THE EFFECT OF PHYSICAL ACTIVITIES ON THE DEVELOPMENT OF MOTOR ABILITIES IN INTACT AND INTEGRATED CHILDREN WITH BEHAVIOR DISORDERS

Erika Chovanová1, Tatiana Dubayová2

1 Department of Sports Educology and Humanistics, Faculty of Sports, University of Prešov (SLOVAKIA)
2 Department of Special Education, Faculty of Education, University of Prešov (SLOVAKIA)

Abstract

Over the recent years, finding evidence about motor skills of prepubertal children focuses on the searching and explication of the interaction of motor fitness, motor competences and cognitive development of students. This issue is highly topical due to the fact that coordination abilities play an important role in preventing, or moderating the so-called negative trajectory. One of the research objectives is to verify the possibility of using physical activities in order to develop motor abilities in intact (groups formed according to Body mass index) and integrated children with behavior disorders. The state and changes in motor skills of children will be determined using standardized test of coordination abilities - Körperkoordinationstest für Kinder (KTK) (Schilling, Kiphard, 2007). To determine behavior changes for the purposes of monitoring the progress of students’ behavior and in the research context also for the purposes of determining the educational effects, we will apply the NICHQ rating scale, using which we will determine the effects of work with children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD).

Keywords: Motor abilities, prepubertal age, obesity, children with behavior disorders, Körperkoordinationstest für Kinder, Vanderbilt Rating Scale.

1 INTRODUCTION

Human motor skills are an integral part of the personality structure and contribute to personality development during all stages of ontogeny. Current concepts, interpretations and theoretical models of motor skills are still hypothetical and their explanation is conditioned by long-term empirical research. Designing a concept of a hypothetical model of motor skills in school-aged children and the explanation of internal relationships contribute to the update concerning theoretical foundations necessary to formulate educational goals, especially with regard to their more precise operationalization. They also allow determining the areas of physical fitness, which are decisive during this developmental period for conceptual, balanced and intentional development of children’s motor skill in relation to the health aspects of physical fitness. The aim of physical and sports education within the concept of physical education at this age is targeted at the development of physical literacy within various elementary and specialized physical activities. The knowledge about the developmental psychomotor potential of an individual, including the individual limits, enables us to effectively form the motor competences and also to affect the interests, needs, and current state of preconditions. Exercise programs which proportionally cover dominant domains of motor functions may offer an effective educational tool for both intact children and individuals with special educational needs, or with decreased physical fitness levels. The domain mentioned above is researched within the grant project VEGA MSVVaŠ SR and SAV 1/0625/16 entitled “The effects of physical activities on the development of motor abilities in intact and integrated children with behavior disorders”.

The grant project is based on collecting data about motor skills in school-aged children, focusing on searching and explication of the interaction of motor fitness, motor competences and cognitive development of students. This issue is highly topical because coordination abilities play an important role in preventing, or moderating the so-called negative trajectory.

To affect the development of motor abilities in intact children and children with behavior disorders, children will participate in a variety of physical activities. To assess the state and changes in children's motor skills, we will administer a standardized test of motor coordination - Körperkoordinationstest für Kinder (KTK) [1]. The test-retest reliability coefficient for the raw score on the total test battery is 0.97 while reliability coefficients for individual test items range from 0.80 to 0.96. This test battery allows a
complex assessment of motor coordination. This battery is an appropriate test battery to be applied in school setting in terms of personal, material and time context. The battery enables to relatively determine the level of motor coordination. Raw scores for particular test items are converted to equivalent values of the so-called motor quotient (MQ) according to age and gender (MQ1, MQ2, MQ3, and MQ4). The sum of these values forms the basis for the determination of the total value of MQ KTK test for every individual, which is derived from a norm-referenced table. Consequently, the level of motor coordination can be assessed for all individuals. This test battery allows a relatively complex assessment of coordination abilities. We may conclude that literature review has shown that this test battery has not so far been used to test the coordination abilities of Slovak children.

