DIFFERENCES IN THE MOTOR SKILL OF MASTERING SPACE AND THE KINANTHROPOLOGICAL CHARACTERISTICS OF PRESCHOOL CHILDREN

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Abstract

Aim: *The aim of this research was to apply a system of 10 variables on a sample of 60 preschool-aged children (28 boys and 32 girls), of which three variables refer to morphological characteristics, five variables to motor abilities, one variable to aerobic abilities, and one variable to the motor skill of mastering space, to determine the differences in motor achievements and kinanthropological characteristics in children with respect to their age and gender in order to formulate as rational a procedure as possible in the planning of kinesiological contents.* ***Materials and methods:*** *The research was conducted at the Maksimir Kindergarten in Zagreb, the capital of the Republic of Croatia, in the academic year 2018/2019.* ***Results:*** *The Pearson correlation coefficient revealed high reliability (r = 0.89) of the Space Polygon test. The t-test results confirmed the existence of statistically significant differences in motor achievements and kinanthropological characteristics in children with regards to age, whereby the older children achieved better results in overcoming obstacles and in some kinanthropological characteristics. Furthermore, specific differences were observed between boys and girls in favor of the boys in most of the measured variables, except in the variable that tested flexibility.* ***Conclusion:*** *The results of morphological characteristics, motor and functional abilities, and levels of biotic motor knowledge for mastering space can assist the preschool teachers and kinesiologists in the planning of PE lessons that would be tailored to the individual needs of each child.*

Key words: *children, kinanthropological characteristics, motor skill of mastering space, differences.*

Introduction

The preschool years area favorable period to stimulate the development of the overall kinanthropological status and a time to increase the optimal reach of biotic motor knowledge (successful overcoming of space, obstacles, resistance, and object manipulation) of children. It is well known that opportunities missed during this period to influence the development of the quality and quantity of all knowledge and abilities cannot be compensated for in later stages of life, however intensified the developmental incentives may be either in the family as an autonomous educational environment or in all forms outside the family circle (Pejčić and Malacko 2005).

The fact is that today's children live and grow up in a society where institutions and professionals in the field of education have a significant impact on their lives. The awareness of this has been confirmed in the Pedagogical Standard of Primary Education in the Republic of Croatia (hereinafter: DPZ) (2008), according to which the implementation of health care measures in the kindergarten are necessary "to ensure systematic monitoring of the growth and development of children and their nutritional status as well as the implementation of organizational forms of physical and health education areas (exercise program)" (DPZ, 2008: 30). One of the significant aspects of stimulating the development of different potentials of preschool children relates to the possible development of the acquisition level of biotic motor knowledge.

The basic knowledge that man acquires from birth as well as the knowledge that is sufficient for man not only from birth but also from the beginnings of humankind, which is essential for human development and existence and is genetically conditioned, is biotic motor knowledge (Pejčić, Trajkovski 2018). This knowledge is upgraded with other motor skills, and its acquisition is a prerequisite for moving to the next level related to the acquisition of motor skills. Preschool teachers need to know the principles of child growth and development so that they can effectively and optimally plan, program, and evaluate the physical education process in the kindergarten. Adopted biotic motor skills are the foundation for acquiring specific motor skills at a later age. Failure to master basic motor skills in early and preschool years may be a predictor of failure and frustration at a later age. The aim of this research was, therefore, to identify differences in the levels of motor achievement and kinanthropological characteristics in children concerning age and gender in order to formulate as reasonable a procedure as possible in the planning of kinesiological contents.

Methods of research

A system of 10 variables, of which three variables referred to morphological characteristics, five variables to motor abilities, one variable to aerobic abilities, and one variable to motor achievements for mastering space was implemented on a sample

of 60 preschool children (28 boys and 32 girls; 18 four-year-olds, of which 14 girls and 4 boys, 17 five-year-olds, of which 11 boys and 6 girls, and 25 six-year-olds, of which 14 boys and 11 girls). The following variables were used to evaluate morphological characteristics: *longitudinal skeleton dimensionality*– body height (HEIGHT), *body mass and volume* - body mass (MASS), and *nutrition status*– body mass index (BMI). The morphological characteristics were measured using a standard procedure according to the international biological program and the measures that are usually implemented in kinanthropometric procedures (Mišigoj-Duraković, 2008). The following variables were applied to assess motor skills: *movement structuring mechanism*– cube transfer (CT), backward had walk (WALK), *intensity and duration control mechanism*–standing long jump (JUMP), sit-ups in 15 seconds (STOMACH15), and *Mechanism of functional synergy and muscle tone control*– seated forward bend (BEND). The metric characteristics of tests designed to assess the strength, coordination, and flexibility of 4-year-olds were verified according to the results of Trajkovski Višić et al. (2007). The 1-minute running (RUN) variable was used for the assessment of aerobic endurance, which implies movement in a 10x5m space for 1 minute. A newly constructed polygon called Space Polygon, shown in Figure 1, was constructed to assess the level of acquisition of biotic motor knowledge to master space in order to test motor achievement.

