square	4.840a
DPTPSP	7	df	1
In total	25	Asymp. Sig.	.028
NPTPSP - Normal body posture in the thoracic part of the sagittal plane of the spine; DPTPSP - Deviation from normal posture in the thoracic part of the sagittal plane of the spine		a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 14.0.	
Difference in the state of postural status of the spine in the lumbal part of the sagittal plane in adolescent swimmers		**Test Statistics**	
	Frequency	Hi square test	
NPLPSP	16	Chi-Square	1.960a
DPLPSP	9	df	1
In total	25	Asymp. Sig.	.162
NPLPSP - Normal body posture in the lumbal part of the sagittal plane of the spine; DPLPSP - Deviation from normal posture in the lumbal part of the sagittal plane of the spine.		a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 14.0.	

normal posture and with diagnosed disorder was not noticed.

Based on the results obtained from Table no. 5, it may be observed that the proportion of the respondents, juvenile swimmers who do not have postural disorder in the frontal plane, does not differ statistically significantly (sig=1.000) from the proportion of the respondents, adolescent swimmers.

Results presented in the table no.5 indicate that there is no statistically significant difference (sig=0.108) between respondents - adolescent and juvenile swimmers in the proportion of the postural disorders in the thoracic part of the sagittal plane of the spine. Also, it can be observed that the proportion of the respondents, juvenile swimmers who do not have postural disorders in the frontal plane, does not differ statistically significantly (sig=1,000) from the proportion of the respondents, adolescent swimmers.

Based on the results presented in the table no 5, it can be observed that the proportion of the respondents, juvenile swimmers without postural disorders in the lumbar part of the sagittal plane of the spine, does not differ statistically significantly (sig=0,237) from the proportion of the respondents, adolescent swimmers.

Table no. 5. Difference in state of the postural status of the spine in the frontal and sagittal plane in juvenile and adolescent swimmers

Difference in state of the postural status of the spine in the frontal and sagittal plane in juvenile and adolescent swimmers								
Difference in state of the postural status of the spine in the frontal plane in juvenile and adolescent swimmers								
	Value	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Value	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.030a	.862						
Continuity Correctionb	.000	1.000						
Likelihood Ratio	.030	.862						
Fisher's Exact Test			1.000	.581				
Linear-by-Linear Association	.030	.863						
N of Valid Cases	53							
a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 3.77.								
b. Computed only for a 2x2 table								

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Table no. 5. Difference in state of the postural status of the spine in the frontal and sagittal plane in juvenile and adolescent swimmers

Difference in state of the postural status of the spine in the sagittal plane in juvenile and adolescent swimmers								
	Thoracic part				Lumbal part			
	Value	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Value	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.557a	.059			2.237a	.135		
Continuity Correctionb	2.582	.108			1.401	.237		
Likelihood Ratio	3.617	.057			2.252	.133		
Fisher's Exact Test			.094	.053			.212	.118
Linear-by-Linear Association	3.490	.062			2.194	.139		
N of Valid Cases	53				53			
	a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.38.				a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.60.			
	b. Computed only for a 2x2 table				b. Computed only for a 2x2 table			

Discussion

Obtained results in the conducted research indicate generally a high level of prevalence of postural disorders of the spine in the frontal and sagittal plane in juvenile and adolescent swimmers. The results obtained show that even 85.7% of the juvenile respondents have some of the deformities in the frontal plane, while in adolescent swimmers 84%. In the sagittal plane, the prevalence of the postural disorders is 64,3% and in adolescent swimmers 52%. In accordance with the obtained results of this research and with the recent researches in respondents of this age and who are not trained swimmers, the results significantly differ in favour of the respondents exposed to the testing of this research (Jorgić, Milenkovič, Ždrele, Milenković, Stanković, & Bubanj, 2015; Jorgić, Milenković, Milenković, Stanković, & Bubanj, 2015; Radaković, Madić, Radaković, Protić-Gava, Radanović, & Marković, 2016; Vukićević, Čokorilo, Lukić, Miličković, & Bjelica, 2018; Vukićević, Pajić, Čokorilo, Lukić, Miličković, & Bjelica, 2018). Recent researches, where the diagnostics of the postural status of the spine in swimmers of this age was done, significantly greater presence of the postural disorders of the spine was observed (Milenković, Živković, Bubanj, Bogdanović, Živković, & Stošić, 2012).

By statistical analysis, the Hi square test, which is used to examine the quality of matching within groups, i.e. to determine the existence of statistically significant differences between the respondents with normal postural status and those where a deviation from the normal postural status of the spine in the frontal and sagittal plane was diagnosed in both juvenile and adolescent respondents. This analysis determined the existence of statistically significant differences in the frontal plane in juvenile (sig=0,000) but also in adolescent (sig=0,001) respondents in the level of the prevalence of the postural disorders and normal body posture. The same results can be noticed in earlier researches with the same age groups (Jorgić, Milenkovič, Ždrele, Milenković, Stanković, & Bubanj, 2015; Vukićević, Čokorilo, Lukić, Miličković, & Bjelica, 2018). Also, it was observed that in the sagittal plane in respondents of the juvenile age in the thoracic part there are no statistically significant differences in the level of the prevalence of the respondents, swimmers with diagnosed normal posture and those who have deviation (sig=0.705), In lumbar part of the sagittal plane of this group of respondents, a statistically significant difference in favour of the respondents who have normal posture was observed (sig=0.001). In adolescent respondents, statistical analysis revealed the existence of statistically significant differences in the thoracic part of the sagittal plane in favour of the respondents with normal postural status (sig=0.028) while in lumbar part such statistical difference was not observed (sig=0.162). Such results are not consistent with the previous researches (Jorgić, et al., 2015; Jorgić, et al., 2015; Radaković, et al., 2016; Vukićević, et al., 2018; Vukićević, et al., 2018) whose results are with a worsened postural status but whose respondents are children of juvenile and adolescent age who do not train.

The results obtained by determining the differences in the level of the prevalence of postural disorders of the spine in the frontal and sagittal plane between juvenile and adolescent respondents indicated that there are no statistically significant differences in frontal plane (sig=1.000), in thoracic (sig=0.108) and lumbar part (sig=0.237) of the sagittal plane. The results of the earlier researches (Milenković, et al., 2012; Jorgić, et al., 2015; Vukićević, et al., 2018) are not consistent with the obtained results of this research. Also, an earlier research (Đokić, Međedović, & Smiljanić, 2011) found the existence of an increase in the number of postural disorders in the spine in adolescent children compared to juvenile children. According to the results of this research, it can be indicated that swimming as a form of physical activity is one of the active forms of prevention of postural disorders in children of the most susceptible age for the occurrence of muscle imbalance located on the spine and the occurrence of the postural disorders. The absence of statistical differences between juvenile and adolescent respondents in the level of the prevalence of postural disorders represent an important indicator for health institutions and also for teachers of physical education in elementary schools as well as trainers and parents of children who have been diagnosed with postural changes on the spine.

Conclusion

In accordance with the obtained results on the state of postural status on the spine in the frontal and sagittal plane in juvenile and adolescent swimmers, it can be concluded that the level of postural disorders on the spine in juvenile and adolescent swimmers is high. Also, the level of difference in prevalence of postural disorders is statistically insignificant in juvenile and adolescent respondents, indicating a very significant factor that due to intensive growth and development in adolescent period, swimming as a sport had an impact on establishment of normal muscle balance and not an increase in the number of swimmers with postural disorders on the spine.

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Conflict of Interest
The author declares that there is no conflict of interest.

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Journal of Anthropology of Sport and Physical Education

ORIGINAL SCIENTIFIC PAPER

Differences in Balance with Eyes Closed, Eyes Opened and Virtual Reality Environment: A pilot-study

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Abstract

Many studies have examined differences between maintaining balance with open and closed eyes. In this research Virtual Reality (VR) technology is included as a special type of visual input for creating static and dynamic virtual environments. PURPOSE: The purpose of this paper was to determine whether there is a difference between results in balance tests on Biodex Balance System (BBS) with different visual input. METHODS: Participants (n=12) in the study were young, healthy and active males with an average age of 21.25±1.14 years, body mass 82.57±8.37 kg and average body height 185.42±5.18 cm. Six balance tests were applied on BBS, four in the real world and two in the virtual environment. Duration and instability level of the BBS platform were the same for all tests. RESULTS: None of the participants finished the test in a dynamic virtual environment so that test was excluded from further statistical analysis. Factor analysis revealed two main factors (latent dimensions). The first factor is characterized by open eyes tests while extremely high projection on the second factor can only be seen in a case of a test done with the eyes closed.

Keywords: *Visual input, Biodex Balance System, Virtual reality, Balance testing, Virtual environment*

Introduction

Studies suggest that the Biodex Balance System is a reliable tool for determining dynamic postural balance ability (Kararti et al., 2021; Karimi, Ebrahimi, Kahrizi & Torkaman, 2008; Sherafat et al., 2013). Postural control is defined as the act of maintaining, achieving, or restoring a state of balance during any posture or activity (Pollock, Durward, Rowe, & Paul, 2000). Studies which tested balance were done on various testing instruments such as force plates (Kuczynski, Rektor & Borzucka, 2009; Ricotti, & Ravaschio, 2011), Kistler force platforms (Zając, Kuczyński, & Bieć, 2017), Balance Master force platform (Srivastava, Taly, Gupta, Kumar, & Murali, 2009), Wii Balance Board (Bower, McGinley, Miller, & Clark, 2014), AccuGait AMTI platform (Wilczyński, 2018). In this study the BBS was used for measuring balance because of its dynamic nature (a movable platform) and high reliability of balance testing (Cachupe, Shifflett, Kahanov, & Wughalter, 2009) as well as to add dynamic component to standing platform that we thought was lacking in a previous, similar study (Fransson, Patel, Jensen, Lundberg, Tjernström, Magnusson, & Hansson, 2019). Studies suggest that visual input is of significance when assessing balance and when assessing balance capabilities with eyes closed and eyes open (Perrin, Jeandel, Perrin, & Béné, 1997; Hammami, Behm, Chtara, Ben Othman, & Chaouachi, 2014). One study analyzed the effects of low-dose alcohol consumption on postural control with the results providing insight into the complexity of regulation balance, which not only depends on the proprioceptive and vestibular system but also strongly on the visual system and its input (Palm, Waitz, Strobel, Metrikat Hay, & Friemert, 2010). It could be said with high certainty that balance is strongly dependent on visual input. The aim of this paper is to investigate differences in the results of the same balance test using different visual inputs. Additionally, the aim is to explore, in depth, the differences in balance between eyes open, eyes closed and to see if virtual reality (VR) technology is representative enough to replace visual input from the real world.