Monitoring and assessment of motor abilities of children represents an integral part of school physical education and at the same time is a motivational determinant underlying children’s attitudes towards physical activity. Within scientific research and using findings of previous research findings [2, 3, 4, 5, 6, 7, 8], intact and integrated children will participate in recommended physical activities. The authors have presented evidence about the development of coordination abilities in prepubertal children through participation in movement games and physical activities, which had positive effect on the correction of behavior disorders in integrated children. The authors will study the issue further because the results have unequivocally confirmed that physical activities are among factors that may have positive effect on the physical education process and educational process. Despite negative correlations between body mass index (BMI) and motor abilities [9], we may assume that various physical activities included in ISCED1 and appropriate motivation should be used with children with higher BMI values in order to develop their coordination abilities.

In school physical education, coordination abilities are developed according to the model, the elements of which share common features, namely natural movement. The development of coordination abilities has been studied by a variety of authors [10, 11, 12]. The results of their educational experiments showed that the motor coordination improved several tenths percent faster in experimental classes (20-50%) compared to their control counterparts. Several authors [13, 14] have found through their experiments that even as little as six weeks suffices to develop coordination abilities, including reaction speed, frequency ability, and balance. There were no significant gender differences in motor coordination. Some of the studies have shown improved fine motor skills of girls compared with boys [3, 15].

Psotta et al. [16] studied 404 Czech students and reported that 4.4% suffered with gross motor skills disorders, with worldwide mean values ranging from 5 to 10%. He concluded that BMI values of boys and girls diagnosed with motor disorders compared to their gender-matched counterparts with normal motor functions did not differ significantly. Contrary to that, Lopes et al. [9] carried out a cross-sectional study on children aged 6 to 10 years (n=7,175) and reported negative correlations between BMI and motor abilities for both boys and girls. The results of this study also indicate for both boys and girls lower level of coordination abilities in children with lower BMI values compared to children with normal body weight. Hyperactive children typically demonstrate the tendency to move constantly. Such children have problems staying relaxed and perform purposeless movements and when made to stay in place feel anxious and uncomfortable [17]. “Physical activities are beneficial for children with attention deficit hyperactivity disorder (ADHD)”, even existentially beneficial. Authors [18, 19] agree that hyperactive children should not be limited in their movement. Children diagnosed with learning disorders as well as with ADHD benefit from the effects of educational and exercise programs, which consist primarily of balance, variable and coordination exercises as well as activities aimed to develop manipulative skills, catching and throwing, etc. [20].

To monitor progress in children’s behavior and to assess the educational effects within the research, we will use the Vanderbilt assessment scale (NICHQ) to determine the effects of new methods in students diagnosed with ADHD. Dubayová, Chovanová [21] verified psychometric properties of the Vanderbilt rating scale in terms of assessing students with ADHD. In their pilot study, 30 children (M = 10.93 years, SD = 2.56 years) demonstrated excellent psychometric parameters of the scale, with reliability ranging in particular subscales from 0.808 to 0.971.

2 OBJECTIVES

The objectives of the project are to:

- analyze particular determinants of movement procedures and their effect on the level and development of motor abilities in intact and integrated children and on correction of hyperkinetic disorders of children,
• design and apply an appropriate exercise program in terms of its effect on the state and
development of motor abilities in intact and integrated children as well as the factor having
effect on the correction of behavior disorders,
• highlight the importance of a healthy lifestyle, daily schedule (at school, family, and sanatorium),
way of living, physical activities, which are the key elements in children’s lives,
• determine the level and development of motor abilities using the Eurofit test battery and the
KTK test battery,
• identify ADHD symptoms using the screening tool – NICHQ rating scale,
• present collected evidence to educational practitioners, educational and psychological
counselling centers, teachers, parents, and experts who work with intact and integrated
children.

