RESEARCH INTO MOTION PERFORMANCE CHANGES OF PRIMARY SCHOOL CHILDREN OVER A PERIOD OF 20 YEARS

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This research was implemented within the VEGA 1/0122/19 project *Somatic and motor characteristics of primary school children and their development trends with special emphasis on handicapped Romany communities.*

Abstract: This research tested 950 primary school pupils in the age from 7 to 10 years. All of them attended primary schools in East Slovakia at the time of testing. We employed the Eurofit test and compared our results to those provided in Turek (1999). The Eurofit test was used for the sake of compatibility with Turek's research. Based on the measured and computed data we identify the trend in motion performance and somatic parameters. The data collected in 2019 is evaluated by standard statistical methods. It is compared to Turek's (1999) data by means of the parametric one sample t–test. The results indicate worse motion performance in primary school pupils compared to the 1999 measurements.

Keywords: somatic parameters, motion performance, Eurofit test, t-test

Introduction

The Act of Sports, No.440/2018, introduced in the Slovak Republic an obligatory nationwide testing of motion performance of pupils attending the 1st and the 3rd years of primary school. Despite numerous problems, which accompanied the testing process (material problems, personnel, etc.), the test results will no doubt become a valuable source of information of motor predispositions of children and will contribute to a higher effectiveness of the selection of talented children for sports. A Commission of the Ministry of Education, Science, Research and Sports specified the following motor and somatic tests: body height and weight, BMI - body mass index, repeated composition with a club, pull-up upper-catch endurance, standing long jump, shuttle run 4x10 m., sit-and-reach, rolling three balls, and multistage endurance run. Apart from the somatic parameters of the body height, body weight and BMI, the tests include a battery of nine test items six of which are a part of the Eurofit test. The first stage of the nationwide testing process included children attending the first year of primary school. The present research encompasses 7-10-year-old pupils tested for somatic parameters and motor performance by means of the Eurofit test battery. The results are compared to those presented in Turek (1999).

1 Problem

The motion performance testing in Slovakia and former Czechoslovakia has a long tradition. The first nationwide testing was implemented by Pávek (1966). New test batteries, which were focused on the evaluation of physical abilities and performance of pupils were introduced in the countries of West Europe and North America in 1950s and 1960s. The Committee for Sport Development of the European Council formulated fundamental principles for mapping physical development and motion performance in children and youth in the EUROFIT monograph (1987) which summarized empirical results and defined testing methods.

The Eurofit motion performance measurements also included somatometry, i.e., measurements of the body height and weight, subcutaneous tissue measurements for the determination of the fat percentage, and specification of the BMI – the body mass index.

Pávek (1966) was one of the first to examine and measure the motion performance in the former Czechoslovakia. A large-scale project examining physical abilities and motion performance was implemented by Moravec et al. (1987). Moravec and his team repeated their measurements in 1996. Motion performance tests were later implemented by Moravec (2002), Zapletalová (2002), Turek (1999), Glesk and Merica (2000), Horváth (2001), Čillík (2016), Šimonek (2018) and others. Somatic parameters and motion performance in Romany children were tested by Horváth (2001) and Horváth, Bernasovská, Boržíková and Sovičová (2010). A research team of the Department of Physical Education and Sports, Constantine the Philosopher University in Nitra collected data from 169 pupils attending the first year of primary schools in Nitra, and compared it to the test data in Moravec (2002), Zapletalová (2002) and Čillík (2016) within a pre-research stage of the nationwide program of motion performance testing. The results were confirmed by the 2019 nationwide testing itself published in Ružbarský and Perič (2019). Recent approaches prefer to focus on basic motion competencies of pupils of individual age categories instead of diagnosing the motion performance. The new test batteries MOBAK1-2, MOBAK 3-4 and MOBAK 5-6 motivate pupils of the 1st to 6th years of primary school to master natural motion activities.

2 Method

2.1 Data collection method

The research data was collected at primary schools of East Slovakia. We tested 950 children, including 465 boys and 485 girls. We measured somatic parameters in 7- to 10-year-old children and tested them for eight items of the modified Eurofit test.