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Methods

The study took place in Autumn of 2019 at the Faculty of Kinesiology, University of Split. Twelve (n=12) young, healthy and active males participated in this study. All participants live in Split, Croatia and were students in the University of Split from various faculties. Anthropological measurements of the participants were taken upon entering the training facilities, before conducting the balance tests. The participants had an average of 21.25±1.14 years, body mass of 82.57±8.37 kg and average body height of 185.42±5.18 cm. The Biodex Balance System (BBS) was used as the apparatus for testing the balance capabilities of the participants. The testing was done over 4 days because of the lengthy testing procedure which is normal for that kind of testing on the BBS. To match the conditions of testing from day to day, the testing was done in the afternoon so that sunlight can be utilized instead of artificial lightning which put a reflection on the screen of the BBS, causing visual distractions for the participants and therefore a potential study limitation. Before the testing started for the day, the BBS was calibrated each day of testing to minimize mistakes caused from other people handling the BBS between active periods of testing. Six tests were applied on the participants using the BBS and each test was 90 seconds long. The duration of all the tests were tailored to the sixth test because the dynamic environment in this test, which will be explained later, had a duration of 90 seconds and could not be changed. The level of instability of the BBS platform was uniform across all 6 tests and was set to 6. The range of instability on the BBS can be set from 1 to 12. Before the actual tests, the participants stepped on the BBS platform and their center of body mass (COM) was adjusted so that the cursor was in the middle of the screen. In the adjusting phase, the screen was blocked from the vision of the participants to avoid the participant trying to lean to adjust his COM. Instead, stepping and physically moving his location was favored so that the participant was upright, without lean. The positioning of the participants' feet was recorded so there is no difference in stances. The participants were allowed to rest between tests for up to a maximum of 3 minutes. The tests varied only in visual input whilst every other parameter stayed the same. Before embarking on the actual testing, the participants had a moment to familiarize themselves with standing on the platform. When ready, the participants were asked to maintain their balance for 90 seconds for each test, respectively. In the first test, the screen of the BBS was covered so the cursor which visually displays the COM of the participants was not visible to them. In the second test, the participants were able to see the screen and their COM. In the third test, a pre-recorded video on a tablet was put instead of the screen. The video was recorded prior to testing the subjects and it shows a different (false) position of COM rather than the real participants. In the fourth test, the participants had their eyes closed. In the fifth test, VR technology was applied. The participants had a VR headset strapped to their head and it showed the participants a static room which was a part of the software and interface of the technology. In the sixth test, VR technology is also applied. This time the environment was dynamic, and the participants were shown a roller coaster simulation (Desert Ride Coaster developed by iNFINITE Production released December 7th, 2016) which lasted 90 seconds. This type of test design was intended to serve as a method of assessing if the participants could successfully ignore the visual input in such an environment and to maintain balance relying only on the proprioceptive and vestibular system. The sixth test was intentionally put as the last because of the expected high difficulty. The fifth test was the methodological step back to the sixth test, to familiarize the participants with the VR technology environment, the actual weight that is placed on the participants' heads and to see their behavior in the static VR environment with their eyes open. The fourth, closed eyes test, was put last in the VR-free tests because of the expected high difficulty and to act as a kind of safety net in regard to figuring out if the participants closed their eyes in the fifth and sixth test because the version of the used VR technology did not have an eye tracking mechanism. If some participants did try to close their eyes in the VR tests, results could simply be compared to the fourth test which had their eyes closed. The third test tried to challenge the balance with a different visual stimulus. The second test simply showed the visual feedback of their COM (the classic BBS test). HTC VIVE VR technology was used for this study. The participants were instructed to avoid movement of the feet on the platform even if they lose their balance and are falling or have reached the maximum range of motion of the platform. If they did indeed completely lose their balance they were instructed to freely fall and let the people around them catch them. There were always 2 people around the participants to ensure their safety. During the VR tests, one person held the wire from the headset to minimize the weight of the cable pulling up the head of the participants.

Results

The sixth test was not included in the statistical analysis because none of the participants were able to finish the full duration of the test. Descriptive statistics (Table 1) were used to describe the sample of participants, which included age, body height, body mass and the tests, except for the sixth test as mentioned previously. Valid variables for every mentioned parameter were 12 (valid N = 12) except for the fourth test, which had 9 valid variables because 3 of the participants were not able to complete the full 90 seconds of the test. The average age of the participants was 21.25±1.14 years with a body mass of 82.57±8.37 kg and average body height of 185.42±5.18 cm. The average result of the first test was 2.80±1.02, the second 1.31±0.24, the third 2.03±0.62, the fourth 8.59±2.43 and the fifth 5.00±1.23. The normal distribution for all variables included in the analysis was confirmed by the Kolmogorov-Smirnov normality test (p>0.20).

Table 1. Descriptive statistics

V	N	Mean+SD	MIN	MAX	KS	p
Age	12	21.25±1.14	19.00	23.00	0.25	>.20
BH	12	185.42±5.18	177.50	196.00	0.12	>.20
BW	12	82.57±8.37	63.50	95.30	0.19	>.20
TEST 1	12	2.80±1.02	1.80	5.00	0.22	>.20
TEST 2	12	1.31±0.24	0.90	1.90	0.19	>.20
TEST 3	12	2.03±0.62	1.20	2.90	0.16	>.20
TEST 4	9	8.59±2.43	4.20	12.50	0.15	>.20
TEST 5	12	5.00±1.23	3.30	7.40	0.13	>.20

Legend: V – variable; N – number of valid participants; Mean – arithmetic mean; SD – standard deviation; MIN – minimum; MAX – maximum; KS – KolmogorovSmirnov test; p – p-value

The factor analysis (Table 2) revealed two main factors or latent dimensions. The first factor showed statistically significant correlation with the second and third test, while the second factor showed statistically significant correlation with the fourth test.

The correlation matrix (Table 3) showed statistically significant correlation between the second and third test.

Table 2. Factor analysis of the tests

V	F1	F2
TEST 1	0,461093	0,383795
TEST 2	0,979131*	-0,078051
TEST 3	0,802614*	0,274197
TEST 4	0,016148	-0,974128*
TEST 5	-0,487253	-0,570637
Expl. Var	2,053169	1,503126
Prp. Totl	0,410634	0,300625

Legend: V – variable; F1 – First factor extracted from statistical analysis; F2 – Second factor extracted from statistical analysis; * - p > 0.05 indicates statistical significance and correlation of the test to the extracted factor

Table 3. Correlation matrix of the tests

V	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5
TEST 1	1,000000	0,457498	0,240379	-0,177342	-0,152217
TEST 2	0,457498	1,000000	0,698472*	0,194150	-0,436598
TEST 3	0,240379	0,698472*	1,000000	-0,174272	-0,442531
TEST 4	-0,177342	0,194150	-0,174272	1,000000	0,348817
TEST 5	-0,152217	-0,436598	-0,442531	0,348817	1,000000

Legend: V – variable; * - p > 0.05 indicates statistically significant correlation

Discussion

By observing participants' results we can assume that the sixth test was hardest to complete as none of the participants were able to finish it (the best result was 35 seconds out of a maximum of 90). In the dynamic virtual reality, the roller coaster ride went suddenly downhill in the simulation and with a sudden increase in acceleration. This alone proved that the participants were very reliant on visual input while balancing on the BBS. When viewing the results of the Overall Stability Index (OSI) in the descriptive statistics (Table 1), it is important to understand that the lower result in the OSI parameter is considered better overall balance performance. The standard deviation of the OSI parameter indicates that the more the COM of the participants is "dancing" around the screen, the higher the deviation and movement of the platform. This number could indicate the rate of engagement of the muscles used, but further studies and incorporation of perhaps electromyography could be needed to prove this thesis. Factor analysis (Table 2) extracted two factors (latent dimensions). In the first factor, test 2 and 3 contributed the most. In the second factor, test 4 contributed the most. Although this pilot study was of an explorative nature, it was expected that at least two factors were to be extracted, which proved to be true. It could be said with assurance that the factors extracted were balance with eyes open (first factor) and balance with eyes closed (second factor). This study, along with previous ones, proved that the BBS is a good apparatus for identifying balance as a latent dimension (Cachupe et al., 2001; Kararti et al., 2021), as well as differentiating between balance with eyes open and eyes closed as two separate dimensions (Maciaszek, Osinski, Szeklicki, Salomon, & Stemplewski, 2006; Sherafat et al., 2013). It was also expected that a third factor would be extracted because of the incorporation of VR technology and when viewing the correlation matrix (Table 3) it is visible that the first and fifth test are not significantly correlated, and it is logical why a third factor was not extracted. These results suggest that a static VR environment differently influences the balance of the participants but not enough to be extracted as an independent factor. The correlation matrix also indicates that participants who have a good result in the first three tests could have worse results in the fifth test which indicates that participants who are "good" in balancing with visual input are worse in the eyes closed test, which could be explained in their dependency on visual input for maintaining balance. This was observed to be true in all groups of athletes when assessing balance with eyes closed versus eyes open (Hammami et al., 2014). There was also some clear confusion for the participants in test 5 which could of interfered with the true correlation between these two tests (the weight of the headset, the headset cable pulling up on the head, birds flying in the VR environment, people blocking the sensors from the headset which caused the static environment to turn black, looseness of the headset around the eyes which caused latency of movement, the latency of the visual input of VR in regard to real life movement, the fear of falling). Fatigue from previous test (especially the fourth test, which clearly was challenging for the participants), the familiarization of testing in the first test could also have been limiting factors in assessing the true correlation between the open eyes tests with the VR tests. Other study limitations were a small sample size and inappropriate height of the screen in relation to the eye level of the participants (screen was lower than the participants eye level). In this study, balance with eyes open and eyes closed could be differentiated as separate abilities on the settings used on the BBS. The sixth test proved that the participants strongly relied on visual input for maintaining balance on the BBS which could imply that the HTC Vive and the accompanying software for creating the virtual environment are a good representation of reality.

Conclusion

The findings of this study suggest that maintaining balance on BBS with open eyes is a different ability than maintaining balance on BBS with eyes closed. Participants cannot maintain balance on BBS if they are immersed in a dynamic virtual environment because they obviously rely on visual input.

Conflict of Interest
Authors declare no conflicts of interest.

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ORIGINAL SCIENTIFIC PAPER

Implementation of Physical Education component within the basic science and technology curriculum and the time allocation in comparison to other basic science and technology subjects

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Abstract

The objective is to assess the implementation of physical education (PE) component within the basic science technology subjects (BST) curriculum and the time allocation in comparison to other BST subjects. Descriptive survey research was adapted. The population was 109,778, comprising 109,383 students, 78 PE teachers and 317 head teachers of public Junior Secondary School (JSS), representing eighteen (18) Local Government Areas (LGAs) in Edo State. The sample size was 1,060 comprising 70 PE teachers, 90 Head teachers and 900 students; and they were selected using multi-stage sampling procedure. Two instruments were used to obtain data: "Implementation of PE component of BST curriculum questionnaire (IPECBSTCQ) and Time Allocation and General time table information for PE and BST subjects schedule (TAGTIPEBSTS). The cronbach alpha statistics was used to determine the reliability of the instrument, the r-value of 0.95 was obtained for the IPECBSTCQ. Main findings suggest an endorsement of policy statements related to PE within the BST by the PE and Head teachers. Also, PE is not accorded necessary attention compared to other subjects within the BST curriculum. It was concluded that PE and other Head teachers were conversant with National Policy on Education (NPE) stipulations as relates to PE within the BST curriculum; just as it was necessary for more time to be allotted to PE on the general time table in comparison to other BST subjects. It was chiefly recommended that supervisory officials of the Ministry of Education should ensure strict adherence to policy implementation related to PE within the BST.

Keywords: *Physical Education, Basic Science and Technology, Implementation, Curriculum, Time allocation*

Introduction

In consonance with the emphasis on physical education as advocated by international organizations, the National Policy on Education (2013) recommended the teaching of physical education at all levels of education. In actualizing this, the Nigeria government among others, stated that various measures shall be taken to implement the policy where physical and health education are emphasized at all levels of the educational system. This, however, is presently not the case as physical education and hence physical exercises have reduced drastically within the school system (Abubakar, Rabiu, Usman, & Yahaya, 2015). If physical and health education is emphasized at all levels of the education system as stated in the National Policy on Education, it would have impacted positively on the attitudes of the young ones to physical activity and on their health since most children spend the majority of their day in schools or in other educational settings (Lator, 2021).

