MOTOR DEVELOPMENT OF SLOVAK AND HUNGARIAN 6 – 7-YEAR-OLD PUPILS IN THE ASPECT OF DEGREE OF OBESITY (FIRST PHASE OF A LONGITUDINAL STUDY)

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ABSTRACT

Introduction and aim: In Hungary (HUN) there are everyday PE lessons (5 per week), while there are significantly fewer PE lessons (2 per week) in Slovakia (SVK). We compare SVK and HUN children who started to attend primary school in the autumn of 2018 and our main hypothesis is that more regular PE lessons have more positive effect on motor development due to the improvement in the degree of obesity.
Methods: 311 children from both countries and genders (SVK: 94 boys and 104 girls; HUN: 57 boys and 56 girls) participated in the study. Their BMI percentiles were defined according to the BMIs of the measured children from the same country and then they were classified by BMI percentiles to lean (L; percentile was less than 25%), normal (N; percentile was between 25.1 and 74.9%) and overweight/obese (OOB; percentile was more than 75%) categories. To examine their motor development we used the Test of Gross Motor Development-2 (TGMD-2) which does not measure performance, but classifies motor coordination based on given observation criteria. TGMD-2 contains locomotor (run, gallop, hop, leap, horizontal jump, slide) and object control (striking a stationary ball, stationary dribble, catch, kick, overhand throw, underhand roll) tasks.
Results: 23.01% was L and 24.78% was OOB among the HUN pupils and 23.23% was L and 24.75% was OOB among the SVK children. There were no significant differences between the BMI categories or the two countries in the results of different locomotor tasks. The L HUN pupils (38.5 ± 1.2 S.E.M.) were significantly better than the OOB HUN children (33.39 ± 1.49) in the overall results of locomotor tasks. We did not detected similar difference among the SVK pupils. In the object control tasks, there were no significant differences between the BMI categories' or the two countries' results of striking a stationary ball, stationary dribble or underhand roll. The L SVK children's results of catch was significantly lower (3.72 ± 0.27) than the N SVK pupils' (4.79 ± 0.14) or the L HUN children's (5.08 ± 0.23) results. The L HUN children kicked the ball with higher points (6.58 ± 0.35) than the L SVK pupils (5.13 ± 0.33). There were remarkable differences between SVK and HUN pupils in all the three BMI categories' results of overhand throw (L SVK: 3.24 ± 0.27; L HUN: 5.46 ± 0.31; N SVK: 3.22 ± 0.17; N HUN: 5.76 ± 0.25; OOB SVK: 2.98 ± 0.24; OOB HUN: 5.54 ± 0.26). In the

overall results of object control tasks, there were no significant differences among the BMI categories, but the points of L (33.15 ± 0.97) and N (34.29 ± 0.79) HUN children were higher than the SVK pupils' results in the same BMI categories (L SVK: 25.8 ± 1.21; N SVK: 28.23 ± 0.84). In the cumulate outcome of TGMD-2, the OOB HUN pupils' scores (64.29 ± 2.02) were remarkably lower than the L (71.65 ± 1.51) or N (70.73 ± 1.23) HUN children's scores. The L HUN pupils achieved higher overall TGMD-2 scores than the L SVK children (62.72 ± 1.48).

Conclusions and further perspectives: Our results seem to prove that the OOB children's motor skills are weaker. We detected a few significant differences between SVK and HUN pupils' motor development, but we would like to perform the same examinations once in every semester during the first two school years, and follow up the same indicators among the same children. Now we reported the results of the first measurement period with participants who newly enrolled in 1st class of school education after nursery. We suppose that the differences would be more remarkable when the pupils spend more time in the system of everyday PE than in the system of 2 PE lessons per week.

Keywords: motor development, degree of obesity, 6 – 7-year-old pupils

INTRODUCTION

Numerous studies have proven the positive effects of regular physical activity on motor development (Fisher et al., 2005; Graf et al., 2004; Houwen et al., 2008) or physical (Bailey, 2006), cognitive (Sibley and Etnier, 2003; van der Niet et al. 2015) and social (Taras, 2005) abilities. The progress in these areas also contributes to a better quality of life of the children concerned (Bailey, 2006). As a counterpoint, the relevant literature emphasizes that the number of overweight children increases in industrial countries (Allison et al., 1999; Barth et al., 1997; Bundred et al., 2001; Kromeyer-Hauschild et al., 1999) due to lack of physical activity (Dietz and Gortmaker, 1985; Gortmaker et al., 1990). As a result, the number of children with mobility problems increases as well (Cairney, 2005).