3 METHODOLOGY

To conduct a more detailed analysis, we selected samples including standard classes at primary
schools with integrated students diagnosed with ADHD, classical classes and classes making part of a
medical sanatorium in Slovakia. To determine the level of coordination abilities in a complex way, we
have selected the KTK test battery [1].

Our contribution is mainly in that by designing exercise programs an effective education tool will be
offered in order to develop motor abilities of individuals with impaired level of motor skills (children will
be divided into groups according to BMI) and for integrated children diagnosed with behavior
disorders.

The characteristics of “School intervention movement program” with integration of students diagnosed
with ADHD. The movement program has been designed and adjusted for school conditions by Sally
G. Blythe. A group of children exercises for 10 to 15 minutes per day under the supervision of a
trained educator, a school special educator, or a school psychologist. The children who could benefit
from this program are identified via shortened diagnostic assessment (although children without
disorders could also benefit from the program, but the effects are not that visible). The child’s statutory
representative must provide a written informed consent to include the child into the program. If a child
suffers from health problems or receives neurological therapy or treatment, the inclusion into the
program should be consulted with the physician first.

The minimal length of the exercise program varies between 9 to 12 months. This means that one
school is not enough and the intervention period extends into the next school year. Children must
undertake exercise at least five times a week. Each sample of exercises includes a maximum of 4
exercises performed during the period of four to 6 weeks. This period may be extended if the state of
the group requires further intervention. To achieve desirable effects, children need to acquire
movements sufficiently.

If any regressive signs in child’s behavior occur after the program starts, it is necessary to decrease
the number of exercises or to decrease the number of repetitions if the regression persists. If needed,
it is possible to seek help and advice of the INPP therapist [22].

The characteristics of the exercise program of “Interventional movement games” for intact children and
children with impaired levels of motor skills (children will be divided into groups according to BMI),
which will be administered in the experimental group of children with the purpose of developing motor
abilities through playing games. Children will undertake the designed physical activities over the
period of two months. The exercise program, model will include movement games, which children will
play during physical education classes and also within the use of interdisciplinary relations (Fig. 1).
To have children undertake the designed movement games during physical education classes, we will create an organizational plan – concept for the teacher. The plan will include the designed movement games according to the number of the week, number of the class within the week and the part of the class during which children should play the games. Teachers will have to organize the physical activities on their own during classes other than physical education classes according to the current situation in class.

We will provide a detailed description of all movement games included in the plan, assigned according to their character to particular parts of the physical education class:

- warm-up movement games,
- movement games for the main part of the class,
- relaxation movement games.

According to their applicability movement games within the interdisciplinary relations will be included in other classes:

- movement games during Slovak language classes,
- movement games during math classes,
- movement games during natural sciences classes,
- movement games during music classes,
- movement games during arts classes.

We will specify what the assessment procedures used to monitor motor abilities should contain in order to represent children's motor potential as accurately as possible at this developmental stage. This may extend the evidence and knowledge about motor tests or potential selection of motor tests for school-aged children and thus form the basis for reducing the test batteries. This means to conduct a complex assessment of children’s physical fitness levels through administration of a small number of motor tests acceptable under conditions of school physical education.

To assess motor coordination and proficiency of children, we will administer a standardized test battery - Körperkoordinationstest für Kinder (KTK) [1]. The testing system of Eurofit will, to a certain extent, represent only a complementary methodology tool to determine the level of motor fitness.

In our research the scale NICHEQ will be used as a tool to measure behavior changes of students with ADHD. Besides that the aim of the research is to determine the effects of new methods of students diagnosed with ADHD. Vanderbilt ADHD Diagnostic Teacher Rating Scale (VADTRS) is a tool designated for teachers to evaluate children who allegedly suffer with ADHD [23]. The scale takes into account the associated ADHD symptoms such as anxiety, depression, opposing behavior, or behavior disorders. The advantage of the scale lies in the easy administration and clear scoring. Despite the fact that the scale is primarily based on the criteria of DSM-IV, it is adequate to be adapted in the setting of European countries including Slovakia.