Prior to this study, physical education has been a subject in the school curriculum as a wholesome entity. The new school physical education (PE) curriculum has become laminated within other subjects under the new name 'basic science and technology

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(BST)'. This has the potential of likely diminishing its visibility and could affect its implementation. Report by Hardman and Marshall (2019) on Second World-wide Survey of School Physical Education, conducted by the International Council of Sport Science and Physical Education, revealed several areas of continuing concern, such as: gaps between policy and practice; physical education curriculum quality and relevance; insufficient curriculum time allocation; perceived inferior subject status; lack of competent qualified and inadequately trained teachers; deficiencies in facilities, equipment and teaching materials and inadequate provision or awareness of pathway links to wider community programs and amenities outside of schools. In the update on the state and status of physical education world-wide, physical education is neither compulsory nor offered by girls in 50% of countries of which 40% are in Africa and 17% in the Middle East (Hardman & Marshall, 2019).

The World Health Organization Stepwise Approach to Chronic Disease Risk Factor Surveillance revealed that insufficient physical activity is a public health problem in some countries and population subgroups in Africa (Bovet, Damasceno, Sambo, Tesfaye & Armstrong, 2011). This situation was linked to the low level of physical activity (Bovet et al, 2011) which in turn is a reflection of the low status of Physical Education in Africa. In many schools in Nigeria, PE seems relegated or marginalised because it is not a compulsorily examinable subject at the senior secondary school certificate level and also because it lacks standards and a strong policy implementation from the Ministry of Education. It has been found that PE periods in most schools are not taken serious and in fact there is inadequate time allotment to physical education and sports in the school time table, and this influences the effective utilization of physical education teaching resources, if at all available (Ugwuanyi, 2013). In a study on the declining profile of Physical Education programme in educational institutions in Nigeria, Akindutire and Olanipekun (2014) revealed that Physical Education in educational institutions in Nigeria like other subjects in the school curriculum is faced with many problems which affect students' participation in the programme. Several studies carried out to establish the factors affecting the implementation of junior secondary school (JSS) PE curriculum in Nigeria have shown that resource materials and facilities, teachers incompetence, the school environment, learners attitude, culture and ideology, instructional supervision and assessment as well as stakeholders and interest groups, are militating factors (Ibenegbu, 2018).

Implementation of the PE component of the Basic Science and Technology Curriculum can be examined in the light of: policy issues; PE objectives; PE status; availability and adequacy of facilities, equipment and infrastructural requirements; professional qualifications; availability and use of instructional materials; in-service training; instructional abilities employed by Physical Education teachers; and students' attitude toward PE; among others. Piasta, Justice, McGinty, Mashburn, and Slocum (2015) have identified four dimensions for assessing good curriculum implementation, called curriculum fidelity, and they are: adherence, exposure, quality of programme delivery, and participant responsiveness. The Caribbean Community Secretariat (CARICOM) (2011) pointed out that, once a curriculum has been adopted, policies must be put into place to guide the achievement of the objectives and goals. These include policies, time allotments and scheduling, play attire, learning facilities, health and safety.

Several studies have been carried out in Nigeria and other countries on the Implementation of Physical education curriculum. Emeh, Isangadighi, Asuquo, Agba, and Ogaboh (2011), examined the reactions from education stakeholders in South-South States of Nigeria on issues facing curriculum design and implementation especially at secondary school level. Information from participants revealed that the curriculum content, pedagogy, evaluation techniques among others in secondary schools is inadequate, unrealistic and should be reviewed.

The effective implementation of the PE and sports programmes (instructional, intramural and extramural) has become necessary in order to reap bountifully from this subject in the area of PE curriculum implementation and improved sports performance and development in Nigeria.

Statement of the Problem

It seems the teaching and learning of Physical Education has rapidly declined in secondary schools, due to its marginalisation when compared with other popular school subjects as is reflected on schools time table. This agrees with why Ojeme (1990) lamented that the falling standard of PE seems to justify the need for soul searching on the importance of PE in the school curriculum.

The situation of PE as a subject in Nigeria was very worrisome when it was standing on its own as a subject. Today, the situation has become more complex and baffling with the combination/integration of the subject with three others, such as Information Technology, Basic Science, and Basic Technology now titled Basic Science and Technology (BST). The subject has become less desirable now that it has been hidden and perhaps laminated/integrated within other subjects. Looking at this from another angle, there is no connection or similarities between or among these subjects which are combined with PE in terms of being related in meaning. Also in terms of results from the junior school certificate, students cannot really tell their score or performance in the subjects. These and others have presented serious curricula issues that need to be addressed.

The need therefore exist for an empirical investigation to assessing the extent of PE implementation within the integrated mode of the physical education curriculum in the basic science and technology curriculum.

Research Questions

1. Is the PE component of BST curriculum implemented in line with policy statements?

2. What time is allocated to PE on the general time table in comparison to other subjects within the BST?

Methodology

Research Design

The descriptive survey research design was adopted for this study. This design was adopted because it allows for a systematic gathering of information related to determining the objectives of physical education component of the Basic Science and Technology curriculum vis-à-vis teachers' competence in JSS

Population of the Study

The population of the study consist of 109,778 respondents, made up of 109,383 students and all 78 PE teachers as well as all 317 head teachers of public junior secondary schools, representing the eighteen (18) local government areas in Edo State. Table 1 is a representation of the population used in this study.

Sample and Sampling Techniques

The sample size of this study was 1,060 respondents comprising seventy (70) PE teachers, ninety (90) Head teachers, and nine hundred (900) students in public junior secondary schools in Edo State.

The multi-stage sampling procedure (Omorogiuwa, 2010) was adopted in the selection of the sample for the study. At the first stage, the researcher used the existing stratification of Edo State into eighteen (18) local government areas spread across the three senatorial districts, namely: Akoko-Edo, Egor, Esan Central, Esan

Table 1. Distribution of PE teachers, head teachers and students in Edo State, Nigeria

S/N	Local Government Area	No of Public Junior Sec Schools	PE Teachers	Head teachers	Students
1	Akoko-Edo	29	5	29	6312
2	Egor	13	5	13	9528
3	Esan Central	14	4	14	2782
4	Esan North East	12	0	12	3589
5	Esan South East	17	1	17	2002
6	Esan West	16	5	16	4135
7	Etsako Central	9	0	9	2049
8	Etsako East	16	0	16	4459
9	Etsako West	28	7	28	6888
10	Igueben	10	0	10	1149
11	Ikpoba-Okha	20	17	20	22498
12	Oredo	14	5	14	18157
13	Orhionmwon	28	5	28	3848
14	Ovia North East	29	8	29	6413
15	Ovia South West	15	5	15	2882
16	Owan East	16	4	16	4116
17	Owan West	10	2	10	3210
18	Uhunmwonde	21	5	21	5366
	TOTAL	**317**	**78**	**317**	**109383**

Source: Post Primary Education Board (2021)

North East, Esan South East, Esan West, Etsako Central, Etsako East, Etsako West, Igueben, Ikpoba-Okha, Oredo, Orhionmwon, Ovia North East, Ovia South West, Owan East, Owan West, and Uhunmwonde.

At the second stage, the simple random sampling technique of balloting with replacement was used to select ninety (90) public junior secondary schools in Edo state. This involved the use of pieces of paper, which were folded and put in bags from which the researcher picked schools based on their local government area; put it back in the bag, and then picked another. The procedure was used to select five (5) public JSS in each LGA, thus giving a total of ninety (90) out of 317. At the third stage, the simple random sam-

Table 2. Representation of Sampled population included in the study

S/N	LGA	No of Schools Considered from each LGA	No of PE teachers selected from each LGA	No of Head teachers selected from each LGA	Number of students selected from each LGA
1	Akoko-Edo	5	4	5	50
2	Egor	5	3	5	50
3	Esan Central	5	4	5	50
4	Esan North East	5	0	5	50
5	Esan South East	5	1	5	50
6	Esan West	5	4	5	50
7	Etsako Central	5	0	5	50
8	Etsako East	5	0	5	50
9	Etsako West	5	7	5	50
10	Igueben	5	0	5	50
11	Ikpoba-Okha	5	16	5	50
12	Oredo	5	4	5	50
13	Orhionmwon	5	5	5	50
14	Ovia North East	5	8	5	50
15	Ovia South West	5	4	5	50
16	Owan East	5	4	5	50
17	Owan West	5	2	5	50
18	Uhunmwonde	5	4	5	50
	TOTAL	**90**	**70**	**90**	**900**

pling technique was also used to select 70 teachers from the 78 PE teachers from all LGA in the State. The fourth stage involved using proportionate random sampling technique to select ten (10) students from each of the 90 selected public JSS to give a total of 900 students selected for the study (i.e. 50 students from each LGA). Additionally, the head teachers/principals of each of the sampled schools were used in the study, totalling 90 head teachers/principals. Table 2 is a representation of the sample used in the study.

Research Instruments

The instruments used were implemented for the first time in this study:

1. Implementation of PE component of BST curriculum questionnaire (IPECBSTCQ)

2. Time Allocation and General time table information for PE and BST subjects schedule (TAGTIPEBSTS)

The IPECBSTCQ is a questionnaire used by PE teachers in assessing the extent to which the PE component of BST curriculum was and is being implemented in JSS. Assessment options were based on the modified Likert scale of Strongly Agree (4), Agree (3), Disagree (2), and Strongly Disagree (1).

The TAGTIPEBSTS solicited time allocation and general time table information for PE and other BST subjects for JSS. This was carried out by the Head teacher/principal on the scale of time allocation per period (minutes), number of periods per week, total time allocation, and number of forms per class.

Validity of the Instrument

The instrument was validated by the two experts of Human Kinetics and one expert of Educational Measurement and Evaluation in the University of Benin. This was carried out to ascertain the construct and content validity of the instrument.

Reliability of the Instrument

To establish reliability of the instrument, the researchers carried out a pilot test using twenty students, ten teachers, and ten head teachers drawn from twenty public junior secondary schools in Edo State. These students, teachers, and head teachers were not involved in the main study. The instrument was given to the various respondents to fill, the data obtained were analysed using Cronbach's Alpha Statistics, which is a measure of the internal consistency of test items. A reliability coefficient of the instrument obtained was: PE component of BST curriculum implementation (0.95).

Method of Data Analysis

The data collected were analysed using the descriptive statistics of frequency count, percentage, mean and standard deviation to answer the research questions. The Statistical Packages for Social Sciences (SPSS) was employed in carrying out the analyses.

Results

Table 3 represents the mean+standard deviation of the participants' responses in IPECBSTCQ.

