ORIGINAL ARTICLE

Motor coordination and weight status in children according to area of residence

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Abstract

A good understanding of potential differences in motor coordination and weight status in children from rural and urban areas may advance targeted measures implemented by experts in the field of sports and physical education. This research study is focused on investigating differences in the total motor coordination score and weight status in 70 children aged (7 to 8) living in different residential areas within the territory of the city of Šabac, Republic of Serbia (35 urban and 35 rural areas). The Körperkoordinations Test für Kinder battery of tests was used for the assessment of the overall motor coordination. By application of t-test for independent samples, the obtained results indicate that there are statistically significant differences in the majority of the applied motor tests (walking backward, p=0.000; hop for height on one leg, p=0.033; side jumps, p=0.002), as well as in the total motor coordination scores (p=0.000) in favor of the children from rural environments. The weight status of children indicates no statistically significant differences between the two groups (p=0.376).

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Keywords areas of residence • motor coordination • weight status • KTK battery of tests.

Introduction

An important factor in proper physical (Denker & Andersen, 2008; Ortega, Ruiz, Castillo & Sjostrom, 2008) and mental development in children (Sibley & Etnier, 2003; Fedewa & Ahn, 2013; Gu, Chang & Solmon, 2016) is considered participation in various types of physical activities. Despite the traditional stance that the level of physical activity in preschool and school-aged children is significantly higher than in other age categories and, for the most part, meets the recommended minimum, scientific research studies deny this (Keane, Li, Harrington, Fitzgerald, Perry & Kearney, 2017; Bornstein, Beets, Byun, & McIver, 2011; Hinkley, Salmon, Okely, Crawford, & Hesketh, 2012).

Changes in motor abilities take place in certain socioeconomic conditions characteristic of the environment in which an individual or a group of people live and which is made up of a set of cultural, material, and other factors. The social standard, level of cultural development, place, and role of physical education, and social status of parents and children are merely some of the factors of the social environment that may indirectly influence the development of motor skills in the population living in the given environment, as well as the degree of participation in sports activities (Gadžić and Vučković, 2009; Matić, Kuljić, and Maksimović, 2010). Numerous environmental

factors may be either stimulating or demotivating in terms of children's engagement in physical activity which may have long-term effects on their development. All the said factors indirectly affect the morphological status of children. Some of the demotivating factors nowadays include industrialization, mechanization, and robotics. Prensky (2006a) refers to the children of today as "digital natives". They gratify their needs for company, belonging, and communication sitting in a chair, in front of a computer, tablet or mobile phone.

As early as 22 years ago, Ruel et al., (1998) indicated in their research that girls from urban environments spend most of their spare time reading, playing computer games or watching TV, while girls from rural environments spend more time outdoors, thus enjoying more freedom in play and physical activity. Data obtained from the EU countries indicate that children from rural areas mature at an earlier age in comparison with their peers from urban areas (Bielicki, 1986). More recent research studies indicate that the children from urban areas are more prone to sedentary way of life as opposed to their peers from rural areas (Özdirenç, Özcan, Akin, & Gelecek, 2005; Albarwani, Al-Hashmi, Al-Abri, Jaju, & Hassan, 2009) and the sedentary way of life contributes to the increase in obesity in children, which is also confirmed by the studies (Sedell, 2008; Kosti and Panagiotakos, 2006; Odgen et al., 2006). The dramatic rise of overweight and obesity has been recorded among children on global level and threatens to reach pandemic proportions. On the country of the Republic of Serbia results on the prevalence of obesity in children speak of epidemic proportions (Đorđić et al., 2016). Current rise in the prevalence of obesity among younger population is putting children at risk when of chronic illnesses such as hypertension, high cholesterol levels, diabetes type 2 and development of cardiovascular disease, all of which have already been associated with obesity in children (Daniels, 2006). Certain research studies indicate that the place of residence has no explicit influence on the level of motor abilities in children living in urban and rural environments (Tsimeas, Tsiokanos, Koutedakis, Tsigilis, & Kellis, 2005; Bathrellou, Lazarou, Panagiotakos, & Sidossis, 2007; Krombholz, 1997).

Bearing in mind the results of recent studies and the fact that the need for socialization and physical activity is vanishing before social networks and services, the objective of this research is to determine the existence of differences in the overall level of motor coordination and weight status in children according to their area of residence.

Method

Subject

The research study involved 70 boys and girls aged (7 to 8). Based on their residential area, the children were divided in two groups (35 urban and 35 rural). The investigation was organized as part of the project "Bring sports to schools-Grow healthy" that is approved by the Serbian Ministry of Education, Science, and Technological Development (Ref. No. 601-00-54/2012-15), and it is under implementation on the territory of the city of Šabac (Republic of Serbia). The criteria for inclusion were: that the rural area is at least 20km away from the city and that the children are healthy and do not suffer from any diseases.

