

Does the gross motor development of Romanian and Hungarian 6 – 7-year-old children depend on the degree of obesity? (First phase of a longitudinal study)

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Abstract

Introduction and aim: In Hungary (HU) there are everyday PE lessons (5 per week), while there are fewer PE lessons (2 per week) in Romania (RO). We compare RO and HU children who started to attend primary school in the last semester and we hypothesize that more regular PE lessons have more positive effect on motor development due to the improvement in the degree of obesity.

Methods: 361 children from both countries and genders (RO: 132 boys and 116 girls; HU: 57 boys and 56 girls) participated in the study. 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. Their motor development was measured by Test of Gross Motor Development-2 (TGMD-2) which 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: The rate of L or OOB pupils was similar in both countries. There were no differences between the BMI categories in either countries in the results of different locomotor and object control tasks. N and OOB RO pupils achieved higher scores in hop than HU children in the same BMI categories. In the overall results of locomotor tasks L HU pupils were significantly better than OOB HU children and L RO pupils achieved higher points than N or OOB RO children. N or OOB RO pupils' overall locomotor scores were higher than HU children in the same BMI categories. The N RO children's results of catch were lower than N HU pupils' results. In the overall results of object control tasks, there were no differences among the BMI categories or the countries. In the cumulate outcome of TGMD-2, the OOB HU pupils' scores were lower than the L or N HU children's scores. The OOB RO pupils achieved higher cumulate TGMD-2 scores than the OOB HU children.

Conclusions and further perspectives: Our results seem to prove that the OOB children's motor skills are weaker. We detected a few differences between RO and HU pupils' motor development, but we would like to perform the same examinations once in the following semesters among the same children. Now we reported the results of the first measurement period. We suppose that the differences would be more remarkable when the pupils spend more time in the system of everyday PE or 2 PE lessons per week.

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

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1. Introduction

Since the autumn of 2012, everyday physical education (PE) lessons have been introduced in Hungary (HU) within the framework of statutory regulations (Magyar Közlöny, 2012). This means five 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 contrast, schools in Romania have only two PE lessons for children per week (Ministerul Educației Naționale, 2016).

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 RO and HU.

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.

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., 2009) or physical (Bailey, 2006), cognitive (Sibley & 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 & Gortmaker, 1985; Gortmaker et al., 1990). As a result, the number of children with mobility problems increases as well (Cairney et al., 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). Lima 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).

2. Methods

2.1. Participants

361 children from both countries and genders (RO: 132 boys and 116 girls; HU: 57 boys and 56 girls) participated in the study. They were newly joined in the system of everyday PE in HU and the system of 2 PE lessons per week in RO and we performed the measurements in the beginning of their first semester. The children attend to primary schools in the downtown area of Cluj-Napoca and Arad (RO) and Szeged (HU). For each participant, their parents gave written consent and ethics approval was gained from the relevant school institutional body.

2.2 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 1.

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

	Romania	Hungary
BMI (kg/m ²) percentile=25%	14.60	15.20
BMI (kg/m ²) percentile=75%	17.45	17.55

The rate of the participants in the three BMI groups is demonstrated in Table 2. The proportions of L or OOB pupils (L RO: 22.18%; L HU: 23.01%; OOB RO: 25.00%; OOB HU: 24.78%) were similar in both countries.

Table 2. The rate of the participants in the different BMI groups

	Romania	Hungary
lean (BMI percentile less than 25%)	22.18%	23.01%
normal (BMI percentile between 25.1 and 74.9%)	52.82%	52.21%
overweight/obese (BMI percentile more than 75%)	25.00%	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 (maximum point available (mpa): 48).

The sum of the overall scores from locomotor and object control subtest was the cumulate outcome (mpa: 96). 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 & 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).

2.3. Statistical analysis

Data were expressed as means \pm S.E.M. The data were tested for significance 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 RO and HU in the same BMI groups.

3. Results

There were no significant differences between the BMI categories in either country in the results of different locomotor tasks (Table 3).

N ($8.66 \pm 0.16^{\#}$) and OOB ($8.6 \pm 0.24^{\#}$) RO pupils achieved higher scores in hop than HU children in the same BMI categories (N: 7.54 ± 0.28 ; OOB: 6.54 ± 0.48). In the overall results of locomotor tasks L HU pupils ($38.50 \pm 1.20^*$) were significantly better than OOB HU children (33.39 ± 1.49) and the L RO pupils ($41.65 \pm 0.68^*$) were significantly better than N (39.74 ± 0.6) or OOB (39.37 ± 0.86) RO children. N or OOB RO pupils' overall locomotor scores were higher than HU children in the same BMI categories (N: 36.44 ± 0.75).