It is well-known that there is a strong correlation between the body fat content and the motor development. Already in infancy it was noticeable that overweight children's motor development was delayed compared to non - obese children (Slining et al., 2010). It is shown among older children (5 to 10 years old) as well, that motor development of obese children is fallen behind than normal weight children (D'Hondt et al., 2009). Limaa et al. (2018) followed up children from 6 to 13 years of age, and similarly to the previous studies, they found that overweight children perform worse in movement coordination.

Moreover, childhood overweight can be the starting point for a number of additional adult complications (abnormal obesity, motor problems, type 2 diabetes mellitus, hypertension, metabolic syndrome, etc.) that greatly contribute to the deterioration of the quality of life (Parsons et al, 1999; Wabitsch, 2000). One of the options to prevent these problems is the regular physical activity in school education (Bailey, 2006), the increase in the number of PE lessons, and the regular physical activity as a daily routine (Holm et al, 2001). Since the autumn of 2012, everyday physical education (PE) lessons have been introduced in Hungary (HUN) within the framework of statutory regulations (Magyar Közlöny, 2012). This means 5 PE lessons per week for every student in primary and secondary schools. The purpose of this provision is to educate a healthier lifestyle, prevent various diseases and thus ensure a better quality of life (Meszlényi et al. 2017; Rétsági and Csányi, 2014). In Slovakia (SVK), the subject of PE is precisely called 'PE and Sport'. It is required to teach the subject at school twice a week. All schools in Slovakia can choose two

preferred items, in which case they would have an extra 1-1 lesson per week. In this case, the PE and sports are taught in 3 lessons per week (Telesná a športová výchova, 2014).

Our main hypothesis is that more regular PE lessons have more positive effect on motor development due to the improvement in the degree of obesity. Our aim was to compare the motor development of different BMI groups from SVK and HUN.

Now we report the results of the first measurement period with participants who newly enrolled in 1st class of school education after nursery, but we would like to perform the same examinations once in every semester during the first two school years, and follow up the same indicators among the same children.

MATERIAL AND METHODS

Participants:

311 children from both countries and genders (SVK: 94 boys and 104 girls; HUN: 57 boys and 56 girls) participated in the study. They were newly joined in the system of everyday PE in HUN and the system of 2 PE lessons per week in SVK and we performed the measurements in the beginning of their first semester. The children attend to primary schools in the downtown area of Nitra and Komarno (SVK) and Szeged (HUN). For each participant, their parents gave written consent and ethics approval was gained from the relevant school institutional body.

Procedures:

Body mass index (BMI) was measured by Omron BF 511 body composition monitor (Healthcare Co., Kyoto, Japan). The participant's degree of obesity was specified based on their BMI percentiles that were defined according to the BMIs of the measured children from the same country. Then they were classified by BMI percentiles to the following three groups: lean (L; percentile was less than 25%), normal (N; percentile was between 25.1 and 74.9%) and overweight/obese (OOB; percentile was more than 75%) categories. The 25% and 75% BMI percentile values of the pupils from both countries are presented in *Table 1a*. The rate of the participants in the three BMI groups is demonstrated in *Table 1b*.

Table 1a *The 25% and 75% BMI percentile values of the participants*

	SVK	**HUN**
BMI (kg/m^2) percentile=25%	15.30	15.20
BMI (kg/m^2) percentile=75%	18.25	17.55

Table 1b *The rate of the participants in the three BMI groups*

	SVK	**HUN**
lean (BMI percentile less than 25%)	23.23%	23.01%
normal (BMI percentile between 25.1 and 74.9%)	52.02%	52.21%
overweight/obese (BMI percentile more than 75%)	24.75%	24.78%

To examine the children's motor development we used the Test of Gross Motor Development-2 (TGMD-2) (Ulrich, 2000) which does not measure performance, but classifies motor coordination based on given observation criteria. The TGMD-2 contains 12 motor skills divided into two subtests: locomotor (run, gallop, hop, leap, horizontal jump, slide) and

object control (striking a stationary ball, stationary dribble, catch, kick, overhand throw, underhand roll) tasks. The test administration took approximately 20 min for each child. The assessment protocol involved providing children with a demonstration of the correct technique before assessment. Children were then asked to perform the skill twice. Each attempt was scored with each component receiving a '1'if correctly executed or a '0' if not. The sum of the observed criteria for each subscale comprises the overall score (0–48 points). The sum of the overall scores from locomotor and object control subtest was the cumulate outcome (up to 96 points). During the performances general encouragement was given but no specific verbal feedback about skill performance.