Table 3. Mean responses on PE component of BST curriculum in line with policy implementation

Policy statements	Mean	Std. Deviation	Decision
PE teachers teach the PE content component of Basic Science and Technology	3.34	.539	Agree
PE is considered compulsory instructional component of the Basic Science and Technology curriculum	3.09	.702	Agree
The daily PE content requirement is implemented as prescribed	3.00	.594	Agree
The teacher-student ratio is 1:35 for effective teaching and learning at the JSS level	2.71	.789	Agree
PE is taught at all class levels of the JSS as prescribed by the Basic Science and Technology curriculum	3.29	.860	Agree
PE instructions are undertaken for at least 45 minutes twice weekly as stipulated in the Basic Science and Technology curriculum	2.89	.963	Agree
The instructional PE content includes basic human and sports games, movement of body parts, athletics, contact and non-contact sports as stipulated in the Basic Science and Technology curriculum	2.86	.912	Agree
Teachers and students have access to playground and sporting facilities as required	2.71	1.045	Agree
The inspectorate division of Ministry of Education monitors adherence to policy guidelines of the implementation of PE instructional content	2.77	.731	Agree
PE is taught with up-to-date instructional materials	3.03	.785	Agree
PE instructional content is taught as in the Basic Science and Technology curriculum	2.86	.879	Agree
Time is adequately allotted for instructional process in PE as in the other subjects that make up Basic Science and Technology	2.77	.942	Agree
The number of specialist teachers teaching PE are adequate	2.71	.825	Agree
Periods allocated for teaching of PE are adequate	2.80	.964	Agree
PE lessons are usually cancelled in comparison to the other compositing subjects in Basic Science and Technology	2.57	.815	Agree
The PE content diversity meets the Basic Science and Technology specification	2.77	1.003	Agree
PE teachers are considered of the same status as teachers in the other Basic Science and Technology specification	2.49	1.197	Agree

(continued on next page)

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Policy statements	Mean	Std. Deviation	Decision
PE is considered as subject of "no academic status" in comparison to the other Basic Science and Technology subjects	2.40	1.265	Agree
Only qualified PE teachers teach the diverse areas of physical education content	2.80	1.023	Agree
PE is supported by the same level of budgetary allocation as other subjects that make up Basic Science and Technology	2.54	1.039	Agree
Most instructional objectives for each PE class lesson are adequately met	2.77	1.031	Agree
Head teachers, teachers of other subjects, parents and members of the wider community view PE at the same level of importance as other subjects that make up Basic Science and Technology	2.69	1.157	Agree
Opportunities to promote school and instructional sports development and competitions are provided for within the PE content	2.51	1.040	Agree
The time devoted to physical education in schools could be more profitably used in studying other relevant subjects	2.43	.948	Agree
A person will be off emotionally if he did not participate in physical education	2.54	.611	Agree
Physical education class provide nothing which will be of value outside the class	1.94	.906	Disagree
Participating in physical education programme opens up a wider variety of career opportunities	2.89	.758	Agree
Skills learnt in physical education class do not benefit the learner	2.09	1.095	Agree
Cluster	2.73	0.91	Agree

Table 1 in relation to research question 1 revealed a cluster mean of 2.73 which falls within 2.00 and 4.00, which shows a strong agreement by head teachers of secondary schools to most of the policy statements raised as it relates to Physical education, except that most head teachers of schools disagree with the statement that "Physical education class provide nothing which will be of value outside the class."

Figures 1, 2 and 3 represent the time allocation of PE subject on the general time-table in comparison to other subjects within the BST for JSS 1, 2 and 3 respectively.

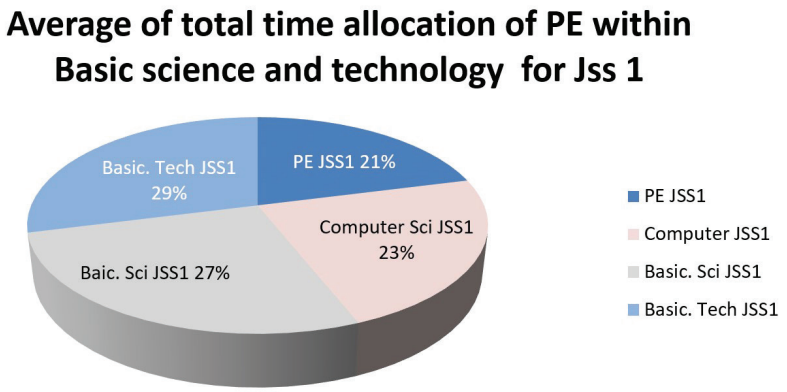

FIGURE 1: Pie Chart statistics on time allocation to PE on the general time table in comparison to other subjects within the BST for JSS 1

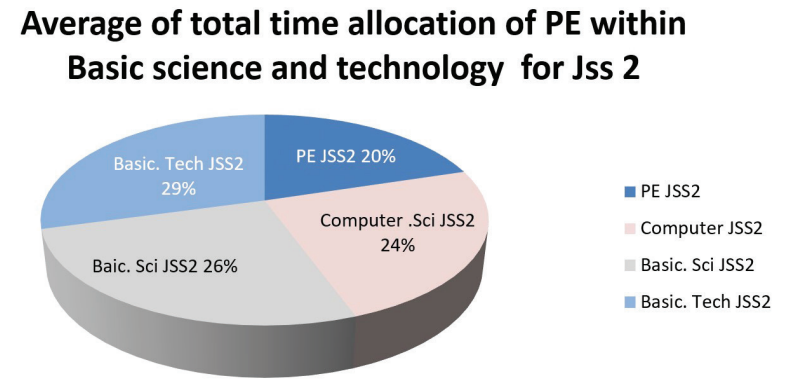

FIGURE 2: Pie Chart statistics on time allocation to PE on the general time table in comparison to other subjects within the BST for JSS 2

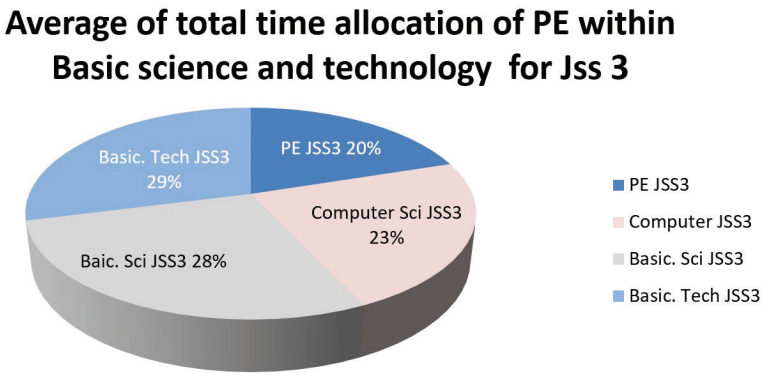

FIGURE 3: Pie Chart statistics on time allocation to PE on the general time table in comparison to other subjects within the BST for JSS 3

The data in Figure 1 showed the average of total time allocation of PE within BST for JSS 1. It is seen that of the four subjects comprising the BST curriculum, PE accounted for 21%, Basic Science was offered 27%, Computer Science was 23% and the time allocated Basic Technology was 29%. Thus, PE was allocated the least time amongst the four subjects making up the BST curriculum.

The data in Figure 2 showed the average of total time allocated to PE within the BST curriculum for JSS 2 was 21%, Basic Science was allotted 26%, Computer Science was allocated 24% and Basic Technology was 29%. Hence, the time allocated to PE on the general time table in relation to the BST curriculum was the shortest amongst the subjects constituting the curriculum.

The data in Figure 3 revealed that in the average of total time allocation for BST curriculum of JSS 3 showed PE being allocated 20%, Basic Science 28%, Computer Science was 23% and Basic Technology was 29%. Again, time allocated to the BST curriculum showed PE being allotted the least duration in relation to the other three subjects.

Discussion

Results from research question 1 show high endorsement of Policy statements related to physical education within Basic Science and Technology. This finding implies that most policy statements are meant to enhance the importance of physical education within Basic Science and Technology, as much still needs to be done to enhance the status of PE in schools. This agrees with the findings of Varja (2018), who revealed that there are certain areas in that need to be improved to better prepare students for teaching in teachers-colleges. Those areas as a matter of policy were related to the facilities and materials, the structure, the timing, the content of the program, quality of the knowledge from previous educational levels, the concern of the small amount of graduated PE and Sport professionals, and limited time and attention to the people with disabilities. This finding also agrees with that of Ongong'a, Okwara and Okello (2010), who assert that lack of policies for national PE; programme is elaborated but not totally carried out or need of some changes as it is not updated. This also agrees with the observations and findings by Marshall and Hardman (as cited in Kahiga, 2014), Wanyama and Quay (2014), Osborne, Belmont, Peixoto, Azevedo and Carvalho (2016) who all believe PE is a devalued subject and so needs policy implementations to increase its status.

Results from research question 2 show that PE is not given serious attention compared to other subjects that make up Basic Science and Technology curriculum, i.e. Basic science, Basic technology, and Computer and information technology. This agrees with the findings of Sacli, Demirhan, Yesim and Murat (2014), who showed that course time was a limitation facing PE among other factors. This also agrees with findings by Quick, Simon, and Thornton (2010), who revealed that only a small number of pupils across primary and secondary schools, around 6%, completed three hours of PE and sport within school time.

Conclusion

It was concluded that PE component of BST curriculum is valuable to learners' education in and out of the classroom; as it was also obvious that the PE and other head teachers were conversant with the stipulations of the NPE. Lastly, there was the need for more time to be allotted to PE on the general time table in comparison to other subjects within the BST.

Recommendations

1. Adequate course time should be allocated to PE on the general school time table.
2. There is the need for the State Ministry of Education officials to ensure strict adherence to the implementation of policy stipulations related to PE within the BST
3. Learners should be enlightened on the fact that the PE programme throws up a variety of occupational options so as to arouse their interest in pursuing a career at it.
4. Only specialist teachers should be hired to teach PE in schools
5. PE as a school subject should be made to stand alone and not integrated into other subjects (in this case the BST subjects) as there is no connection or similarities between or among these subjects which are combined with PE in terms of being related in meaning/conceptual structure.

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Conflict of Interest
The author declares that there is no conflict of interest.

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ORIGINAL SCIENTIFIC PAPER

Relationship between Fine Motor Skills and BMI of Preschool Children

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Abstract

The study aimed to determine the relationship between fine motor skills and BMI categories of preschool children 5-6 (6.14±.43) years of age (body height 118.86±5.96 cm, body mass 22.88±4.68 kg). 129 subjects, preschool children (59 boys and 70 girls) participated in this transversal study. Body mass index (BMI) was calculated based on measures of body height and body mass, and WHO cutoff points were used to create BMI categories while fine motor skills were determined using two Bruininks-Oseretsky (BOT-2) subtests for children's motor efficiency. Pearson's correlation coefficient was used to determine the relationship between the variables. The results showed a significant negative correlation between BMI and fine motor integration (r=-.235, p<.001), manual dexterity (r=-.290, p<.001), and the overall result of fine motor skills (r=-.342, p<.001). These results indicate that in addition to the significant connection between gross motor skills and basic motor skills, proven by numerous previous studies, higher BMI also has a negative effect on the fine motor skills of children, even in preschool age. Overweight children have lower scores on fine motor skills tests compared to normal weight children, which can have consequences for motor development in later life.

Keywords: *BOT-2, manual dexterity, fine motor integration, motor development, nutritional status*

Introduction

Fine motor skills represent the ability to use the smallest body muscles to perform precise movements. These skills are closely related to the eye-hand coordination, and they refer to hand dexterity skills, which include reaching, grabbing, manipulating objects, and using different tools. Fine motor integration and manual dexterity which together indicate the fine motor skills of children are most frequently investigated (Aleksić Veljković, Katanić & Mašanović, 2021). The fine motor skills of children are also associated with coordination skills. The coordination here, where the main parameters are the eye and the hand, refers to the ability of the fingers and the hand to properly perform the task ordered and controlled by the eye (Brown, 2012). Abilities and skills are dramatically developed at the preschool age, which is defined as the age of 3 to 6 in children (Copple & Bredekamp, 2009). During the preschool age, children develop many basic skills and functions (Zwicker & Harris, 2009). More and more researches in the last few years indicates that preschool children spend a lot of time playing and exploring their environment.

In addition to the development of motor skills, special attention should be paid to the development of the fine motor skills in children, because they are crucial for proper growth and development, as well as for the motor progress of children that comes later, and especially for participation in different activities during school, but also for normal functioning and performance of daily activities (Min, Jung, Jung, & Kang, 2008). The authors of many researches deal with the question of why the correct acquisition of basic motor skills is of crucial importance for the children's development. According to Whitall (2003), careful studying of the motor skills of children gives a clearer picture of perceptive, cognitive, and affective processes. From today's point of view, there is a large number of children who master motor skills slowly and with much effort, so it is important to know which level of ability is expected at a given age and how to make an individual program for students who have problems with mastering certain skills.

