COMPARISON OF MOTOR SKILLS OF YOUNG SCHOOL STUDENTS

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Abstract

The aim of this paper was to investigate whether in the younger school-age there is a decline in motor skills compared to previous generations. The study was conducted on a sample of students of the fourth and fifth grades of elementary schools, tested in two different periods (234 students tested in 2011 and 2012 and 311 students tested in 2017 and 2018). The student's motor skills were tested and the EUROFIT test battery was applied. Differences in motor skills were determined by Mann-Whitney (U test) test. Analyzing the obtained results, it was found that there are statistically significant differences in five of the seven tests, which show that a newer generation of students has achieved significantly lower results than the older generation in both sexes. Although there has not been a long period of time between these two tests, it can be assumed that in the past few years there have been marked changes in the way of life of children, which resulted in reduced physical activity and poor motor skills.

Keywords*: younger school age, motor skills, EUROFIT battery*

INTRODUCTION

It is commonly accepted that younger generations lead a sedentary lifestyle, which can be seen in two aspects. The first is time spent in school, which is characterized by low levels of physical activity and focused on intellectual skills (Morton, Atkin, Corder, Suhrcke, & van Sluijs, 2016). The second is leisure time, which is increasingly spent on fun activities involving technological devices (Griffiths, 2010). This kind of lifestyle negatively affects young people's motor skills development (Mitic, 2011; Scragg, Quigley & Taylor, 2006; Ostojic et al., 2009). Children today have less developed motor and functional skills than their peers twenty or more years ago (Djokic, Medjedovic & Smiljanic, 2011; Stojanovic, Stojanovic & Stojanovic, 2013) and it is clear that their optimal motor skill levels condition their optimal growth and development (Badric et al., 2012, according to Findak et al., 1996), or in other words, their positive health status (Janssen, & LeBlanc, 2010; Aadland, Kvalheim, Anderssen, Resaland & Anderson, 2018).

Lack of physical activity is listed as the main cause of poorly developed motor skills (Nikolic, Bokor, Breslauer, 2008; Dzibric, Dedic, Bojic & Brcaninovic, 2013). Studies have also shown that obesity, as a side effect of a sedentary lifestyle, affects most motor skills in a negative way (Tokmakidis, Kasambalis & Christodoulos, 2006; Kostic at al., 2010; Ostojic at al., 2011; Djokic & Medjedovic, 2013).

The quantity (as well as the quality) of physical activity is especially significant during early school age since that is the crucial phase in the acquisition of motor skills (Timmons, Naylor, & Pfeiffer, 2007). This period is also important for motor skills development (sensitive periods in motor skill development), because the muscle system develops rapidly and there is a need to take care of the improvement of movement coordination through simple exercises, as well as specific, technically more demanding movements (Jurak, Strel, Leskosek & Kovac, 2011).

Regular physical activity, as well as organized physical exercising in childhood, is a part of the solution which could improve children's motor and functional skills (Timmons et al., 2007). Besides everyday physical activities that help human beings function normally (walking, getting dressed, playing), it is important to integrate organized physical activity into daily routines, not only at school but also in extracurricular activities.

Organizing physical activity in order to improve motor skills is purposeful only if it contains regular motor skill tests (Milanovic, Janic, Capric & Mirkov, 2016). Regular systemic assessment of different age groups' motor skills in different timeframes and comparisons among generations can provide insight in the quality of physical activities, as well as point to other factors (economic, cultural, technological, etc.) which affect development in positive or negative ways (Jurimae, Volbekiene, Jurimae & Tomkinson, 2007). This process has been incorporated in many countries for decades. It points out clearly visible negative trends and also provides the necessary information the society can use to react to those trends. Boddy et al. (2012) state that in Great Britain children aged 9-10.9 showed 1.8% weaker results in flying 20-meter sprint test every year in the period between 1998 and 2010. Long-distance running tests were performed in Asia