Table 3. Results of locomotor tasks

	Romania			Hungary		
	L	N	OOB	L	N	OOB
Run (mpa: 8)	6.80 ± 0.21	6.67 ± 0.16	6.68 ± 0.22	6.31 ± 0.32	6.08 ± 0.20	5.68 ± 0.33
Gallop (mpa: 8)	7.09 ± 0.20	6.58 ± 0.15	6.66 ± 0.24	6.35 ± 0.42	5.95 ± 0.26	5.64 ± 0.32
Hop (mpa: 10)	8.69 ± 0.24	8.66 ± 0.16 [#]	8.60 ± 0.24 [#]	7.73 ± 0.40	7.54 ± 0.28	6.54 ± 0.48
Leap (mpa: 6)	5.05 ± 0.19	4.61 ± 0.14	4.40 ± 0.23	4.73 ± 0.33	3.88 ± 0.22	3.61 ± 0.32
Horizontal jump (mpa: 8)	6.62 ± 0.22	6.21 ± 0.19	6.29 ± 0.24	6.12 ± 0.47	5.81 ± 0.29	5.29 ± 0.41
Slide (mpa: 8)	7.40 ± 0.12	7.02 ± 0.16	6.74 ± 0.26	7.27 ± 0.35	7.17 ± 0.21	6.64 ± 0.35
Overall score (mpa: 48)	41.65 ± 0.68*	39.74 ± 0.60 [#]	39.37 ± 0.86 [#]	38.50 ± 1.20*	36.44 ± 0.75	33.39 ± 1.49

The results of object control tasks are presented in Table 4. We did not detect any significant differences between the BMI categories in either country in the results of different object control tasks.

The N RO children's results of catch were significantly lower ($4.40 \pm 0.12^{\#}$), than N HU pupils' (5.27 ± 0.13) results. In the overall results of object control tasks, there were no significant differences among the BMI categories or the two countries.

Table 4. Results of object control tasks

	Romania			Hungary		
	L	N	OOB	L	N	OOB
Striking a ball (mpa: 10)	6.27 ± 0.33	6.27 ± 0.23	6.08 ± 0.25	5.46 ± 0.45	5.93 ± 0.26	4.86 ± 0.44
Dribble (mpa: 8)	5.20 ± 0.34	5.24 ± 0.23	4.84 ± 0.31	4.88 ± 0.46	4.53 ± 0.32	3.79 ± 0.42
Catch (mpa: 6)	4.45 ± 0.20	4.40 ± 0.12 [#]	4.37 ± 0.18	5.08 ± 0.29	5.27 ± 0.13	5.00 ± 0.20
Kick (mpa: 8)	6.31 ± 0.28	6.53 ± 0.16	6.05 ± 0.30	6.58 ± 0.35	6.64 ± 0.20	5.86 ± 0.30
Overhand throw (mpa: 8)	5.45 ± 0.26	5.53 ± 0.16	5.16 ± 0.26	5.46 ± 0.31	5.76 ± 0.25	5.54 ± 0.26
Underhand roll (mpa: 8)	5.85 ± 0.30	6.03 ± 0.18	6.16 ± 0.23	5.69 ± 0.41	6.15 ± 0.22	5.86 ± 0.30
Overall score (mpa: 48)	33.55 ± 1.02	34.00 ± 0.68	32.66 ± 0.89	33.15 ± 0.97	34.29 ± 0.79	30.89 ± 0.79

The obesity-degree dependent cumulate outcomes of TGMD-2 are demonstrated in Table 5. In the cumulate outcome of TGMD-2, the OOB HU pupils' scores ($64.29 \pm 2.02^*$) were remarkably lower than the L (71.65 ± 1.51) or N (70.73 ± 1.23) HU children's scores. The OOB RO pupils achieved higher cumulate TGMD-2 scores ($72.03 \pm 1.52^{\#}$) than the OOB HU children.

Table 5. Cumulate outcomes of TGMD-2

	Romania			Hungary		
	L	N	OOB	L	N	OOB
Cumulate outcomes of TGMD-2 (mpa: 96)	75.20 ± 1.48	73.74 ± 1.10	72.03 ± 1.52 [#]	71.65 ± 1.51	70.73 ± 1.23	64.29 ± 2.02*

4. Discussion

To answer the question in the title, our results seem to prove that the gross motor development of Romanian and Hungarian 6 – 7-year-old children depends on the degree of obesity. Similarly to previous findings (D’Hondt et al., 2009; Limaa et al., 2018; Slining et al., 2010), we observed that OOB children’s motor skills are weaker. We may conclude that according to our results, in both countries L children achieved higher overall scores in locomotor task than OOB children. Furthermore, OOB HU pupils performed worse in cumulate outcomes of TGMD-2 than non-obese HU children.

Okely et 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. Similarly, in our research among younger participants, the overall scores of locomotor tasks depended on the degree of obesity, but the object control task’s overall results did not. Moreover, it is worth mentioning that in our study, the participants seemed to achieve higher overall scores in the locomotor subscale than in the object control tasks.

Surprisingly we observed several differences between the results of RO and HU children. The HU children caught the ball with higher scores, but performed the hop with lower scores than the RO pupils. There were significant differences between RO and HU pupils in the overall results of locomotor 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 HU and the system of 2 PE lessons per week in RO. 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 cannot 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.

5. Further perspectives

Our research is a part of a longitudinal international (RO-Slovakia-HU) 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 et al., 2007; Robitail et al., 2007; The KIDSCREEN Group Europe, 2006). We perform the same measurements in Slovakia (Nitra and Komarno) as well.

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