TH	Body weight	
TV	Body height	
BMI	Body mass index	
TR	Flamingo balance test	Factor: Static balance
TAPP	Plate tapping	Factor: Frequency speed
PRKL	Sit and reach	Factor: Body flexibility
SKOK	Standing long jump	Factor: Dynamic strength of legs
LS	Sit - ups	Factor: Dynamic and endurance strength of abdominal and loins-thigh muscles
VZH	Push –up test	Factor: Static and endurance strength of arms
CBEH	Shuttle run 10x5m	Factor: Running velocity with direction changes
VBEH	Multistage shuttle run endurance	Factor: Running endurance

Our data was compared to those in Turek (1999). The latter provides data on 3,590 children, including 1,855 boys and 1,735 girls living in East Slovakia.

2.2 Research hypotheses

H0-1 We hypothesize no statistically significant differences in somatic parameters between the results in Turek (1999) and the 2019 research.
H1-1 We hypothesize statistically significant differences in somatic parameters between the results in Turek (1999) and the 2019 research.
H0-2 We hypothesize no statistically significant differences in individual motion performance test items between the results in Turek (1999) and the 2019 research.
H1-2 We hypothesize no statistically significant differences in individual motion performance test items between the results in Turek (1999) and the 2019 research; in addition, we hypothesize that the results in Turek (1999) will be better than those in our 2019 research.

2.3 Data processing

Hypotheses H0-1 and H0-2 were verified by means of Student's one sample t-test. The correct use of this test required verification of the set normality by means of Shapiro wilk test. Since the set normality was confirmed by this test the hypotheses could be verified by the parametric Student's one sample test.

$$t= \left(\frac{x_{1999}-x_{2019}}{s}\right)\sqrt{n}$$

where

x_{1999} – arithmetic mean of the values in Turek (1999)

x_{2019} - arithmetic mean of the values in our 2019 research

s – standard deviation in 2019

n – number of testees in 2019

The calculated value t was compared at the postulated significance level of α= 0,05 to the table value of Student's distribution at n-1 degrees of freedom $t_{krit.}$

If $t>t_{krit}$ the null hypothesis H0 is rejected and the alternative hypothesis H1 is accepted.

3 Results and discussion

The results of Student's t-test are given in Tables 1 and 2. Student's t-test was used to identify possible, statistically significant differences between Turek (1999) and our 2019 results in individual test items. The t-test results are commented together with the diagrams.

Table 1: T-test results - boys

α=0,05	7-year-old boys	8-year-old boys	9-year-old boys	10-year-old boys
	n=105	n=130	n=112	n=118
	tkrit=2,020	tkrit=1,978	tkrit=1,981	tkrit=1,980
TV	0,937	0,89	3,22**	2,68**
TH	2,54**	1,74	2,39**	5,37**
BMI	3,02**	2,48**	1,25	3,36**
TR	9,96**	1,31	5,22**	2,27**
TAP	12,74**	5,63**	6,22**	2,12**
PRKL	9,15**	13,35**	11,95**	10,98**
SKOK	3,1**	6,26**	3,01**	9,5**
LS	0,95**	0,94	1,84	5,22**
VZH	6,17**	3,24**	0,138	3,23**
CBEH	5,67**	0,35	0,151	2,09**
VBEH	2,02**	1,35	0,89	1,66

α - statistical significance

n – number of probands

** statistically significant difference at the significance level of α=0,05

Table 2 : t-test results - girls

α=0,05	7-year-old girls	8-year-old girls	9-year-old girls	10-year-old girls
	n=115	n=123	n=123	n=124
	tkrit=1,980	tkrit=1,980	tkrit=1,980	tkrit=1,980
TV	2,01**	4,66**	1,35	2,78**
TH	0,62	0,25	2,97**	5,06**
BMI	0,125	1,7	3,09**	4,08**
TR	14,48**	5,84**	4,25**	4,47**
TAP	7,52**	3,92**	5,24**	3,58**
PRKL	13,39**	10,75**	11,85**	11,53**
SKOK	4,01**	4,54**	4,86**	8,62**
LS	2,2**	0,76	0,04	5,81**
VZH	4,66**	0,17	1,71	0,39
CBEH	3,65**	2,59**	0,67	2,25**
VBEH	4,03**	0,7	0,7	1,08