Fine motor skills are one of the basic functions of the body,

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and their center is located in the cerebral cortex. It is a center for movement coordination which occupies a significant part of the cerebral cortex (Schmid, Miodrag, & DiFrancesco, 2008). If a child does not develop fine motor skills, synapses will not be formed between these centers, and various cognitive disorders can occur, such as dyslexia, dysgraphia, various learning disorders, etc, which can cause many problems later in life. These centers are connected by direct connections between the nerves, nervous system, and all the muscles of the body (Min et al., 2008). By developing fine motor skills, children develop skills of coordination which they need for all life activities (Schmid et al., 2008). The children who do not develop this ability from the earliest age are less active, slower thinkers, and react badly to numerous life situations.

Recently, many studies have focused on the analyses of the BMI status of children to determine the differences between normal weight and overweight children. Thus, World Health Organization (WHO) indicates that even 340 million children and adolescents aged 5-19 are overweight or obese. The prevalence of overweight and obesity among children and adolescents aged 5-19 has increased dramatically from just 4% in 1975, to over 18% in 2016. (World Health Organization, 2021). It is well known that obesity in children is connected with many health issues such as diabetes mellitus type 2, asthma, hypertension, psychosocial problems, early arteriosclerosis, etc. (Dikanović & Vignjević, 2009). Also, obesity negatively affects the motor efficiency of children (Han, Fu, Cobley, & Sanders, 2018) and their participation in physical activities in general (Lopes et al., 2012; Gentier et al., 2013; Spessato, Gabbard, Robinson, & Valentini, 2013).

That is why more and more papers deal with the correlation between BMI and motor skills in children (Graf et al., 2004; D'Hondt, Deforche, De Bourdeaudhuij, & Lenoir, 2009; Lubans, Morgan, Cliff, Barnett, & Okeli, 2010; Lopes et al., 2012). The studies confirmed that motor efficiency is connected with the BMI status, i.e. that excessively nourished children have a lower level of motor skills (Graf et al., 2004; Lubans et al., 2010; Cliff et al., 2012), although this still applies to gross motor skills. A small number of papers dealt with the connection between BMI and fine motor skills in the population of children, with some authors indicating that the BMI category does not affect the level of the fine motor skills (D'Hondt, Deforche, De Bourdeaudhuij, & Lenoir, 2008). However, research on fine motor skills in the obese children population is limited. Due to all the above, this research aims to determine the connection between fine motor skills and BMI of preschool children, as well as to determine the differences in the fine motor skills between the groups of normal weight and overweight children.

Methods

129 respondents, children aged five to six are participating in this transversal research. The children attend preschool "Ljubica Vrebalov" in Pozarevac. The respondents are compared according to their sex and BMI categories according to WHO criteria. The criteria for inclusion and selection of the respondents were as follow: healthy children of both sexes, aged five to six, not included into any type of organized physical exercise. The research was conducted in accordance with the Declaration of Helsinki, which was approved by the Ethics Committee of the Faculty of Sports and Physical Education in Nis (number: 04-1186/2).

For measuring anthropometric characteristics standardized anthropometric instruments were used (GPM, Switzerland). Measurements were performed according to the established international procedures. Body mass index was calculated based on the standard formula: $BMI=TM(kg)/TV(m)^2$ (World Health Organization, 1995). Body mass index has a high correlation with the quantity of body fat and for that reason is used as an indicator of the children's obesity status (Jensen, Camargo, & Bergamaschi 2016). WHO cut-off points were used to assess (non)obesity status (World Health Organization, 2022).

Two subtests from the BOT-2 tests battery were used to assess fine motor skills (Bruininks-Oseretsky Test of Motor Proficiency). BOT-2 is used as a standardized measure of the level of physical abilities of children and adolescents from 4 to 21 years of age and the previous research in this area has shown that the BOT-2 test was quite valid (Abbas, Jaya Shanker, & Krishnan, 2011). For the purposes of this research, the subtests for fine motor integration (FMI) and manual dexterity (MD) were used, which together indicate the level of fine motor skills (FMS).

SPSS 19.0 software was used for statistical data processing and descriptive statistics results (mean and standard deviation) were presented for all data, while Pearson's correlation coefficient was used to determine the relationship between the variables, and a t-test for small independent samples was used to determine differences between groups, while the significance of interference was determined at the level of $p<.05$.

Results

Table 1 shows the results of descriptive statistics for the examined variables. Based on the results of girls and boys, it was determined that they can make up one group of respondents because there was no significant difference in the achieved results. The average values on the tests were standardized before data processing, and thus it was determined that they are within the normal range for the given age. When the subjects were divided into two groups, according to the BMI category (normal weight and overweight) it was found that there was a significant difference in manual dexterity (.046, $p<.05$) and the overall result of fine motor skills (.023, $p<.05$), while there is no significant difference in the results of fine motor integration.

Table 1. Descriptive statistics and t-test for tested variables

Variables	Boys		Girls		Total		Normal (n=97)		Obese (n=32)		t-test
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p
FMI	13.47	3.58	12.91	4.57	13.17	4.14	13.44	4.21	12.34	3.84	.194
MD	12.05	3.71	11.17	4.78	11.57	4.33	12.02	4.25	10.21	4.33	.046*
FMS	25.52	5.71	23.97	7.37	24.68	6.68	25.48	6.44	22.25	6.89	.023*
BMI	15.89	1.98	16.30	2.61	16.11	2.35	15.08	1.25	19.25	2.09	.000**

Legend: FMI-fine motor integration, MD-manual dexterity, FMS-total fine motor skills, BMI-body mass index

Table 2 shows the result of the Pearson correlation coefficient. The results showed a significant negative correlation between BMI and fine motor integration ($r=-.235$, $p<.001$), manual dexterity ($r=-.290$, $p<.001$), and the overall result of fine motor skills ($r=-.342$, $p<.001$).

Table 2. Correlation between variables

Variables		FMI	MSS	FMS
MD	r	.222*		
	p	.011		
FMS	r	.771**	.778**	
	p	.000	.000	
BMI	r	-.235**	-.290**	-.342**
	p	.007	.001	.000

Legend: FMI-fine motor integration, MD-manual dexterity, FMS-total fine motor skills, BMI-body mass index, *-The correlation is significant at the 0.05 level, **-The correlation is significant at the 0.01 level.

Discussion

This study aimed to determine the relationship between fine motor skills and BMI categories of preschool children, and also to establish differences in fine motor skills between the groups of normal weight and overweight preschool children. The results showed that in addition to the significant association between fine motor skills and BMI, Higher BMI negatively affects the fine motor skills of children, even in preschool age.

The results of this study are consistent with previous studies (Graf et al., 2004; D'Hondt et al., 2009) which showed that normal weight children had better results in motor efficiency tests than obese children. In the study of Marmeleira (Marmeleira, Veiga, Cansado, & Raimundo, 2017), in which children were divided into several groups according to their (non)obesity status, it was found that overweight and obese children have the worst motor performance. The reason for these results is the assumption that the excess weight prevents obese children from performing optimal movements because it is necessary to carry their weight and most of the excess weight must be moved against gravity during the tasks performed (Graf et al., 2004; D'Hondt et al., 2009; Castetbon & Andreyeva, 2012). Castetbon & Andreyeva (2012) point out that the relationship between motor skills and obesity varies depending on the type of motor skills. That is, motor skills are negatively associated with obesity only in those movements in which the excess weight of children directly complicates the performance of the task (Castetbon & Andreyeva 2012; Quka, Selenica, Quka, & Shore, 2019). Accordingly, Marmeleira et al. (2017) point out that the negative impact of being overweight is greater for gross motor skills, while they believe that fine motor skills are relatively independent of the limitations imposed by being overweight, which is not the case in our study.

When it comes to fine motor skills, the authors D'Hondt et al. (2009) found that obese children had poorer results in manual dexterity, which corresponds to our results. However, in our study, in addition to manual dexterity, obese children achieved significantly lower results in overall fine motor skills. In the study of D'Hondt et al. (2009) was found a significant negative correlation between BMI and visual-motor integration, and the analysis of differences showed that girls with low BMI values were significantly more advanced in fine motor performance, which is also in line with the results of our study in which negative correlation was accomplished between BMI and all parameters of fine motor skills of preschool children. Marmeleira et al. (2017) also established a negative relationship, but only between certain subtests results of motor skills (visual-motor integration) and BMI of preschoolers. In contrast, Castetbon & Andreyeva (2012) found that there was no significant association between obesity and fine motor skills in the population of children aged four to six, although this association was nevertheless confirmed at a later age. These insufficient and contradictory data point to the need for more complete research in this area. It should be noted that fine motor skills are not directly affected by the amount of excess weight involved in the movement, so it is not enough to explain the differences between BMI groups. Therefore, some authors suggest that there may be a deficit in the integration and processing of sensory information in obese children (Marmeleira et al., 2017). However, this relationship between perceptual-motor functioning and obesity in children needs to be further investigated. Prevention of fine motor skills violation in early childhood is important so that all children have the same chance of successful development (Castetbon & Andreyeva, 2012). Some authors emphasize that in addition to gross motor skills, children must also develop fine motor skills because integral motor development is necessary for the later development of more complex and specialized movements so that children can competently participate in various physical activities and sports (Quka, Selenica, Quka, & Shore, 2019). It should be added that fine motor skills have a positive effect on the sensorimotor development of the nervous system (Ivković i sar., 2004), so special attention should be paid to its development during the entire period of childhood.

The limitations of our study are reflected in the small sample of respondents, as well as the fact that due to the small sample size, they could not be divided into several categories in relation to BMI, but only into two groups: normal weight and overweight children. In relation to the mentioned limitations, the proposal for further research would be to conduct a study on a larger sample of respondents, as well as to divide the sample according to the (non)obesity status into underweight, normal weight, overweight and obese children. Also, the fine motor skills of children should be examined with the help of several parameters. Such research could give a detailed insight into the level of fine motor skills in relation to different BMI categories of preschool children.

Conclusion

Overweight children have lower scores on fine motor skills tests than normal weight children, which can have consequences on motor development in later life, so it is recommended to implement various activities and programs for their development at an early age, for prevention.

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Conflict of Interest
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Journal of Anthropology of Sport and Physical Education

LETTER TO THE EDITOR

The effect of static stretching exercise on flexibility and speed ability in young football players

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Abstract

Training programmes for young football players are designed to stimulate an optimal development of physical performances relevant to football game. The primary aim of this research is to establish the effect of the static stretching exercise on the motor abilities (flexibility and speed) of young football players. A total of 24 young football players (U17 category) from Football Club "Ramiz Sadiku" were included in this pilot study. Participants were divided into control and experimental group. The research implemented 6 variables: 1) 2 variables for estimation of morphological characteristics (body height, body mass) and 2) 4 variables for estimation of motor abilities such as flexibility (Sit-and-Reach test), and speed (sprint 5m, sprint 10m and sprint 30m). Data processing was conducted with the software package SPSS, 23.0 version and uni-variant analysis was performed. Acquired results show that conducted experimental program for development of flexibility have statistically significant effect only on flexibility variable "sit and reach test" with the experimental group, and no significant effect on speed 5m, 10m and 30m. Based on the data obtained in this research, it is recommended to use static stretching exercises after training (in the recovery phase), 2-3 times a week for the optimal development of the flexibility of the players at the U17 category.

Keywords: *young footballers, static stretching, flexibility, speed*

Introduction

Football is a sport characterized by numerous and various complex dynamic kinesiology activities with a large number of cyclic and acyclic movements (Bjelica et al. 2013). Performing a large number of movements in soccer (such as sprinting, changing the direction of movement, performing technical elements), depends, among other things, on the flexibility of the player's locomotor system.