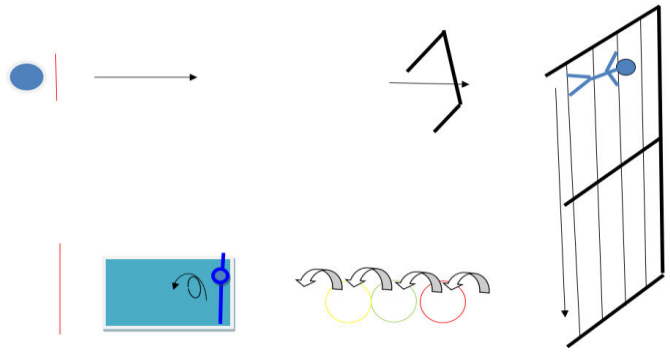

Figure 1. Space Polygon

Task description: The child is standing behind the starting line and begins the task at the sign of the preschool teacher clapping. First, he runs 3m then crawls under the obstacle and climbs the first gymnastic wall bar, moves sideways to the end, and climbs down. After that, with two-leg jumps he moves from one hoop into another (three hoops are placed on the floor), rolls sideways, and crosses the finish line. The total distance from the start to the finish is 15 m (7,5x2). The result is recorded when the child crosses the finish line. The time is measured twice: the first time during the first performance and the second time after all other children have passed the polygon for the first time.

The following statistical central and dispersion parameters were calculated for each variable applied: arithmetic mean (AS), minimum value (min), maximum value (max), and standard deviation (SD). The Pearson correlation coefficient was used to calculate the reliability of the polygon space test. Differences were calculated using the t-test for independent samples and the analysis of variance (ANOVA).

Results and discussion

The Pearson correlation coefficient was calculated for the newly constructed Space Polygon (r = 0.89) whereby its high correlation coefficient indicates very high reliability between the tests. Table 1 presents the results of the measured variables in boys and girls and the t-test for independent samples.

Table 1. Test results for boys and girls (AS±SD arithmetic mean and standard deviation; t-test=t-test for independent samples; p=significance level)

VARIABLES	BOYS AS±SD N=29	GIRLS AS±SD N=31	t-test	p
MASS	21.10 ±3.84	18.72±3.73	-2.61	**0.01**
HEIGHT	117.07±7.74	110.84±8.37	-2.99	**0.00**
BMI	15.23±1.79	15.15±1.30	-0.19	0.85
CT	15.10±2.87	16.53±2.63	2.02	**0.05**
WALK	10.84±4.14	12.83±4.01	1.89	0.06
JUMP	92.53±19.48	79.09±27.42	-2.18	**0.03**
BEND	4.38±3.81	8.52±6.18	3.10	**0.00**
STOMACH15	8.00±2.51	6.19±3.27	-2.39	**0.02**
RUN	125.41±17.64	117.87±16.14	-1.73	0.09
SPACE POLYGON 1	19.66±5.60	24.65±6.74	3.11	**0.00**
SPACE POLYGON 2	19.01±4.79	22.78±5.70	2.76	**0.01**

The current results show that boys are on average 117.07 cm tall and weigh 21.10 kg. Their average body mass index (BMI) is 15.23. The average body weight of girls is 18.72 kg, and the height is 110.84 cm. The BMI of girls is 15.15. The obtained results show that boys are heavier and taller than girls, but their BMIs are fairly even and satisfactory. Differences in the test scores (CT, JUMP, STOMACH15, SPACE POLYGON 1 and 2) are in favor of the boys, while the girls performed better in the flexibility test (BEND), as has been confirmed in previous research (Živčić et al., 2008; Horvat et al., 2013; Trajkovski et al., 2014). No significant differences were obtained in the 1-minute running test for aerobic endurance, possibly because previous research had used 3-minute tests and the boys showed better results (Trajkovski et al. 2015). Here, however, the results of the boys and girls were fairly equal, which may mean that boys show better endurance in those tests that last longer. It is interesting to note that a better result was obtained in the second measurement when testing motor achievement for mastering space (SPACE POLYGON 1 and 2), but this was to be expected because the more times a polygon is mastered, the better the results, especially initially while a motor program is being acquired. Also, the obtained results show that there is no statistically significant difference in the BMI, thus refuting the results of the Croatian Institute for Public Health (2018), which suggest that boys are fatter than girls and that there are more overweight girls in the continental region where the City of Zagreb is located. However, our results should not be considered representative because they relate to a relatively small sample of children included in the research, and this research initiated a pilot project that studies this area. The results of the t-test for independent samples reveal that there are statistically significant differences in motor achievement (Space Polygon) and anthropological characteristics in children with respect to gender.