α - statistical significance

n – number of testees

** statistically significant difference at the significance level of α=0,05

3.1 Somatic parameters

3.1.1 TV – Body height

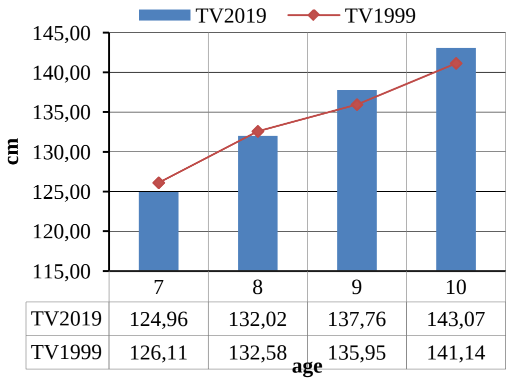


Diagram 1: Body height comparison - TV - boys

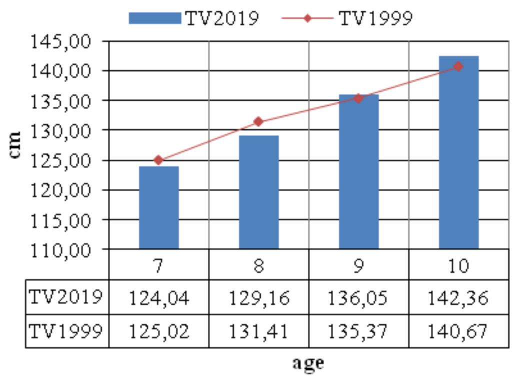


Diagram 2: Body height comparison - TV - girls

Our analysis of the t-test and the diagrams show that the 2019 male testees are taller in a statistically significant way only in the age categories of 9- and 10-year-old pupils. The girls from Turek (1999) are even taller in a statistically significant way in the age categories of 7- and 8-year-old pupils. While girls in the age of 9 show minimum differences, the 10-year-old girls from our 2019 research are taller in a statistically significant way.

3.1.2 TH –body weight

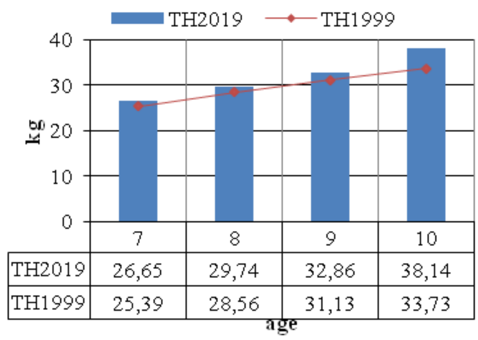


Diagram 3: Comparison of the body weight –TH - boys

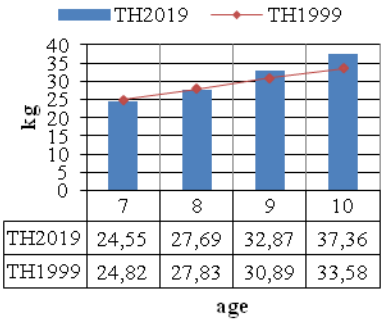


Diagram 4: Comparison of the body weight –TH - girls

It follows from Table 2 that the body weight is higher in our research in a statistically significant way only in 7-, 9- and 10-year-old boys. Statistically significant differences were also found in 9- and 10-year-old girls. The differences increase with the age in both boys and girls. The difference in average values in 10-year-old boys is 4.41kg, which is 13.01%; in 10-year-old girls it is 3.78kg, i.e., 10.01%.

3.1.3 BMI - Body mass index

The body mass index is a calculated value which gives relevant information about the proportion between the weight and the height. It enables us to identify a too low or a too high weight, or even obesity. In children, it is evaluated differently from adults - cf. Diagram 7.