(China, Japan, South Korea, and Singapore) during the period between 1964 and 2009 for children aged 9-17 and the results showed a 16% decrease (Tomkinson et al, 2012). Similar results were found in Finland, where the Cooper test was used to track the results of 20-year olds in the period between 1975 and 2004 and there was an 8% lower result (Santtila et al., 2006).
Unfortunately, we do not have a systemic approach to this issue, so the available information mostly comes from individual research (Krajcar & Svoboda, 2005; Siljeg, Zecic, Mrgan & Kevic, 2008; Stojanovic, Stojanovic & Stojanovic, 2013). It is the case with this study, which was conducted with the aim of offering information on the current situation and making connections with previous research in order to make comparisons and come to new conclusions. The focus of this paper is motor skill testing of fifth and sixth-grade students of both sexes in Banja Luka in 2018 and 2019. The aim is to make connections with a similar study (same age characteristics) conducted in 2011 and 2012. The observed period is short, but if we bear in mind the fact that the reported results show decreasing skill levels annually, this comparison of generations six years apart seemed justified, as well as the expectation that different motor skills test results will show a regression of average values in both sexes.

METHOD

The standard procedure for monitoring youth growth and development refers to the measurement and testing of relevant anthropometric characteristics and motor skills. In this study, of a non-experimental - transversal type, motor skills testing was conducted in 4th and 5th-grade students in 2017 and 2018. For comparison purposes, data from a similar type of survey (Tadić, 2013) conducted in 2011 and 2012 were taken. Bearing in mind that a large number of countries around the world report a decline in motor skills of current generations of young people compared to previous ones (Boddy, et al. 2012), it has been sought through this paper to examine whether these phenomena characterize this geographical area as well. Although this is a relatively short period of comparison, confirmation of the assumption given would be one in a series of evidence that society should pay absolute attention to this issue.

Sample

In this study, a sample of respondents consisted of 311 (136 boys and 175 girls) students in the fourth and fifth grades of elementary schools, ages 10-11, from Banja Luka (BiH). Students were tested in physical education classes in May 2017 and 2018. The second sample was taken from a master's thesis by Tadic (2013) for the purpose of comparing results from two different periods. This sample consisted of 234 students (120 boys and 114 girls) aged 10-11 from Modrica (BiH). In this research, the author compared motor skills between students living in rural and urban areas of Modrica municipality. For the purposes of this paper, only a sample of boys and girls from urban area was taken to relate to the sample of respondents in this study.

Instruments

In this paper, a standardized test battery called "EUROFIT" (The Eurofit Physical Fitness Test Battery; Eurofit, 1993) was used. The Council for sport development of Europe Committee has proposed a given battery of tests as an effective means of monitoring the motor status of school children and is used in many schools around the world (Council of Europe, 1993). This battery consists of 7 tests and each of the tests treats one motor skills. The *Flamingo balance test* is used to evaluate balance, while a test called *Plate tapping* is used to evaluate the speed of alternative hand movements. The *Seat and reach* is a test of flexibility in the hip joint, while the *Standing broad jump* treats the explosive power of the lower extremities. *Sit-ups in 30 seconds* measures the repetitive strength of the abdominal and hip flexor muscles, *Bent arm hang* assesses the static force of the arm and shoulder muscles, while the *10x5 shuttle run* test gives insight into running speed and agility (for details on the procedures for conducting these tests, see Eurofit, 1993).

Statistical processing

The first step of statistical processing was the determination of descriptive statistics. For motor skills, the following descriptive parameters were calculated: arithmetic mean (M), standard deviation (SD), minimum score (Min.) and maximum score (Max.).
The results of the Kolmogorov-Smirnov (K-S) test found that most variables did not have a normal distribution of results. Based on the results of the K-S test, the Mann-Whitney (U test) test was chosen as the basic method for determining differences between samples in terms of motor skills. Differences in the results of the new generation of students compared to the older one will be represented as a percentage, by calculating the difference between the older and newer variables, then dividing the resulting difference by the older result and multiplying by 100.
Data processing was done by SPSS (Statistical Package for the Social Sciences) version 20.