One the secondary aims of the project is to adapt this scale to be used by teachers in the settings of Slovak schools. The adaptation will take into consideration also diagnostic criteria MKCH-10, which is valid in European countries.

The effects of physical activities on motor abilities of intact and integrated children with behavior disorders will be presented in form of a logical analysis and mathematical and statistical procedures. All students will participate in the research upon obtaining written informed consent of their parents.
3.1 Specification of reaching the project objectives and project timetable

*First research stage:*
- specification of researchers’ tasks and specification of cooperation with domestic and foreign researchers,
- analysis of scientific and expert literature will deal with the examined issue of the effect of physical activities on the development of motor abilities in intact children (grouped according to BMI) and integrated children diagnosed with behavior disorders,
- designing exercise programs for intact and integrated children with behavior disorders,
- securing cooperation of workplaces participating in the research project,
- specification of tasks resulting from the research aim and hypotheses, determination of the selection technique procedures (data collection), processing the collected data and data interpretation,
- pilot study, the selection of standardized motor tests to determine the level of coordination abilities (state and changes in motor skills of children will be assessed using standardized tests, especially the KTK and the Eurofit test battery,
- measurement of behavior changes for the purposes of monitoring the progress of student’s behavior and in the research context also for the purposes of assessing the educational effects the scale NICHQ will be used to determine the effectiveness of new methods when working with students with ADHD,
- particularization of the selection of the research sample,
- testing coordination abilities of intact and integrated children with behavior disorders under field conditions in the selected areas and selected elementary schools.

*Second research stage:*
- selection and procession of collected data, continuous presentation and peer review of results,
- continuous transfer of the research findings into practice in form of partial reports, published papers at domestic and foreign seminars and conferences, in expert and scientific Slovak and foreign scholarly journals,
- expert seminar with fellow researchers and participating institutions, which will make use of research outcomes,
- organizing an Olympic Day, Children’s Day, Mother’ Day, Father’s Day for intact and integrated children with behavior disorders participating in the project,
- processing and evaluating the final research report,
- publishing the research results in form of a monograph,
- organizing an international scientific conference
- completion of research and submission of final report.

4 RESULTS

Chovanová, Majherová [5] monitored a sample of 13-year-old boys and girls during the school year of 2015-2016. The sample which included 113 students (51 boys and 62 girls) consisted of intact population of children. The research question of this study was: Will children with higher BMI show lower levels of motor coordination? Data for particular tests were recorded in KTK testing protocols, which we used to compare the level of motor coordination between 13-year-old boys and girls. The level of studied parameters was expressed using mathematical and statistical characteristics, that is, arithmetic average (\(M\)), median (\(Mdn\)) and standard deviation (\(SD\)). Statistically significant differences between boys and girls in parameters of motor coordination were determined at \(p < .05\) using Mann-Whitney U-test and the statistical software STATISTICA v.12. The relationships between parameters were determined using Pearson’s product-moment correlation.
Values of somatic parameters showed that thirteen-year-old boys were 4 cm taller than girls of the same age. Mean body height for boys and girls was 1.63 m and 1.59 m, respectively. Boys showed higher values of body mass compared with girls (52.92 kg for boys compared with 49.5 kg for girls). Mean BMI values for boys and girls were 19.72 and 19.42, respectively. Higher value of standard deviation shows greater variability of data for girls. According to World Health Organization (WHO), BMI values for girls and boys included in the sample showed normal weight of children.