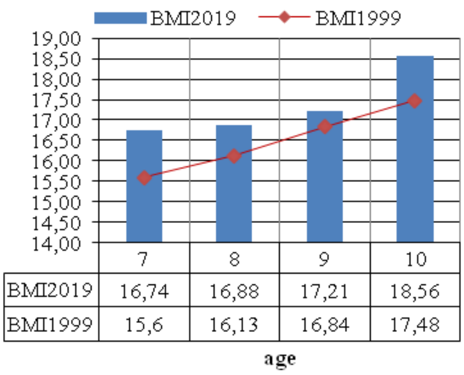


Diagram 5: Comparison of the body mass index - BMI - boys

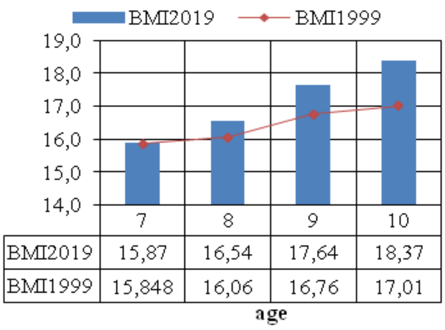


Diagram 6: Comparison of the body mass index – BMI - girls

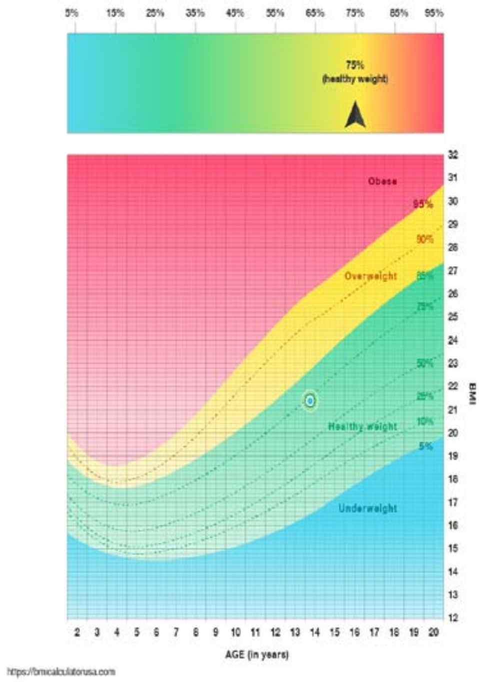


Diagram 7: Illustration of the BMI by age
Source:https://bmicalculatorusa.com

Diagram 7 provides us with the BMI values for children of a specific age. The differences between the values obtained in 1999 by Turek and our values increase with the growing age of both boys and girls. The differences in 9- and 10-year-old children are statistically significant at the significance level of $\alpha=0,05$

With regard to hypothesis H0-1, the evaluation is ambiguous for all age categories. There are no statistically significant differences between the 1999 and the 2019 data in terms of somatic parameters, in particular, the body height of 7- and 8-year-old boys and 9-year-old girls. The alternative hypothesis H1-1 applies to the categories of 9- and 10-year-old boys and 9-year-old girls. This means that there are significant differences in the values obtained in the two research projects in the body height of these age categories. The 2019 children are taller than the 1999 children. As far as the body weight is concerned, hypothesis H0-1 has been confirmed in 8-year-old boys and 7- and 8-year old girls. It is only in these age categories that there are no significant differences between the 1999 and the 2019 children in terms of physical weight. The other age categories of boys and girls manifest statistically significant differences between the two sets of research data in the somatic parameters of body height and body weight. The body weight of the 2019 children is higher than that of the 1999 children.