The TGMD is already widespread in the US and in many countries of the world (Bakhtiar, 2014; Kit et al., 2017; Pang and Fong, 2009; Valentini, 2012), but it is not well-known yet in Central and Eastern Europe, although there was a study in the Czech Republic that used this test system (Cepicka, 2010).

Statistical analysis:

Data were expressed as means ± S.E.M. The data were tested for signicance via Bonferroni-test, and differences were regarded as significant at *$p<0.05$ between the BMI groups in the same country and $^{\#}p<0.05$ between SVK and HUN in the same BMI groups.

RESULTS

There were no significant differences between the BMI categories or the two countries in the results of different locomotor tasks (*Table 2*). The L HUN pupils (38.5 ± 1.2 S.E.M. *) were significantly better than the OOB HUN children (33.39 ± 1.49) in the overall results of locomotor tasks. We did not detected similar difference among the SVK pupils.

Table 2 *Results of locomotor tasks*

	SVK			**HUN**		
	L	**N**	**OOB**	**L**	**N**	**OOB**
Run (mpa: 8)	6.04 ± 0.32	6.50 ± 0.17	6.22 ± 0.24	6.31 ± 0.32	6.08 ± 0.20	5.68 ± 0.33
Gallop (mpa: 8)	5.75 ± 0.29	5.77± 0.23	5.43 ± 0.36	6.35 ± 0.42	5.95 ± 0.26	5.64 ± 0.32
Hop (mpa: 10)	8.15 ± 0.32	7.91 ± 0.32	7.55 ± 0.29	7.73 ± 0.40	7.54 ± 0.28	6.54 ± 0.48
Leap (mpa: 6)	4.78 ± 0.17	4.67 ± 0.15	4.29 ± 0.24	4.73 ± 0.33	3.88 ± 0.22	3.61 ± 0.32
Horizontal jump (mpa: 8)	5.93 ± 0.27	6.57 ± 0.15	5.88 ± 0.26	6.12 ± 0.47	5.81 ± 0.29	5.29 ± 0.41
Slide (mpa: 8)	6.26 ± 0.27	6.83 ± 0.70	6.45 ± 0.28	7.27 ± 0.35	7.17 ± 0.21	6.64 ± 0.35
Overall score (mpa: 48)	36.91 ± 0.96	38.25 ± 0.62	35.82 ± 1.03	**38.50 ± 1.20 ***	36.44 ± 0.75	**33.39 ± 1.49**

Abbrevations:
SVK – Slovakia, HUN – Hungary, L – lean, N – normal, OBB - overweight/obese,
mpa – maximum point available;
**p<0.05 significant difference between the BMI groups in the same country.*

In the object control tasks, there were no significant differences between the BMI categories' or the two countries' results of striking a stationary ball, stationary dribble or underhand roll (*Table 3*). The L SVK children's results of catch was significantly lower (3.72 ± 0.27) than the N SVK pupils' (4.79 ± 0.14 *) or the L HUN children's (5.08 ± 0.23 #) results. The L HUN children kicked the ball with higher points (6.58 ± 0.35 #) than the L SVK pupils (5.13 ± 0.33). There were remarkable differences between SVK and HUN pupils in all the three BMI categories' results of overhand throw (L SVK: 3.24 ± 0.27; L HUN: 5.46 ± 0.31 #; N SVK: 3.22 ± 0.17; N HUN: 5.76 ± 0.25 #; OOB SVK: 2.98 ± 0.24; OOB HUN: 5.54 ± 0.26 #). In the overall results of object control tasks, there were no significant differences among the BMI categories, but the points of L (33.15 ± 0.97 #) and N (34.29 ± 0.79 #) HUN children were higher than the SVK pupils' results in the same BMI categories (L SVK: 25.8 ± 1.21; N SVK: 28.23 ± 0.84).