RESULTS

Table 1 shows the descriptive parameters of boys' motor skills. We observe large values of standard deviation relative to the arithmetic mean for the variables *Flamingo balance test* and *Bent arm hang*, indicating greater heterogeneity of results in these variables. These values indicate that there are greater individual differences in the manifestation of balance and static force of the hand and shoulder muscles in both samples. Values Min. and Max. indicate that there are both extremely good and extremely poor results in all variables.

Table 1. Descriptive parameters of boys' motor skills

N = 120 i 136	Generation	M	SD	Min.	Max.
Flamingo balance test	2011-2012	5.10	3.19	1.47	16.65
	2017-2018	3.34	1.87	.50	10.67
Plate tapping	2011-2012	11.50	1.68	8.43	17.16
	2017-2018	15.40	2.98	10.50	32.58
Seat and reach	2011-2012	15.64	7.98	0	34
	2017-2018	15.02	5.73	.00	32.0
Standing broad jump	2011-2012	156.94	28.12	100	232
	2017-2018	141.90	21.35	82.0	197.0
Sit-ups in 30 seconds	2011-2012	21.33	5.27	0	32
	2017-2018	20.17	3.80	7	30
Bent arm hang	2011-2012	32.61	26.64	.00	123.70
	2017-2018	14.08	14.10	.00	68.00
Shuttle run 10x5	2011-2012	20.85	1.89	16.72	26.88
	2017-2018	21.38	2.51	16.34	29.52

Legend: N - number of respondents; M - arithmetic mean; SD - standard deviation; Min. - minimum score; Max. - maximum score.

Table 2 shows the descriptive parameters of girls' motor skills. Based on the arithmetic means, we can see some differences between these two samples of girls. The ratio of standard deviation to arithmetic mean indicates that the greatest heterogeneity of results are in the variables *Flamingo balance test* and *Bent arm hang*.

Table 2. Descriptive parameters of girls' motor skills

N = 114 i 175	Generation	M	SD	Min.	Max.
Flamingo balance test	2011-2012	5.41	3.54	1.35	22.09
	2017-2018	3.84	2.10	.50	11.91
Plate tapping	2011-2012	11.31	1.75	8.32	18.93
	2017-2018	15.08	2.32	11.40	27.27
Seat and reach	2011-2012	21.71	6.98	3	36
	2017-2018	19.01	5.96	3.0	39.0
Standing broad jump	2011-2012	139.06	21.39	90	194
	2017-2018	133.09	18.41	78.0	180.0
Sit-ups in 30 seconds	2011-2012	18.28	5.08	0	28
	2017-2018	18.87	3.26	5	29
Bent arm hang	2011-2012	21.23	18.70	.00	95.53
	2017-2018	11.77	11.54	.00	61.00
Shuttle run 10x5	2011-2012	22.40	2.07	18.34	28.82
	2017-2018	22.46	2.53	17.41	29.99

Legend: N - number of respondents; M - arithmetic mean; SD - standard deviation; Min. - minimum score; Max. - maximum score.

Based on the significance of the U-test (Table 3), we observed statistically significant differences for all variables except the *Seat and reach* and the *Shuttle run 10x5*. It can be stated that the boys tested in 2011 and 2012 were more successful in the domain of balance, speed of alternative movements, explosive strength, muscular endurance of abdominal muscles and static force of arms and shoulder muscles than boys of the same age tested in 2017 and 2018. In tests that assess the flexibility and running speed and agility, boys of the earlier generation also scored better, but these differences were not statistically significant.