3.2 Motion performance

3.2.1 TR -Balance test - factor: static balance

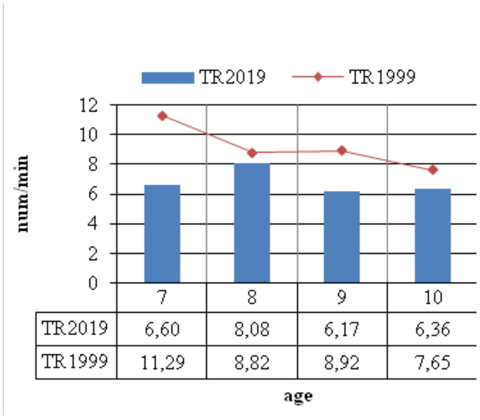


Diagram 8: Comparison based on the balance test – TR - boys

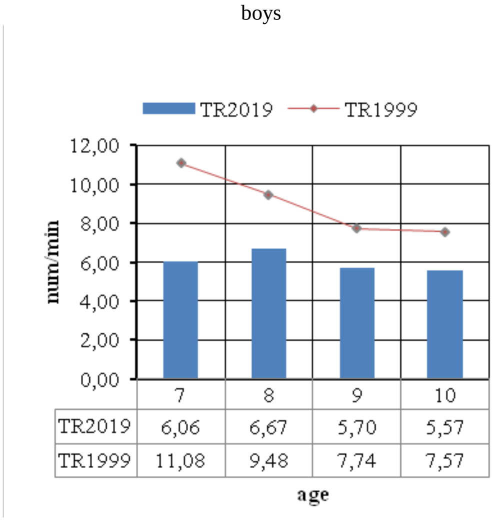


Diagram 9: Comparison based on the balance test – TR – girls

The balance test is designed to evaluate static balance. The t-test results confirm a statistically significant difference between the data from 1999 and 2019 in all age categories, with the exception of 9-year-old boys. Nevertheless, the 2019 results in this age category are still better, even though this fact is not confirmed by the t-test. Contrary to our expectations, the 2019 results are better than those obtained in 1999.

3.2.2 TAP - Plate tapping - factor: frequency speed of arm

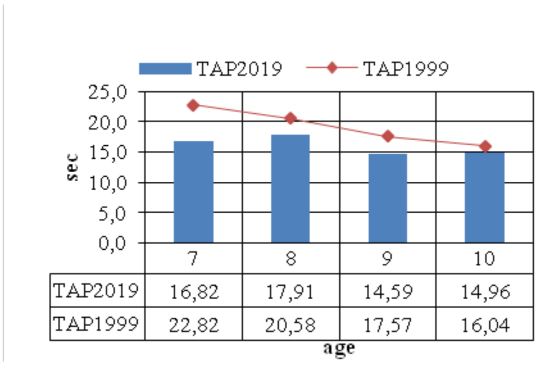


Diagram 10: Comparison based on plate tapping – TAP- boys

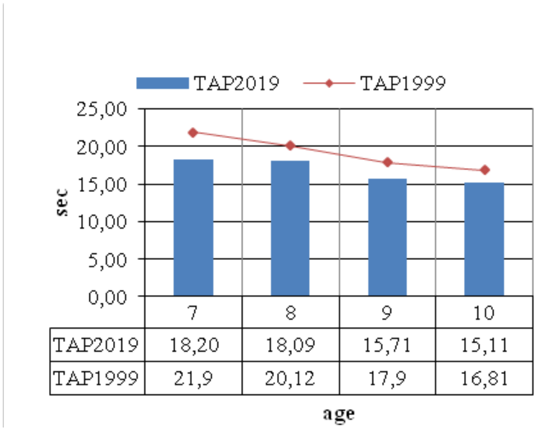


Diagram 11: Comparison based on plate tapping – TAP- girls

This test is designed to evaluate the arm frequency speed. The t-test results suggest that the differences between the 1999 and the 2019 data are statistically significant in all age categories of boys and girls; in particular, the 2019 results are better than the 1999 results. This gives support to hypothesis H1-2 postulating significant differences between the two sets of data. However, in contrast to our expectations, better results were achieved by children in the 2019 tests.

3.2.3 PRKL - Sit-and-reach –factor: body flexibility

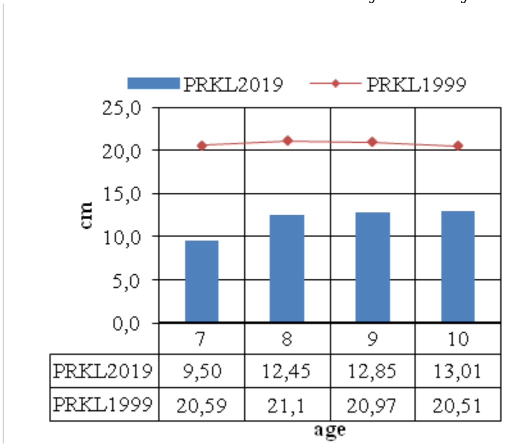


Diagram 12: Comparison based on sit-and-reach – PRKL- boys

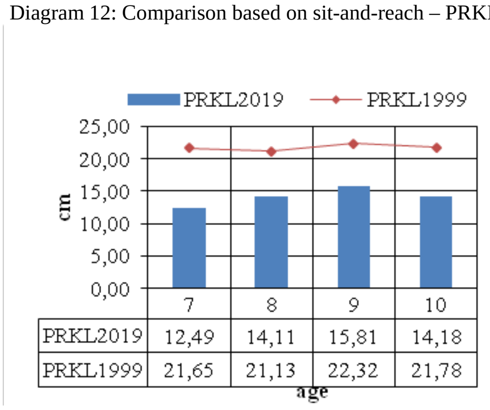
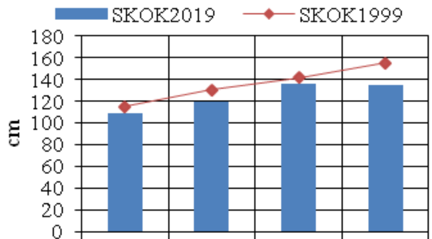