Procedures

The respondents performed the tests barefoot and dressed in sports attire. The tests were conducted in school gyms, in a predetermined order, by trained evaluators and professors of sport and physical education. The respondents were introduced with the testing purpose and technique. Only physically and mentally health children able to perform all the tests were tested. The parents provided written consents for participation. This research was conducted in accordance with the ethical standards laid down in the Declaration of Helsinki.

Urban and rural area

The city of Šabac covers the area of 795km² with a total of 122.893 residents. Geographical position of the center point of Šabac lies at grid coordinates 44°46` N and 19°14` E. Šabac is located at 80m above sea level and is a lowland city situated on flat terrain, in a valley.

The village of Krivaja is situated at 197 m above sea level, beneath Cer Mountain (coordinates: 44°33′19″ N and 19°36′07″ E). It is located 29.3km from the city of Šabac and is characterized by hilly and mountainous terrain. It covers the area of 23km² with a total of 812 inhabitants.

Anthropometric measurements

Body height and weight measurements were taken according to standardized procedures (Lohman et al., 1988). All the children were barefoot during measuring. Body height was measured using a

stadiometer ("SECA 213", Hamburg, Germany), with accuracy of 0.5cm. Body weight was measured using a Body Composition Monitor "OMRON BF511" (Omron, Japan) with an accuracy of 0.1kg. BMI is calculated using formula to indicate the ratio between weight and height of a person. (BMI = weight (kg)/height (m^2)).

Motor coordination measurements

The KTK battery of tests was used for evaluating overall motor coordination (Kiphard, & Schilling, 1974) comprising four motor tasks used to test balance, rhythm, side movement, speed and agility. The tests battery was customized for 5 to 15-year-olds, with high reliability (0.90 - 0.97) and validity (r = 0.60-0.80) (D'Hondt et al., 2013; Lopes et al., 2011).

Walking backwards – The respondent is required to walk barefoot on the widest beam (6 cm in width) forwards (as a trial not subject to scoring) and then immediately backwards, without trials on other beams. The respondent has 3 attempts on each beam. Each step is counted and is counted as one point, where the maximum number of points is 8. When the child takes seven steps backwards, this is worth 7 points, when the child takes 6 steps, this is worth 6 points. When the child falls off the beam and touches the floor, the test is stopped and the number of steps taken before the fall i.e., before touching the floor is taken into account. When it takes a lesser number of steps for a child to finish the beam, this is worth 8 points. Maximum number of points is 72 as each beam must be walked three times.

Moving sideways – Moving sideways on a wooden platform with maximum frequency for 20 seconds; the test is repeated twice and both results are recorded. The respondent is required to decide to which side they will be moving (to the left or to the right). Once the decision has been made, the respondent is entitled to two attempts comprising 5 movements of the platform to the preferred side. The respondent is required to stand on the platform with both feet and place another platform opposite to the side the respondent has previously selected. The test is conducted over a 20-second interval, during which time the respondent is asked to perform as many movements of the platform as possible. On the evaluator's mark "Ready-Steady-Go", the respondent starts moving the platforms and stepping from one onto another. Each platform is moved using both hands simultaneously. The responded is required to lift the platform on the one side and transfer it to the other side using both hands. The respondents should be encouraged to move the platforms as fast as possible and not as far as possible. One platform movement is counted as 1 point and stepping onto a platform is counted as another point. The evaluator counts: 1, 2, 3, 4, 5. The test is repeated two times and both results are recorded.

Hopping for height on one leg – the respondent is required to perform a one-legged jump over a foam. Before taking off and after landing, the respondent is required to make a single one-legged hop in order to make sure that the child has established balance for jumping over the foam and for landing. Having jumped over a foam (5 cm in height), the height is increased by adding another foam (5cm in height) and another one, until all 12 foams have been placed or until the respondent has failed to jump over the foam (steps on the foam or loses balance, for example) or after the third attempt. If the respondent is not able to jump over the foams and land on the opposite leg, the attempt is not taken into account. The respondent is entitled to two trials on the right and two trials on the left leg. The initial height for the respondents aged 7 and 8 is 15cm, while the initial height for 9-year-olds is 25cm. The respondent is entitled to three attempts per each height (and per each leg). For a successful jump at the first attempt, the respondents scores 3 points; for a successful jump at the second attempt, the respondent scores 2 points, and for a successful jump at the third attempt, the respondent scores 1 point.

Side jumps – Two-legged side jumps in a limited space, two test repetitions for 15 seconds. The warm-up is comprised of 5 consecutive side jumps. The respondent is required to take up an initial position within one filed, perform as many jumps as possible over a slat in 15 seconds. The respondent starts the test on the evaluators mark "Ready-Steady-Go". When performing lateral jumps, the respondents are required to keep their feet together. One point is scored for each jump. The test is repeated two times and both results are recorded.