To assess complex body coordination, test scores achieved by boys and girls were converted to Motor Quotient (MQ). A global indicator of motor coordination adjusted for age and gender was calculated using the four items and used as indicator of motor coordination. Both boys and girls demonstrated the highest level of motor coordination for coupling ability. Boys showed the lowest level of motor coordination for complex coordination while girls achieved the lowest scores in the lower-body frequency ability test. To determine significant differences between girls and boys in individual test items and also in complex coordination, statistical tests were used (Fig. 2). Boys showed significantly higher scores than girls in coupling ability test only. Girls achieved considerably higher but statistically nonsignificant scores in lower-body frequency ability. Differences between boys and girls in dynamic balance and complex coordination were nonsignificant as well (Fig. 2). The comparison of overall profiles for individual test items according to the total MQ score showed no statistical difference between boys (406.93) and girls (410.46).

Correlation coefficients indicating relationship between BMI and motor coordination tests for boys ranged from -0.256 to 0.211. This means that higher BMI does not automatically demonstrate lower levels of motor coordination. There was a nonsignificant relationship between BMI and the total MQ scores (Tab. 1).

For girls, coefficients of correlation between BMI values and test scores ranged from 0.433 to -0.233. All correlation coefficients were negative, which showed an inverse relationship, that is, higher value of BMI indicated lower MQ scores. The "strongest" correlation (-.433) was found between BMI and total MQ score (Tab. 1).

The answer the formulated research question: There was no effect of BMI on motor coordination for boys. On the contrary, data for girls showed a significant relationship between BMI and balance,
coupling ability, complex coordination, and complex coordination expressed as the sum of partial test item scores in KTK test items.

Regarding the educational practice, the authors recommend physical and sports educators to pay more attention to the development of children’s motor coordination, which is a factor limiting their motor behavior. The level of motor coordination is also important from the viewpoint of using the central nervous system when executing movements.

In their pilot study, Chovanová, Majherová [6] assessed the level of motor skills in 11-year-old children, 46 boys and 57 girls who lived in Košice and Prešov self-governing regions (Fig. 3). According to the norms devised by the Ministry of Health of the Slovak Republic, the sample of 11-year-old boys and girls showed average BMI values. Thus, the boys and girls fell within the category of normal-weight children.

Using the KTK test battery [1], the authors assessed children’s coordination abilities and formulated the following research question: Does somatic development significantly correlate with motor coordination? To process collected data, the authors used the parameter of motor quotient (MQ) and statistical characteristics such as the mean, median, and standard deviation. To compare the samples, the nonparametric independent samples $t$ test was applied. The results of the pilot study showed a good level of coordination abilities. The relationship between somatic development expressed by BMI and motor tests for both boys and girls showed correlations ranging from -0.487 to 0.521. This means that higher BMI values do not automatically indicate lower motor test scores. There was also a nonsignificant relationship between BMI and the total MQ score.

For girls, the correlations between BMI and motor tests ranged from -0.0196 to 0.009. Apart from the first one, all correlations were negative, which indicated an inverse relationship. Higher BMI values were correlated with lower sums of MQ. The strongest correlation of 0.521 for boys was found between BMI and lower-body frequency test scores.

Answer to the research question: There was no significant correlation between Body mass index and coordination abilities in 11-year-old boys and girls.

The authors recommend physical and sports educators to pay more attention to the development of children’s motor coordination, which is a factor limiting their motor behavior.

5 CONCLUSIONS

Our contribution is mainly in that by designing exercise programs an effective education tool will be offered in order to develop motor abilities of individuals with impaired level of motor skills (children will be divided into groups according to BMI) and for integrated children diagnosed with behavior disorders.

We will specify what the assessment procedures used to monitor motor abilities should contain in order to represent children’s motor potential as accurately as possible at this developmental stage. This may extend the evidence and knowledge about motor tests or potential selection of motor tests for school-aged children and thus form the basis for reducing the test batteries. This means to conduct a complex assessment of children’s physical fitness levels through administration of a small number of motor tests acceptable under conditions of school physical education.

![Fig. 3. Significant differences between 11-year-old boys and girls](image-url)
ACKNOWLEDGEMENTS

The study was supported by the grant project VEGA 1/0625/16 entitled The effects of physical activities on the development of motor abilities in intact and integrated children with behavior disorders.

REFERENCES