Diagram 13: Comparison based on sit-and-reach – PRKL- girls

This test item is designed to evaluate body flexibility. It provides unambiguous t-test results. This test confirms statistically significant differences between the 1999 and the 2019 data in all age categories of boys and girls. Body flexibility is much better in the 1999 population than in the 2019 children. This is manifested in diagrams 12 and 13. The biggest differences have been found in 7-year-old boys and 9-year-old girls. This gives support to hypothesis H1-2 saying that there are statistically significant differences between the 1999 and the 2019 testees. In particular, the 1999 children show better results in this test item.

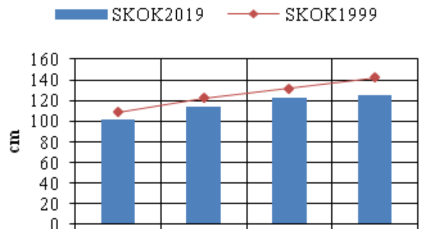
3.2.4 SKOK - Standing long jump – factor: dynamic strength of legs



	7	8	9	10
SKOK2019	108,91	119,90	135,82	135,42
SKOK1999	115,13	130,31	141,66	155,15

age

Diagram 14: Comparison based on the standing long jump – SKOK - boys



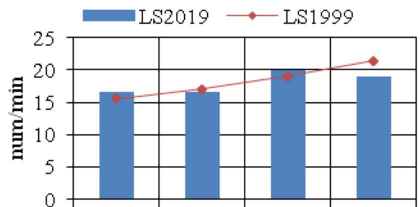
	7	8	9	10
SKOK2019	101,61	113,52	122,98	125,28
SKOK1999	108,73	122,11	131,76	142,28

age

Diagram 15: Comparison based on the standing long jump – SKOK - girls

This test item which makes it possible to evaluate the dynamic strength of legs opposes hypothesis H0-2 for all age groups of boys and girls, and confirms the alternative hypothesis H1-2. This means that there are statistically significant differences between the 1999 and the 2019 results. As it follows from diagrams 14 and 15, the 1999 data is much better than that obtained in 2019. The most striking differences have been identified for the age category of 10-year-old boys with the difference being as high as 13%, and the age category of 10-year-old girls with the difference at the level of 8.4%.

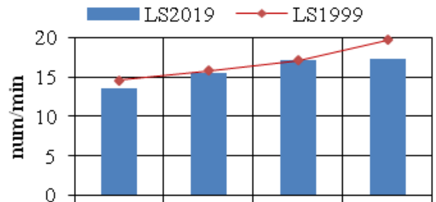
3.2.5 LS - Sit-ups – factor: dynamic and endurance strength of abdominal and loins-thigh muscles



	7	8	9	10
LS2019	16,52	16,67	19,91	19,03
LS1999	15,6	17,07	19,02	21,46

age

Diagram 16: Comparison based on sit-ups - LS- boys



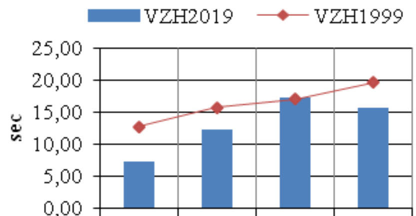
	7	8	9	10
LS2019	13,58	15,50	17,09	17,28
LS1999	14,59	15,8	17,11	19,64

age

Diagram17: Comparison based on sit-ups - LS- girls

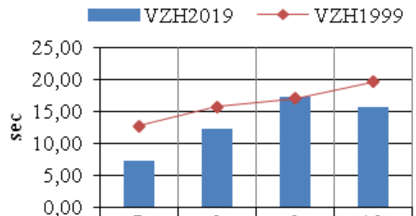
The sit-up item tests the dynamic and endurance strength of abdominal and loins-thigh muscles. The results are rather ambiguous. A statistically significant difference between the two data sets has been confirmed only for 10-year-old boys (in favour of the 1999 testees). In the group of 7-year-old boys, the data is better for the 2019 testees in a statistically significant way. No statistically significant differences have been identified for the groups of 8- and 9-year-old boys. Statistically significant differences in favour of the 1999 testees have been found for 7- and 10-year-old girls. The groups of 8- and 9-year-old girls do not show any statistically significant differences. In general, the results of the 1999 testees are better than those of the 2019 testees.