There are different opinions about the role and influence of flexibility exercise on motor skills. It usually depend on the methods of application more precisely on when, and to what extent certain forms of stretching exercises (dynamic and static) are used for flexibility development (Brandey et al., 2012).

Static stretching exercises as a recovery strategy in football have been widely discussed, but currently there is not enough strong scientific evidence that static stretching exercises contribute to players regeneration (Sands et al., 2013; Nedelec et al., 2013). Furthermore only 50% of professional clubs in France use stretching exercises at the end of the training as a recovery strategy (Nedelec et al., 2013).

It is well know that coaches of younger categories of football players do not pay attention to adequate forms of flexibility exercise (static and dynamic) in the phases of warming up and calming down the body, even though they are necessary for the development of flexibility in the young players.

However, it is not yet sufficiently known to what extent static stretching exercises applied after training in the active recovery phase affect the motor skills of soccer players.

Therefore, we designed a study to investigate the impact of static stretching exercises on the motor skills of young football players, with the hope that it will provide an original contribution both to theory and practice.

Material & Methods

A total of 24 young soccer players (U17 category) from Football Club Ramiz Sadiku from Prishtina werw included in this pilot

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study. The participants were divided into control (n=12) and experimental group (n=12).

The medical checkup was realized in the medical sport Centre in Prishtina and it was confirmed that all the football players are healthy to participate. In accordance with the Helsinki declaration, all the participants have been informed with the aim of the testing procedures and the regular and experimental training program.

Players were involved in the regular and experimental training sessions while compiting in the Kosovo elite soccer league over the season's first macrocycle (preparation and competition) from 1st of August until 1st of December.

During the preparatory and competition period, the training program was conducted in a time span of four months, four times per week, for both of the groups. The content of the regular training program is based on four components: conditioning (KO), technical (TE), tactical (TA) and mental (ME) preparation. The work plan and program was prepared from Sami Sermaxhaj the author of this study - based on the recommendations of the German and Swiss football federations and several authors who represent eminent experts in this field (Bisanz and Gerisch 2008; Bjelica and Popović 2012; Jankovski 2015, Sermaxhaj 2021).

Only the execution manner of the experimental program was different (17 exercises of static stretching) for development of flexibility), which was conducted three times per week only with the experimental group, and with an increased duration at the end of the training session.

The content of the experimental part of the training was: 1) Neck stretch; forward, upwards, right-left, 2) Trunk Stretch; Upper Back, 3) Trunk Stretch; Chest & Back, 4) Trunk Stretch; Shulder & mid – upper Back, 5) Trunk Stretch; Shoulder & triceps, 6) Trunk Stretch; Lateral flexion right-lef, 7) Two Leg Hamstring Stretch, 8) Achiles & Back Stretch, 9) Quadriceps Stretch, 10) Hamstring Groin Stretch, 11) Standing Groin Stretch, 12) Groin Stretch, 13) Chest Stretch, 14) Sitting Hamstring Stretch, 15) Lower Back Stretch, 16) Two Leg Seatet Hamstring Stretch, 17) Achiles Tendon Stretch) (Walker, 2006; Sermaxhaj et al 2018).

Statistical analysis

Statistical analysis was performed with SPSS 23.0 (IBM, Armonk, USA). Uni-variant analysis was performed to calculate the differences between control and experimental group in initial and final measurements. The level of significance was set to $p<0.05$.

Results and discussion

There are no significant differences between the control and experimental groups.

Results of the final measurement for both groups are presented in Table 1.

Table 1. Differences between the young football players (U17 category) from the control and the experimental group at the final measurment

	Variable	CK Mean±SD	EG Mean±SD	Anova P- level
Cadets	Age (years)	15,9±0,4	16,2±0,6	-
	Body mass (Kg)	62,20±8,84	64,05±8,04	0,597
	Height (cm)	177,12±6,5	177,68±6,75	0,838
	Sit and Reach Test	-0,41±3,55	6,25±7,65	0,012
	Sprint 5m	1,18±,10	1,14±,09	0,704
	Sprint 10m	1,92±,08	1,88±,07	0,616
	Sprint 30m	4,66±,21	4,55±,16	0,201

Note: CG= control group, EG=experimental group, Mean=arithmetic mean, SD=Standard Deviation, P=p-value

Based on the results for the Sit and Reach Test, the value of the difference of 6.66 cm is in favor of the experimental group. It was observed that the distance was minimally greater at the final measurement, compared to the initial measurement. Since the experimental group performed the static stretching exercises three times a week during the preparatory and competitive period, -obtained results were expected.

The impact of long-term static stretching exercises on the flexibility of cadet players has been investigated by other authors too (Fernandez et al., 2016; Akbulut and Agopyan 2015, Sermaxhaj et al 2017). Obtained results in this study indicate that in the category of cadet players, long-term static stretching exercise had no significant effect on the 30m. However, Fernandez et al. (2016) found statistically significant effect of the static stretching exercise on the speed in football players.

Acquired results show that conducted program for development of flexibility (static stretching exercises) have statistically important effect only on flexibility (sit and reach test) and no effect on speed (sprint 5m, 10m, 30m), and morphological characteristics (body mass and height) in young football players (U17 category).

Conclusions

Static exercises have essential effect on improvement of flexibility, but without positive or negative effect on speed and morphological characteristics in young football players (U17 category).

We suggest that the positive change in flexibility in the experimental group in the cadet category was due to the influence of the experimental program (static stretching exercises). It is also recommended to apply combined stretching exercises (dynamic and static) at the beginning of training and special supplementary sessions 2-3 times a week (before or after regular training) according to individual needs with the aim of developing optimal flexibility for young football players.

Obtained results present further step in recognizing when and in which players the static stretching exercises should be implemented.

Furthermore, the present study clearly explains if flexibility exercise has positive or negative impact on speed abilities of young football players, and precisely recommends when to be employed.

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Conflict of Interest
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Name the files according to the family name of the first author. Authors submitting revised versions of the manuscript can use the identification number of their manuscript as provided by the Journal Office. *See* example:

- ✓ FAMILY NAME-manuscript.doc – (main manuscript file)
- ✓ FAMILY NAME-statement.PDF – (authorship statement)
- ✓ FAMILY NAME-declaration.PDF – (declaration of potential conflict of interest)
- ✓ FAMILY NAME-fig1.tiff – (Figure 1)

1.4. Peer Review Process

A manuscript submitted for publication will be submitted to the review process as long as it fits the following criteria:

- The study was not previously published, nor has been submitted simultaneously for consideration of publication elsewhere;
- All persons listed as authors approved its submission to JASPE;
- Any person cited as a source of personal communication has approved the quote;
- The opinions expressed by the authors are their exclusive responsibility;
- The author signs a formal statement that the submitted manuscript complies with the directions and guidelines of JASPE.

The editors-in-chief and associate editors will make a preliminary analysis regarding the appropriateness, quality, originality and written style/grammar of the submitted manuscript. The editors reserve the right to request additional information, corrections, and guideline compliance before they submit the manuscript to the ad-hoc review process.

JASPE uses ad-hoc reviewers, who volunteer to analyze the merit of the study. Typically, one or two expert reviewers are consulted in a double-blind process. Authors are notified by e-mail when their submission has been accepted (or rejected). Minor changes in the text may be made at the discretion of the editors-in-chief and/or associate editors. Changes can include spelling and grammar in the chosen language, written style, journal citations, and reference guidelines. The author is notified of changes via email. The final version is available to the author for his or her approval before it is published.

1.5. Open Access License and Publisher Copyright Policies

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The editors of JASPE consider plagiarism to be a serious breach of academic ethics. Any author who practices plagiarism (in part or totality) will be suspended for six years from submitting new submissions to JASPE. If such a manuscript is approved and published, public exposure of the article with a printed mark ("plagiarized" or "retracted") on each page of the published file, as well as suspension for future publication for at least six years, or a period determined by the editorial board. Third party plagiarized authors or institutions will be notified, informing them about the faulty authors. Plagiarism will result in immediate rejection of the manuscript.

JASPE only publishes studies that have been approved by an institutional ethics committee (when a study involves humans or animals). Fail to provide such information prevent its publication. To ensure these requirements, it is essential that submission documentation is complete. If you have not completed this step yet, go to JASPE website and fill out the two required documents: Declaration of Potential Conflict of Interest and Authorship Statement. Whether or not your study uses humans or animals, these documents must be completed and signed by all authors and attached as supplementary files in the originally submitted manuscript.

1.6. After Acceptance

After the manuscript has been accepted, authors will receive a PDF version of the manuscripts for authorization, as it should look in printed version of JASPE. Authors should carefully check for omissions. Reporting errors after this point will not be possible and the Editorial Board will not be eligible for them.

Should there be any errors, authors should report them to the Office e-mail address **jaspe@ucg.ac.me.** If there are not any errors authors should also write a short e-mail stating that they agree with the received version.

1.7. Code of Conduct Ethics Committee of Publications

JASPE is hosting the Code of Conduct Ethics Committee of Publications of the **COPE** (the Committee on Publication Ethics), which provides a forum for publishers and Editors of scientific journals to discuss issues relating to the integrity of the work submitted to or published in their journals.

2. MANUSCRIPT STRUCTURE

2.1. Title Page

The first page of the manuscripts should be the title page, containing: title, type of publication, running head, authors, affiliations, corresponding author, and manuscript information. *See* example:

Analysis of Dietary Intake and Body Composition of Female Athletes over a Competitive Season

Original Scientific Paper

Diet and Body Composition of Female Athletes

Svetlana Nepocatych[1], Gytis Balilionis[1], Eric K. O'Neal[2]

[1]Elon University, Department of Exercise Science1, Elon, NC 27215
[2]University of North Alabama, Department of Health, Physical Education and Recreation, Florence, AL 35632

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2525 CB

Elon, NC 27244

United States

E-mail: snepocatych@elon.edu

Word count: 2,946

Word count: 4259

Abstract word count: 211

Number of Tables: 3

2.1.1. Title

Title should be short and informative and the recommended length is no more than 20 words. The title should be in Title Case, written in uppercase and lowercase letters (initial uppercase for all words except articles, conjunctions, short prepositions no longer than four letters etc.) so that first letters of the words in the title are capitalized. Exceptions are words like: "and", "or", "between" etc. The word following a colon (:) or a hyphen (-) in the title is always capitalized.

2.1.2. Type of publication

Authors should suggest the type of their submission.

2.1.3. Running head

Short running title should not exceed 50 characters including spaces.

2.1.4. Authors

The form of an author's name is first name, middle initial(s), and last name. In one line list all authors with full names separated by a comma (and space). Avoid any abbreviations of academic or professional titles. If authors belong to different institutions, following a family name of the author there should be a number in superscript designating affiliation.

2.1.5. Affiliations

Affiliation consists of the name of an institution, department, city, country/territory (in this order) to which the author(s) belong and to which the presented / submitted work should be attributed. List all affiliations (each in a separate line) in the order corresponding to the list of authors. Affiliations must be written in English, so carefully check the official English translation of the names of institutions and departments.

Only if there is more than one affiliation, should a number be given to each affiliation in order of appearance. This number should be written in superscript at the beginning of the line, separated from corresponding affiliation with a space. This number should also be put after corresponding name of the author, in superscript with no space in between.

If an author belongs to more than one institution, all corresponding superscript digits, separated with a comma with no space in between, should be present behind the family name of this author.

In case all authors belong to the same institution affiliation numbering is not needed.

Whenever possible expand your authors' affiliations with departments, or some other, specific and lower levels of organization.