Table 3. Differences in motor skills of two generations of boys

Variables	U-test	p	Differences in % (generation 2011/12 – 2017/18)
Flamingo balance test	5059.50	**.000**	-34.51
Plate tapping	1386.50	**.000**	33.91
Seat and reach	7715.50	.452	-3.96
Standing broad jump	5659.50	**.000**	-9.58
Sit-ups in 30 seconds	6433.0	**.003**	-5.44
Bent arm hang	4731.50	**.000**	-56.82
Shuttle run 10x5	7044.50	.059	2.54

Legend: p – significance

Percentage differences indicate a large decrease in the new generation of boys in the *Flamingo balance test* and *Bent arm hang*. The variable *Plate tapping* shows an increase of the result by almost 34%, however, because in this test a higher value actually means a worse result, then, in this case, we also note a decrease in the result. The girls from these two samples (Table 4) differ statistically significantly in variables that estimate balance, speed of alternative movements, flexibility, explosive strength, and static force of the arms and shoulder muscles. In all of these variables, girls tested in 2011 and 2012 performed better.

As is the case with boys, here is also the highest percentage drop in scores in the *Flamingo balance test*, *Plate taping,* and *Bent arm hang*.

Table 4. Differences in motor skills of two generations of girls

Variables	U-test	p	Differences in % (generation 2011/12 – 2017/18)
Flamingo balance test	6992.0	**.000**	-29.02
Plate tapping	1537.0	**.000**	33.33
Seat and reach	7420.0	**.000**	-12.44
Standing broad jump	8244.0	**.013**	-4.29
Sit-ups in 30 seconds	9616.0	.604	3.23
Bent arm hang	6919.50	**.000**	-44.56
Shuttle run 10x5	9905.0	.920	0.27

Legend: p - significance

DISCUSSION

Motor skills are a significant factor in children's development (Smith, et al., 2014). However, after analyzing the results obtained we can assume that a period of only several years is enough for lifestyle changes to cause poorer motor skills. It was found that the new generation students' test results were significantly lower than those of the older generation at 5 out of 7 tests performed. These results indicate that the claim stated in earlier studies (Krajcar & Svoboda, 2005; Gajevic, 2009; Stojanovic, Stojanovic & Stojanovic, 2013) - that the younger generations have poorer motor skills - can be accepted as correct. Our findings are important because they justify the need for constant motor skills monitoring and testing, in order to notice negative trends and react on time.

There are a few limitations that stop us from making general conclusions in this study. First, the results were obtained through a cross-sectional study from a small sample of respondents. In order to make general conclusions, it is preferable to conduct a longitudinal study with a greater number of respondents, which could be an extension of this paper. Second, the respondents in this study are from Banja Luka, whereas those in the previous study (Tadic, 2013) were from Modrica. Unfortunately, there are no regular systemic records of children's motor skills (especially at early school age) in the Republic of Srpska, so we used the information obtained in Modrica even though we are aware of the potential environmental impact, for example, a different infrastructural potential or the ways the society values physical activity and encourages young people to engage in it.

The differences between some variables in these two samples are too significant to be ignored, which can be seen in the decreasing percentages. The same negative trends are present in other countries (Boddy et al., 2012; Tomkinson et al., 2012; Venckunas, Emeljanovas, Mieziene & Volbekiene, 2017; Runhaar et al., 2010). In Great Britain Cohen et al. (2011) found a significant decrease in percentages for sit-ups in 30 seconds (-27.1%) and bent arm hang (-25.9%) in a sample of 309 boys and girls aged 10-10.9 in the period between 1998 and 2008. Hand-grip test results decreased slightly less (-6.3%), whereas standing broad jump showed better results (5.5%), which is the opposite of the results we obtained performing that test. The results obtained by Moliner-Urdiales et al. (2010) from a sample of adolescents in Spain between 2001 and 2007 show improved results of agility and aerobic endurance (4x10m and Beep test) and a visible decrease in the results of explosive strength and static force of arms and shoulders (standing broad jump and bent arm hang). In Northern Europe, more specifically in Denmark, the results showed a decrease in strength components (Ekblom, Oddsson & Ekblom, 2007) in the period between 1987 and 2001. The most significant decrease was noticed at the bent arm hang test, while smaller differences were present in standing broad jump and sit-ups. There weren't any differences in aerobic endurance. The results of this study are different than those obtained by a study in Portugal (Costa, et al., 2017), where boys and girls aged 10 and 11 displayed improved speed and strength of abdominal muscles in the period between 2003 and 2013 (40m sprint and sit-ups).