3.2.6 VZH - Push-up test –factor: static and endurance strength of arms



	7	8	9	10
VZH2019	7,23	12,26	17,14	15,52
VZH1999	12,65	15,62	16,94	19,53

age



	7	8	9	10
VZH2019	7,23	12,26	17,14	15,52
VZH1999	12,65	15,62	16,94	19,53

age

Diagram 18: Push-up endurance – VZH - boys

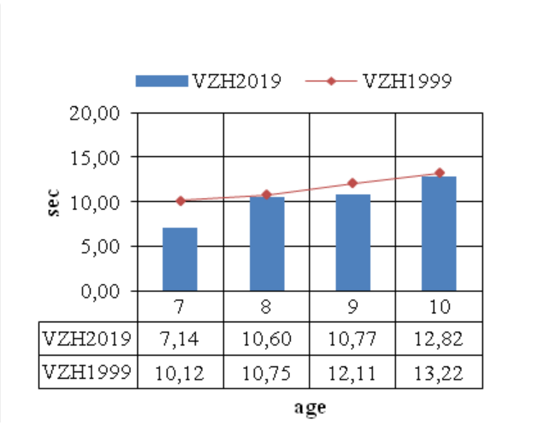


Diagram 19: Push-up endurance – VZH – girls

The push-up endurance test item evaluates the static and endurance strength of arms. There are statistically significant differences between the results of the 1999 and the 2019 testees, in particular, in 7-, 8- and 10-year-old boys and 7- and 9-year-old girls. The measurement validity is, however, problematic because the coefficient of variation (proportion between the standard deviation and the arithmetic mean) in all age categories of boys and girls significantly exceeds 50%. This suggests an extraordinary high dispersion of the measured values with regard to the arithmetic mean. Interestingly, this fact was observed by both Horváth (2001) and Turek(1999).

3.2.7 CBEH - Shuttle run 10x5m factor: running velocity with direction changes

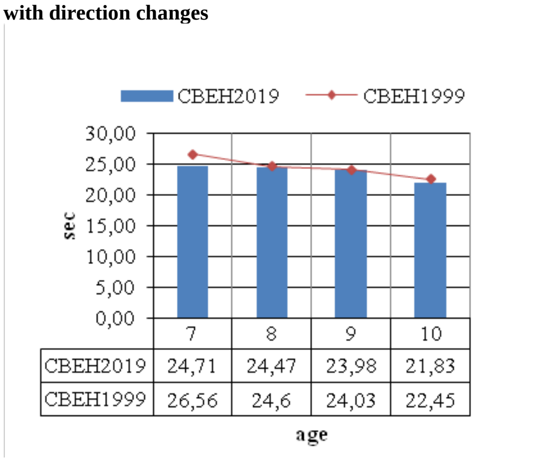


Diagram 20: comparison based on the shuttle run – CBEH - boys

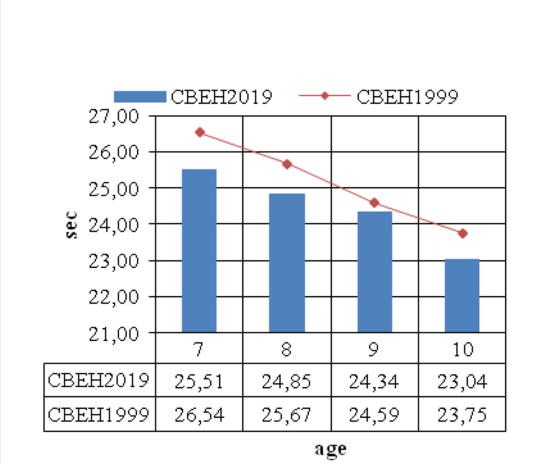


Diagram 21: Comparison based on the shuttle run – CBEH – girls

The t-test results suggest that statistically significant differences between the results of the 1999 testees and the 2019 testees have been confirmed for the shuttle run 10x5 m test item, used to evaluate the running velocity with changes of direction, only for 7- and 10-year-old boys and 7-, 8- and 10-year-old girls. However, the 2019 results are better than the 1999 results in all age categories of boys and girls.