2.1.6. Corresponding author

Corresponding author's name with full postal address in English and e-mail address should appear, after the affiliations. It is preferred that submitted address is institutional and not private. Corresponding author's name should include only initials of the first and middle names separated by a full stop (and a space) and the last name. Postal address should be written in the following line in sentence case. Parts of the address should be separated by a comma instead of a line break. E-mail (if possible) should be placed in the line following the postal address. Author should clearly state whether or not the e-mail should be published.

2.1.7. Manuscript information

All authors are required to provide word count (excluding title page, abstract, tables/figures, figure legends, Acknowledgements, Conflict of Interest, and References), the Abstract word count, the number of Tables, and the number of Figures.

2.2. Abstract

The second page of the manuscripts should be the abstract and key words. It should be placed on second page of the manuscripts after the standard title written in upper and lower case letters, bold.

Since abstract is independent part of your paper, all abbreviations used in the abstract should also be explained in it. If an abbreviation is used, the term should always be first written in full with the abbreviation in parentheses immediately after it. Abstract should not have any special headings (e.g., Aim, Results…).

Authors should provide up to six key words that capture the main topics of the article. Terms from the Medical Subject Headings (MeSH) list of Index Medicus are recommended to be used.

Key words should be placed on the second page of the manuscript right below the abstract, written in italic. Separate each key word by a comma (and a space). Do not put a full stop after the last key word. *See* example:

Abstract

Results of the analysis of

Key words: *spatial memory, blind, transfer of learning, feedback*

2.3. Main Chapters

Starting from the third page of the manuscripts, it should be the main chapters. Depending on the type of publication main manuscript chapters may vary. The general outline is: Introduction, Methods, Results, Discussion, Acknowledgements (optional), Conflict of Interest (optional), and Title, Author's Affiliations, Abstract and Key words must be in English (for both each chosen language of full paper). However, this scheme may not be suitable for reviews or publications from some areas and authors should then adjust their chapters accordingly but use the general outline as much as possible.

2.3.1. Headings

Main chapter headings: written in bold and in Title Case. *See* example:

- ✓ **Methods**

Sub-headings: written in italic and in normal sentence case. Do not put a full stop or any other sign at the end of the title. Do not create more than one level of sub-heading. *See* example:

- ✓ *Table position of the research football team*

2.3.2 Ethics

When reporting experiments on human subjects, there must be a declaration of Ethics compliance. Inclusion of a statement such as follow in Methods section will be understood by the Editor as authors' affirmation of compliance: "This study was approved in advance by [name of committee and/or its institutional sponsor]. Each participant voluntarily provided written informed consent before participating." Authors that fail to submit an Ethics statement will be asked to resubmit the manuscripts, which may delay publication.

2.3.3 Statistics reporting

JASPE encourages authors to report precise p-values. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Use normal text (i.e., non-capitalized, non-italic) for statistical term "p".

2.3.4. 'Acknowledgements' and 'Conflict of Interest' (optional)

All contributors who do not meet the criteria for authorship should be listed in the 'Acknowledgements' section. If applicable, in 'Conflict of Interest' section, authors must clearly disclose any grants, financial or material supports, or any sort of technical assistances from an institution, organization, group or an individual that might be perceived as leading to a conflict of interest.

2.4. References

References should be placed on a new page after the standard title written in upper and lower case letters, bold.

All information needed for each type of must be present as specified in guidelines. Authors are solely responsible for accuracy of each reference. Use authoritative source for information such as Web of Science, Medline, or PubMed to check the validity of citations.

2.4.1. References style

JASPE adheres to the American Psychological Association 6th Edition reference style. Check "American Psychological Association. (2009). Concise rules of APA style. American Psychological Association." to ensure the manuscripts conform to this reference style. Authors using EndNote® to organize the references must convert the citations and bibliography to plain text before submission.

2.4.2. Examples for Reference citations

One work by one author

- ✓ In one study (Reilly, 1997), soccer players
- ✓ In the study by Reilly (1997), soccer players
- ✓ In 1997, Reilly's study of soccer players

Works by two authors

- ✓ Duffield and Marino (2007) studied
- ✓ In one study (Duffield & Marino, 2007), soccer players
- ✓ In 2007, Duffield and Marino's study of soccer players

Works by three to five authors: cite all the author names the first time the reference occurs and then subsequently include only the first author followed by et al.

- ✓ First citation: Bangsbo, Iaia, and Krustrup (2008) stated that
- ✓ Subséquent citation: Bangsbo et al. (2008) stated that

Works by six or more authors: cite only the name of the first author followed by et al. and the year

- ✓ Krustrup et al. (2003) studied
- ✓ In one study (Krustrup et al., 2003), soccer players

Two or more works in the same parenthetical citation: Citation of two or more works in the same parentheses should be listed in the order they appear in the reference list (i.e., alphabetically, then chronologically)

- ✓ Several studies (Bangsbo et al., 2008; Duffield & Marino, 2007; Reilly, 1997) suggest that

2.4.3. Examples for Reference list

Journal article (print):

Nepocatych, S., Balilionis, G., & O'Neal, E. K. (2017). Analysis of dietary intake and body composition of female athletes over a competitive season. *Montenegrin Journal of Sports Science and Medicine, 6*(2), 57-65. doi: 10.26773/mjssm.2017.09.008

Duffield, R., & Marino, F. E. (2007). Effects of pre-cooling procedures on intermittent-sprint exercise performance in warm conditions. *European Journal of Applied Physiology, 100*(6), 727-735. doi: 10.1007/s00421-007-0468-x

Krustrup, P., Mohr, M., Amstrup, T., Rysgaard, T., Johansen, J., Steensberg, A., Bangsbo, J. (2003). The yo-yo intermittent recovery test: physiological response, reliability, and validity. *Medicine and Science in Sports and Exercise, 35*(4), 697-705. doi: 10.1249/01.MSS.0000058441.94520.32

Journal article (online; electronic version of print source):

Williams, R. (2016). Krishna's Neglected Responsibilities: Religious devotion and social critique in eighteenth-century North India [Electronic version]. *Modern Asian Studies, 50*(5), 1403-1440. doi:10.1017/S0026749X14000444

Journal article (online; electronic only):

Chantavanich, S. (2003, October). Recent research on human trafficking. *Kyoto Review of Southeast Asia, 4*. Retrieved November 15, 2005, from http://kyotoreview.cseas.kyoto-u.ac.jp/issue/issue3/index.html

Conference paper:

Pasadilla, G. O., & Milo, M. (2005, June 27). *Effect of liberalization on banking competition*. Paper presented at the conference on Policies to Strengthen Productivity in the Philippines, Manila, Philippines. Retrieved August 23, 2006, from http://siteresources.worldbank.org/INTPHILIPPINES/Resources/Pasadilla.pdf

Encyclopedia entry (print, with author):

Pittau, J. (1983). Meiji constitution. In *Kodansha encyclopedia of Japan* (Vol. 2, pp. 1-3). Tokyo: Kodansha.

Encyclopedia entry (online, no author):

Ethnology. (2005, July). In *The Columbia encyclopedia* (6th ed.). New York: Columbia University Press. Retrieved November 21, 2005, from http://www.bartleby.com/65/et/ethnolog.html

Thesis and dissertation:

Pyun, D. Y. (2006). *The proposed model of attitude toward advertising through sport.* Unpublished Doctoral Dissertation. Tallahassee, FL: The Florida State University.

Book:
Borg, G. (1998). *Borg's perceived exertion and pain scales*: Human kinetics.

Chapter of a book:
Kellmann, M. (2012). Chapter 31-Overtraining and recovery: Chapter taken from Routledge Handbook of Applied Sport Psychology ISBN: 978-0-203-85104-3 *Routledge Online Studies on the Olympic and Paralympic Games* (Vol. 1, pp. 292-302).

Reference to an internet source:
Agency. (2007). Water for Health: Hydration Best Practice Toolkit for Hospitals and Healthcare. Retrieved 10/29, 2013, from www.rcn.org.uk/newsevents/hydration

2.5. Tables

All tables should be included in the main manuscript file, each on a separate page right after the Reference section.

Tables should be presented as standard MS Word tables.

Number (Arabic) tables consecutively in the order of their first citation in the text.

Tables and table headings should be completely intelligible without reference to the text. Give each column a short or abbreviated heading. Authors should place explanatory matter in footnotes, not in the heading. All abbreviations appearing in a table and not considered standard must be explained in a footnote of that table. Avoid any shading or coloring in your tables and be sure that each table is cited in the text.

If you use data from another published or unpublished source, it is the authors' responsibility to obtain permission and acknowledge them fully.

2.5.1. Table heading

Table heading should be written above the table, in Title Case, and without a full stop at the end of the heading. Do not use suffix letters (e.g., Table 1a, 1b, 1c); instead, combine the related tables. *See* example:

- ✓ **Table 1.** Repeated Sprint Time Following Ingestion of Carbohydrate-Electrolyte Beverage

2.5.2. Table sub-heading

All text appearing in tables should be written beginning only with first letter of the first word in all capitals, i.e., all words for variable names, column headings etc. in tables should start with the first letter in all capitals. Avoid any formatting (e.g., bold, italic, underline) in tables.

2.5.3. Table footnotes

Table footnotes should be written below the table.

General notes explain, qualify or provide information about the table as a whole. Put explanations of abbreviations, symbols, etc. here. General notes are designated by the word *Note* (italicized) followed by a period.

- ✓ *Note.* CI: confidence interval; Con: control group; CE: carbohydrate-electrolyte group.

Specific notes explain, qualify or provide information about a particular column, row, or individual entry. To indicate specific notes, use superscript lowercase letters (e.g. $^{a, b, c}$), and order the superscripts from left to right, top to bottom. Each table's first footnote must be the superscript ^{a}.

- ✓ ^{a}One participant was diagnosed with heat illness and n = 19.^{b}n =20.

Probability notes provide the reader with the results of the texts for statistical significance. Probability notes must be indicated with consecutive use of the following symbols: * † ‡ § ¶ || etc.

- ✓ *P<0.05,†p<0.01.

2.5.4. Table citation

In the text, tables should be cited as full words. *See* example:

- ✓ Table 1 (first letter in all capitals and no full stop)
- ✓ ...as shown in Tables 1 and 3. (citing more tables at once)
- ✓ ...result has shown (Tables 1-3) that... (citing more tables at once)
- ✓ ....in our results (Tables 1, 2 and 5)... (citing more tables at once)

2.6. Figures

On the last separate page of the main manuscript file, authors should place the legends of all the figures submitted separately.

All graphic materials should be of sufficient quality for print with a minimum resolution of 600 dpi. JASPE prefers TIFF, EPS and PNG formats.

If a figure has been published previously, acknowledge the original source and submit a written permission from the copyright holder to reproduce the material. Permission is required irrespective of authorship or publisher except for documents in the public domain. If photographs of people are used, either the subjects must not be identifiable or their pictures must be accompanied by written permission to use the photograph whenever possible permission for publication should be obtained.

Figures and figure legends should be completely intelligible without reference to the text.

The price of printing in color is 50 EUR per page as printed in an issue of JASPE.

2.6.1. Figure legends

Figures should not contain footnotes. All information, including explanations of abbreviations must be present in figure legends. Figure legends should be written bellow the figure, in sentence case. *See* example:

- ✓ **Figure 1.** Changes in accuracy of instep football kick measured before and after fatigued. SR – resting state, SF – state of fatigue, *p>0.01, †p>0.05.