Table 3 *Results of object control tasks*

	SVK			**HUN**		
	L	**N**	**OOB**	**L**	**N**	**OOB**
Striking a stationary ball (mpa: 10)	5.02 ± 0.37	5.57 ± 0.26	6.33 ± 0.36	5.46 ± 0.45	5.93 ± 0.26	4.86 ± 0.44
Stationary dribble (mpa: 8)	3.89 ± 0.33	3.96± 0.24	3.55 ± 0.35	4.88 ± 0.46	4.53 ± 0.32	3.79 ± 0.42
Catch (mpa: 6)	**3.72 ± 0.27**	**4.79 ± 0.14 ***	4.49 ± 0.20	**5.08 ± 0.29 #**	5.27 ± 0.13	5.00 ± 0.20
Kick (mpa: 8)	**5.13 ± 0.33**	5.93 ± 0.20	5.51 ± 0.27	**6.58 ± 0.35 #**	6.64 ± 0.20	5.86 ± 0.30
Overhand throw (mpa: 8)	**3.24 ± 0.27**	**3.22 ± 0.17**	**2.98 ± 0.24**	**5.46 ± 0.31 #**	**5.76 ± 0.25 #**	**5.54 ± 0.26 #**
Underhand roll (mpa: 8)	4.80 ± 0.30	4.76 ± 0.21	5.02 ± 0.30	5.69 ± 0.41	6.15 ± 0.22	5.86 ± 0.30
Overall score (mpa: 48)	**25.80 ± 1.21**	**28.23 ± 0.84**	27.88 ± 1.03	**33.15 ± 0.97 #**	**34.29 ± 0.79 #**	30.89 ± 0.79

Abbrevations:
SVK – Slovakia, HUN – Hungary, L – lean, N – normal, OBB - overweight/obese,
mpa – maximum point available;
**p<0.05 significant difference between the BMI groups in the same country;*
#p<0.05 significant difference between SVK and HUN in the same BMI groups.

The obesity-degree dependent cumulate outcomes of TGMD-2 are demonstrated in *Table 4*. In the cumulate outcomes, the OOB HUN pupils' scores (64.29 ± 2.02 *) were remarkably lower than the L (71.65 ± 1.51) or N (70.73 ± 1.23) HUN children's scores. The L HUN pupils achieved higher cumulate TGMD-2 outcomes than the L SVK children (62.72 ± 1.48 #).

Table 4 *Cumulate outcomes of TGMD-2*

	SVK			**HUN**		
	L	**N**	**OOB**	**L**	**N**	**OOB**
Cumulate outcomes of TGMD-2 (mpa: 96)	**62.72 ± 1.48** [#]	66.49 ± 0.86	63.69 ± 1.44	**71.65 ± 1.51**	**70.73 ± 1.23**	**64.29 ± 2.02 ***

Abbrevations:
SVK – Slovakia, HUN – Hungary, L – lean, N – normal, OBB - overweight/obese, mpa – maximum point available;
**p<0.05 significant difference between the BMI groups in the same country;*
[#]p<0.05 significant difference between SVK and HUN in the same BMI groups.

DISCUSSION

Similarly to previous findings (D'Hondt et al., 2009; Limaa et al., 2018; Slining et al., 2010), our results seem to prove that the OOB children's motor skills are weaker. In our research, the OOB HUN pupils performed worse in overall scores of locomotor tasks and cumulate outcomes of TGMD-2 than non - obese HUN children. We did not detect similar differences among the SVK pupils.

Okely at al. (2004) demonstrated in their publication that students in grades 4, 6, 8 and 10 performed better on locomotor tests than those who were overweight. However, in object control tasks, only Grade 6 and Grade 10 not overweight boys performed better than their overweight schoolmates. In our research, among younger participants we did not detect similar differences between the results of locomotor and object control tasks. It is worth mentioning that in our study, the participants seem to achieved higher overall scores in the locomotor subscale than in the onject control tasks.

Surprisingly we observed several differences between the results of SVK and HUN children. The HUN children kicked, caught and threw the ball with higher scores than the SVK pupils and there were significant differences between SVK and HUN pupils in the overall results of object control tasks and the cumulate outcomes of TGMD-2 as well. We did not expect these differences, because the participants of our study newly joined in the system of everyday PE in HUN and the system of 2 PE lessons per week in SVK. We expected these differences between the two countries when the pupils spend more time in their own national system of PE, not when they newly enrolled in 1st class of school education after nursery. It needs further investigations to explain these non-expected differences, because we suppose that it can not be the effect of the everyday PE.

Now we reported the results of the first measurement period of a longitudinal study. We would like to perform the same examinations once in every semester during the first two school years, and follow up the same indicators among the same children. We suppose that the differences would be much more remarkable.

FURTHER PERSPECTIVES

Our research is a part of a longitudinal international (SVK-Romania-HUN) study. Its purpose is to prove the beneficial effects of regular health promotion physical activity including the school PE lessons on body composition, motor skills and quality of life as well among 6-7-

year-old pupils. We would like to study the correlations between these indicators. In addition to the data presented here, we measure the height, weight, relative body fat and muscle content, basal metabolic rate as well. To examine the quality of life we use the child and parental version of KidScreen-27 questionnaire (Ravens-Sieberer U, 2007; Robitail S, 2007; The KIDSCREEN Group Europe, 2006). We perform the same measurements in Romania (Cluj-Napoca and Arad) as well.

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