3.2.8 VBEH - Endurance shuttle run factor: running endurance

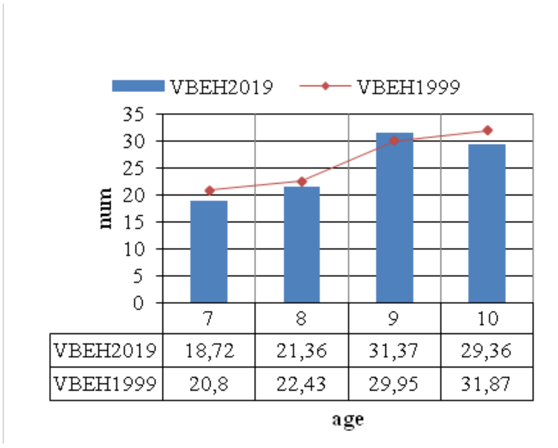


Diagram 22: Comparison based on the endurance shuttle run – VBEH – boys

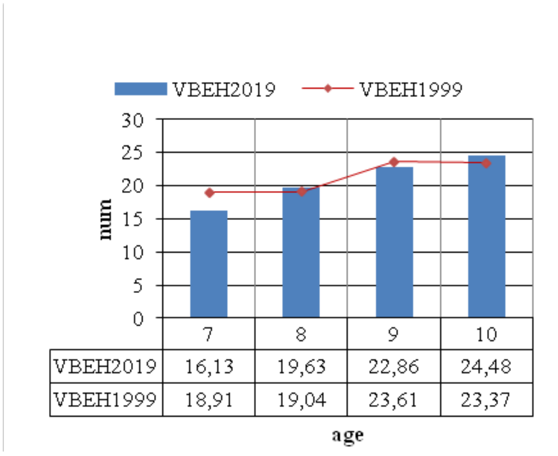


Diagram 23: Comparison based on the endurance shuttle run – VBEH - girls

The endurance run test results are ambiguous. The t-test has confirmed statistically significant differences in 7- and 9-year-old boys in favour of the 1999 testees. The 1999 results of the 8-year-old boys are better than the results of the 2019 testees, however, without any statistical significance. The results of the 9-year-old boys tested in 1999 are even worse than the results of the 2019 testees. Statistically significant differences in favour of the 1999 testees have been confirmed for 7- and 9-year-old girls. The categories of 8- and 10-year-old girls tested in 2019 achieved better results than the same age categories in 1999. However, these results are not significantly better.

4 Conclusion

The findings of our research can be summarized as follows:

- As far as somatic parameters are concerned, we have identified a substantial increase in children's weight compared to the 1999 testees. This fact is also observed, for example, in Čillík (2016) and Šimonek (2018).

Furthermore, this observation was confirmed in the nationwide research focused on children attending the 1st year of primary school. The reason consists in the lack of motion and incorrect dietary habits of the present generation of children. While we know much more about correct dietary principles than in the past, children of this generation eat too much sweets, consume sweet drinks since the early childhood, and, unfortunately, the most popular food of many children is fastfood.

- The motion performance data witness to a similar situation. Turek (1999) developed standards of motion performance for primary school children. When comparing the 2019 results with these standards we cannot but conclude that the majority of the 2019 testees are at the level of 'under average down to poor'. Children do not move sufficiently; they mostly spend their time with mobile phones and at social networks. The motion performance results show that the differences between the 1999 and 2019 testees increase with the growing age. Sports are time- and money-consuming for parents. This is what not all of them can afford or wish to undergo. School circles are rare, and children can hardly spend their time outdoors without supervision. Two hours of physical education at school are not sufficient for healthy development of children. The more so that many children do not attend physical education at all, either due to health reasons or due to the lack of interest. In addition, even if we live in the 21st century there are a number of schools without a proper gymnasium. Our research thus has confirmed the hypothesis that motion performance of 7- to 10-year-old boys and girls has worsened compared to the situation 20 years ago. Moreover, there exists a positive correlation between the growing body weight and worse motion performance.

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