2.6.2. Figure citation

All graphic materials should be referred to as Figures in the text. Figures are cited in the text as full words. *See* example:

- ✓ Figure 1
  - × figure 1
  - × Figure 1.
  - ✓ ….exhibit greater variance than the year before (Figure 2). Therefore…
  - ✓ ….as shown in Figures 1 and 3. (citing more figures at once)
  - ✓ ….result has shown (Figures 1-3) that... (citing more figures at once)
  - ✓ ….in our results (Figures 1, 2 and 5)... (citing more figures at once)

2.6.3. Sub-figures

If there is a figure divided in several sub-figures, each sub-figure should be marked with a small letter, starting with a, b, c etc. The letter should be marked for each subfigure in a logical and consistent way. *See* example:

- ✓ Figure 1a
- ✓ …in Figures 1a and b we can…
- ✓ …data represent (Figures 1a-d)…

2.7. Scientific Terminology

All units of measures should conform to the International System of Units (SI).

Measurements of length, height, weight, and volume should be reported in metric units (meter, kilogram, or liter) or their decimal multiples.

Decimal places in English language are separated with a full stop and not with a comma. Thousands are separated with a comma.

Percentage	Degrees	All other units of measure	Ratios	Decimal numbers
✓ 10%	✓ 10º	✓ 10 kg	✓ 12:2	✓ 0.056
× 10 %	× 10 º	× 10kg	× 12 : 2	× .056

Signs should be placed immediately preceding the relevant number.		
✓ 45±3.4	✓ p<0.01	✓ males >30 years of age
× 45 ± 3.4	× p < 0.01	× males > 30 years of age

2.8. Latin Names

Latin names of species, families etc. should be written in italics (even in titles). If you mention Latin names in your abstract they should be written in non-italic since the rest of the text in abstract is in italic. The first time the name of a species appears in the text both genus and species must be present; later on in the text it is possible to use genus abbreviations. *See* example:

✓ First time appearing: *musculus biceps brachii*

Abbreviated: *m. biceps brachii*

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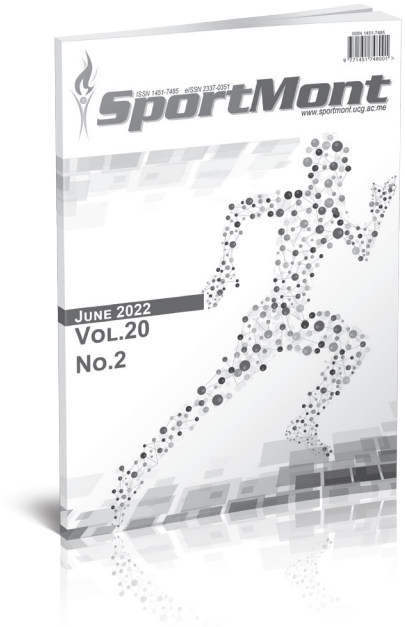

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- Post-publication tools to indicate quality and impact;
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- Worldwide media coverage.

SMJ is published three times a year, in February, June and October of each year. SMJ publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Sports Science and Medicine, as well as it can function as an open discussion forum on significant issues of current interest.

SMJ covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

Prospective authors should submit manuscripts for consideration in Microsoft Word-compatible format. For more complete descriptions and submission instructions, please access the Guidelines for Authors pages at the SMJ website: http://www.sportmont.ucg.ac.me/?sekcija=page&p=51. Contributors are urged to read SMJ's guidelines for the authors carefully before submitting manuscripts. Manuscripts submissions should be sent in electronic format to sportmont@ucg.ac.me or contact following Editors:

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Winter issue – February 2023
Summer issue – June 2023

Montenegrin Journal of Sports Science and Medicine

MONTENEGRIN JOURNAL OF SPORTS SCIENCE AND MEDICINE

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Montenegrin Journal of Sports Science and Medicine (MJSSM) is a print (ISSN 1800-8755) and electronic scientific journal (eISSN 1800-8763) aims to present easy access to the scientific knowledge for sport-conscious individuals using contemporary methods. The purpose is to minimize the problems like the delays in publishing process of the articles or to acquire previous issues by drawing advantage from electronic medium. Hence, it provides:

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- Fast publication time;
- Peer review by expert, practicing researchers;
- Post-publication tools to indicate quality and impact;
- Community-based dialogue on articles;
- Worldwide media coverage.

MJSSM is published biannually, in September and March of each year. MJSSM publishes original scientific papers, review papers, editorials, short reports, peer review - fair review, as well as invited papers and award papers in the fields of Sports Science and Medicine, as well as it can function as an open discussion forum on significant issues of current interest.

MJSSM covers all aspects of sports science and medicine; all clinical aspects of exercise, health, and sport; exercise physiology and biophysical investigation of sports performance; sport biomechanics; sports nutrition; rehabilitation, physiotherapy; sports psychology; sport pedagogy, sport history, sport philosophy, sport sociology, sport management; and all aspects of scientific support of the sports coaches from the natural, social and humanistic side.

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Publication date: Autumn issue – September 2022
Spring issue – March 2023

MONTENEGRIN SPORTS ACADEMY

Founded in 2003 in Podgorica (Montenegro), the Montenegrin Sports Academy (MSA) is a sports scientific society dedicated to the collection, generation and dissemination of scientific knowledge at the Montenegrin level and beyond.

The Montenegrin Sports Academy (MSA) is the leading association of sports scientists at the Montenegrin level, which maintains extensive co-operation with the corresponding associations from abroad. The purpose of the MSA is the promotion of science and research, with special attention to sports science across Montenegro and beyond. Its topics include motivation, attitudes, values and responses, adaptation, performance and health aspects of people engaged in physical activity and the relation of physical activity and lifestyle to health, prevention and aging. These topics are investigated on an interdisciplinary basis and they bring together scientists from all areas of sports science, such as adapted physical activity, biochemistry, biomechanics, chronic disease and exercise, coaching and performance, doping, education, engineering and technology, environmental physiology, ethics, exercise and health, exercise, lifestyle and fitness, gender in sports, growth and development, human performance and aging, management and sports law, molecular biology and genetics, motor control and learning, muscle mechanics and neuromuscular control, muscle metabolism and hemodynamics, nutrition and exercise, overtraining, physiology, physiotherapy, rehabilitation, sports history, sports medicine, sports pedagogy, sports philosophy, sports psychology, sports sociology, training and testing.

The MSA is a non-profit organization. It supports Montenegrin institutions, such as the Ministry of Education and Sports, the Ministry of Science and the Montenegrin Olympic Committee, by offering scientific advice and assistance for carrying out coordinated national and European research projects defined by these bodies. In addition, the MSA serves as the most important Montenegrin and regional network of sports scientists from all relevant subdisciplines.

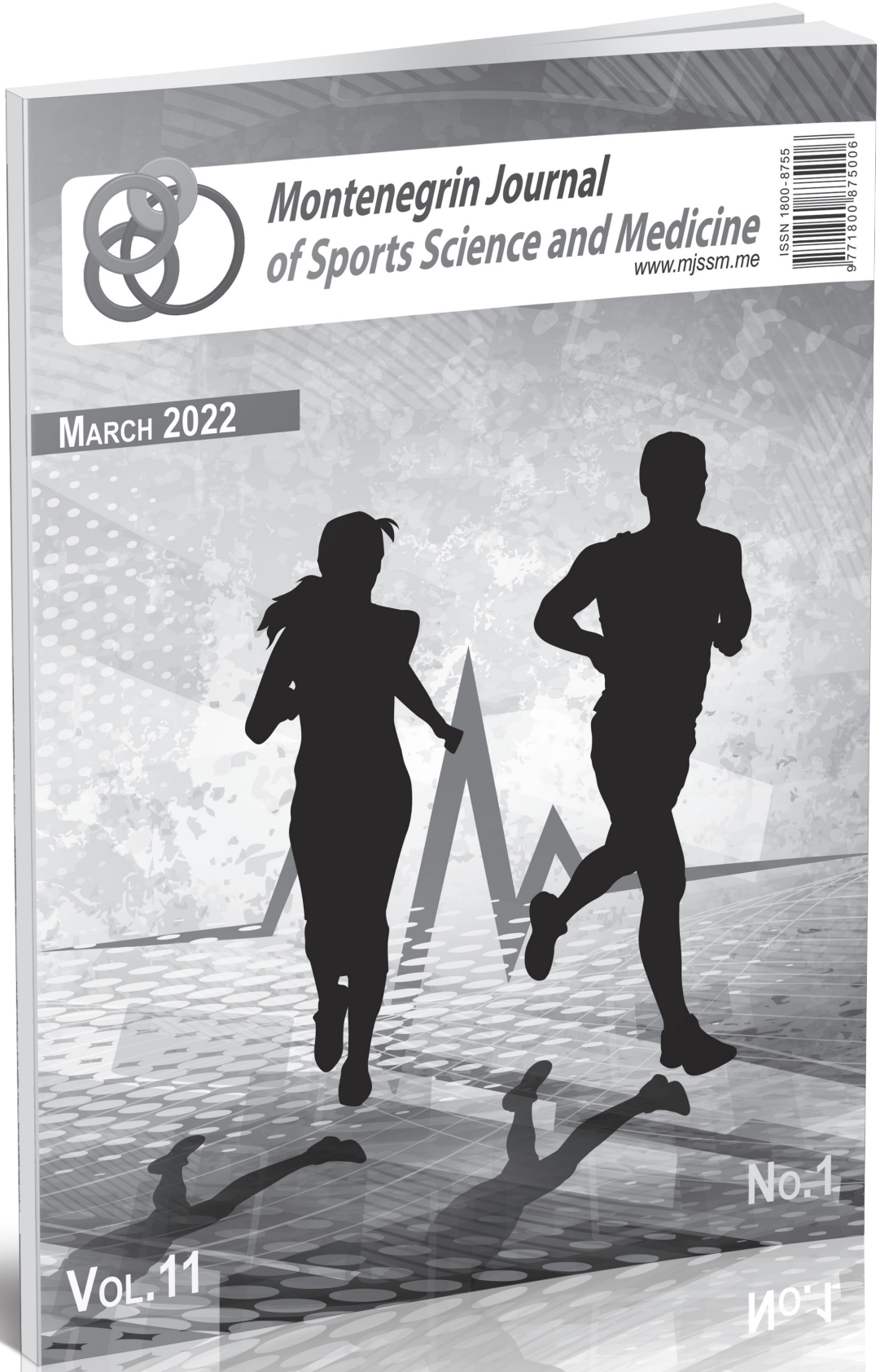
The main scientific event organized by the Montenegrin Sports Academy (MSA) is the annual conference held in the first week of April.

Annual conferences have been organized since the inauguration of the MSA in 2003. Today the MSA conference ranks among the leading sports scientific congresses in the Western Balkans. The conference comprises a range of invited lecturers, oral and poster presentations from multi- and mono-disciplinary areas, as well as various types of workshops. The MSA conference is attended by national, regional and international sports scientists with academic careers. The MSA conference now welcomes up to 200 participants from all over the world.

It is our great pleasure to announce the upcoming 19th Annual Scientific Conference of Montenegrin Sports Academy "Sport, Physical Activity and Health: Contemporary Perspectives" to be held in Dubrovnik, Croatia, from 7 to 10 April, 2022. It is planned to be once again organized by the Montenegrin Sports Academy, in cooperation with the Faculty of Sport and Physical Education, University of Montenegro and other international partner institutions (specified in the partner section).

The conference is focused on very current topics from all areas of sports science and sports medicine including physiology and sports medicine, social sciences and humanities, biomechanics and neuromuscular (see Abstract Submission page for more information).

We do believe that the topics offered to our conference participants will serve as a useful forum for the presentation of the latest research, as well as both for the theoretical and applied insight into the field of sports science and sports medicine disciplines.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