When we look at the studies conducted in this region, we can see that the results are compatible with those obtained by Stojanovic, Stojanovic & Stojanovic (2013), where it can be seen that 13-year-old boys tested in 1970 performed significantly better at explosive strength tests (standing broad jump and standing triple jump), static and repetitive strength tests (bent arm hang and sit-ups on the bench) and speed tests (20m run from a standing start) than the boys tested in 1995. When the movement frequency speed is concerned, there is a significant difference in plate tapping in favor of the 1970 generation, while the 1995 generation performed better at the foot-tapping test. Flexibility tests showed that the younger generation was better at (V – seat and reach) test and the older generation at standing flexion test.

Tests that assess children's aerobic fitness should be added to these studies. If we consider the fact that this aspect is less innate and more likely to change, it is assumed that younger generations would show even more significant differences due to the lack of activity. Siljeg, Zecic, Mrgan & Jevic (2008) noticed a decrease in the aerobic fitness of fifteen-year-olds. New generation students ran a shorter distances within six minutes.

It can be assumed that decreased levels of motor skills displayed by younger generations are a consequence of decreased levels of physical activity and poor diet, which lead to obesity. This conclusion is based on studies dealing with this issue. There are numerous studies indicating that children who engage in physical activities more have more developed motor skills (Nikolic, Bokor & Breslauer, 2008; Dzibric, Dedic, Bojic & Brcaninovic, 2013). Kostic et al. state that obese children showed significantly lower results at explosive strength, speed, and coordination tests. Strong negative correlation between obesity and aerobic fitness in children aged 6-14 was found

in a study conducted by Ostojic et al. There are other studies showing the negative impact of obesity on motor skills (González-Gross et al., 2006; Tokmakidis, Kasambalis & Christodoulos, 2006; Djokic & Medjedovic, 2013). Based on the abovementioned, we can conclude that regular and systematic physical activity, as well as the diet quality, is extremely important for maintaining and improving motor skills.

CONCLUSION

The results of this research show that in the period 2011/12 to 2017/18 there was a decrease in motor skills among students of the fourth and fifth grades of primary school. Respondents from the previous survey achieved significantly better results in five of the seven tests than the newer generation of students. This negative trend is present in both sexes to the same extent. Although this research does not delve deeper into the causes of these phenomena, it does provide clear directions for future research.

Some attention is drawn to the results of tests such as *Bent arm hang* and the *Flamingo balance test*. The question is whether these tests are valid, that is, whether they differentiate well the students' results. If we have a large number of those who can not complete the task, such as in the *Bent arm hang*, or the heterogeneity of the results is as in the *Flamingo balance test*, then we might want to consider other tests or some modifications to them. For example, measuring the static force of the arm and shoulder muscles could be performed using the same principle of *Bent arm hang*, where the subject is able to support the feet from the ground at a certain angle, while the balance test could be facilitated by increasing the standing surface.

When it comes to criticizing EUROFIT battery tests, there was also an unjustified omission of a test that would measure aerobic fitness in subjects, especially because it represents an essential measure of health-related physical fitness (see Milanovic, 2011, p. 25), which is a priority and ultimate goal when it comes to the physical development of children.

Regardless of the limitations stated earlier in the paper, the results of this paper should not be ignored, since it indicates that there is a large decline in motor skills among new generations of students. Future studies with a longer period of testing and monitoring of motor skills in a larger number of subjects should provide more reliable answers to the question of the decline of motor skills in children. Accordingly, we should think about the idea of creating a common database at the state level, about the motor, functional and morphological characteristics of students, through a system of physical education. In this way, it would be easier to monitor student growth and development and implement specific interventions in line with the results.

LITERATURE

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