There were no statistically significant differences between the boys and girls except in the1-minute running and walking backward tests and the BMI scores ($p > 0.05$). In all other scores, there was a significant difference ($p < 0.05$). These results are confirmed by other authors who cite the fact that the differences are biologically conditioned in favor of boys, i.e., that they are related to the basic characteristics of children's growth and development (Horvat et al. 2013; Hraski et al. 2013; Trajkovski et al. 2018; Zekić et al. 2016).

The following table shows the results of the variance analysis, which was applied to test differences with regards to age. These findings provide an insight into the state of the kinanthropological status of children (motor and functional abilities and the level of acquisition of biotic motor knowledge for mastering space).

Table 2 presents the results of basic statistical indicators of the measured variables (arithmetic mean and standard deviation) for children aged 4, 5, and 6 years and the results of the analysis of variance.

Table 2. Test results for 4-year-olds, 5-year-olds, and 6-year-olds and analysis of variance (AS±SD arithmetic mean and standard deviation; p = significance level).

VARIABLES	4-YEAR-OLDS AS±SD N=18	5-YEAR-OLDS AS±SD N=17	6-YEAR-OLDS AS±SD N=25	p
MASS	16.11±1.63	19.47±2.51	22.85±3.48	**0.00**
HEIGHT	104.08±2.83	112.65±4.00	121.70±5.35	**0.00**
BMI	14.96±1.04	15.24±1.18	15.32±2.02	0.75
CT	17.61±3.13	15.42±2.21	14.85±2.42	**0.00**
WALK	14.44±3.17	11.83±3.75	10.04±4.21	**0.00**
JUMP	61.32±20.44	82.94±15.51	104.86±14.35	**0.00**
BEND	7.08±4.46	6.12±6.39	6.38±5.80	0.87
STOMACH15	4.72±3.01	7.94±2.44	8.16±2.54	**0.00**
RUN	111.50±13.45	120.65±13.79	129.32±18.17	**0.00**
SPACE POLYGON 1	28.83±5.97	20.48±4.63	18.68±4.63	**0.00**
SPACE POLYGON 2	26.64±5.17	20.38±3.68	17.26±3.10	**0.00**

From the existing results of anthropometric characteristics of children, and when compared to prior results, it can be concluded that children aged 4-6 years gain an average of about 3.5 kg and 8-9 cm each year, which indicates statistically significant differences concerning a child's age. The body mass index does not increase significantly with respect to the age of the child, which is favorable, and the results do not indicate the tendency towards excessive weight.

In terms of the motor and functional abilities and the Polygon Space test, it is evident that the youngest children show the weakest results. All results improve with age, except for flexibility, which does not change significantly. In other words, as we get older, we become less flexible, especially if we do not develop that ability.

There is a rather substantial increase in the standing long jump result, which increases by about 21 cm with each year of a child's life. There is an improvement in the 1-minute running test; however, the result is only slightly improved (9m) with each passing year, which is worrying. It is for this reason that aerobic capacity should be developed in children; however, since aerobic endurance is not yet sufficiently developed at this age but is instead contained in the complexity of the overall kinanthropological characteristics, it is

recommended that more attention be paid to diagnosing, planning, programming, implementing kinesiological content, and controlling the development of relevant motor skills that are significant in achieving better scores in the children's aerobic ability (Pejčić et al. 2012; Trajkovski et al. 2014).

The results of the Space Polygon test are highest between the fourth and fifth year of life (8.35 seconds better results in the first polygon and 6.26 seconds in the second attempt). In the period between the fifth and the sixth year, the difference in the first attempt at the Space Polygon is 1.80 seconds in favor of six-year-olds and 3.12 seconds in the second attempt, also in favor of six-year-olds. Zekić et al. (2016) highlight in their research better results related to an age-related increase in motor abilities and morphological characteristics. They state that less stagnation is observed at the age of 5 and 6, which is also evident from our research. Morris et al. (1982) examined in their research gender and age differences in children between the ages of 3 and 6 and concluded that age had a more significant impact on the performance of motor tests than gender, whereby the change they registered in children was linear. The results of this 1982 research yielded almost the same results as are evident in our research.

Conclusion

The results of the present research show that there is a statistically significant difference in motor achievement and kinanthropological characteristics in children aged 4-6 years with regards to age and gender, and such findings can help us plan content and work methods. Although the limits of this research are mainly related to the lack of a suitable sample of children, the research was created following earlier research on the morphological, motor, and functional characteristics of preschool children, but it is necessary to construct appropriate contents that encourage the development of abilities and acquisition of motor skills in children in an exciting way (polygons).

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