Data analysis

For evaluating differences in the overall level of motor coordination and weight status between children from rural and urban environments, a t-test for independent samples was used. Borderline level of statistical significance is set at $p \leq 0.05$. Statistical analysis software SPSS (v20.0, SPSS Inc., Chicago, IL, USA) was used for evaluating statistical significance.

Results

Table 1 shows differences in the main descriptive characteristics between rural and urban children (arithmetic mean and standard deviation values) and the results of the t-test for independent samples. By examining the obtained results, one may conclude that the students from rural areas achieved higher scores in most of the tests used to evaluate motor coordination, as well as in the total motor coordination score, in comparison with children from urban areas.

Table 1. Urban-rural differences in the level of motor coordination in younger primary school-age children

Variable	Rural (n = 35) Mean±SD	Urban (n = 35) Mean±SD	t	p
Body height (cm)	134.69±8.09	134.85±7.01	-0.088	0.930
Body weight (kg)	30.69±7.21	31.98±7.61	-0.730	0.468
BMI (kg/m^2)	16.84±3.02	17.50±3.17	-0.892	0.376
Walking backwards (score)	86.77±15.01	70.63±6.73	5.804	0.000
Moving sideways (score)	89.46±13.96	84.51±11.17	1.635	0.107
Hop for height on one leg (score)	87.69±18.10	80.14±9.69	2.173	0.033
Side jumps (score)	92.66±19.44	79.46±14.52	3.218	0.002
Total KTK (score)	86.76±15.76	72.31±8.25	4.789	0.000

Statistically significant differences in the "walking backwards" variable (t=5.804, p=0.000) were established between rural children (Mean=86.77) and urban children (Mean=70.63). The results of the "hopping for height on one leg" variable indicate that there are statistically significant differences (t=2.173, p=0.033) in favor of the children from the rural environment (Mean=87.69) as opposed to the students from the urban environment (Mean=80.14). The results of the "side jumps" variable indicate that there are statistically significant differences (t=3.218, p=0.002) in favor of the children from the rural environment (Mean=92.66) in comparison with the children from the urban environment (Mean=79.46). The total motor coordination scores indicate the existence of statistically significant differences (t=4.789, p=0.000) in favor of the children from the rural environment (Mean=86.76) in comparison with the children from the urban environment (Mean=72.31). The results of the weight status of children do not indicate any statistically significant differences (t=-0.892, p=0.376) between the children from the rural and those from the urban.

Discussion

In reference to the previous research studies documenting the importance of physical activity, the present study was aimed at evaluating differences in the level of motor coordination in younger elementary school-age children according to their area of residence and weight status. The obtained results indicate that there are statistically significant differences between rural and urban children in the majority of motor coordination tests, as well as in the total motor coordination scores, in favor of the children form rural environments. The differences in the weight status between rural and urban children show no statistical significance; however, the arithmetic mean results show a lower Body Mass Index in children from the rural environment.

The results obtained by means of this research are in line with the previous studies that ventured to evaluate the differences in the motor abilities between children living in urban and rural residential areas (Sylejmani et al, 2019; Tinazci, & Emiroglu, 2009; Chillón, Ortega, Ferrando, & Casajus, 2011). The obtained results may also be explained by the fact that the children from rural areas are able to improve their level of motor coordination by frequent engagement in farming activities as life in the countryside involves various types of tasks, such as gardening, working in the field or vineyard, preparing firewood, taking care of the animals, etc. all of which have contributed to an active lifestyle. On the other hand, urban city environments fail to stimulate children to express their motor potential in physical activities (Molnar, Gortmaker, Bull, & Buka, 2004). The consequences of urbanization include air pollution, various changes in air currents, and a decrease in air

humidity. Urban residential areas are continuously expanding and growing, while open courts and sports facilities are dwindling. The above said leads to a conclusion that all of these factors have an influence on the low level of physical activity and increasingly prevailing sedentary way of life among urban population, both adults and children. Petrić, Cetinić, & Novak (2010), Albarwani et al., (2009), Ozdirenc, et al., (2005) suggest that urban children are more prone to spending their spare time in front of the TV. Unlike the urban areas, rural areas provide for more favorable atmospheric conditions which results in more time spent in the open, where people are frequently in close contact with nature. Researchers have established a link between green areas located in the vicinity of residential areas and daily activity patterns of children. Namely, the children who had sufficiently large green areas in the vicinity of their abode spent significantly less time in sedentary activities such as working on a computer and watching TV (Veitch, Timperio, Crawford, Abbott, Giles-Corti, & Salmon, 2011).

Increase in the Body Mass Index in children from urban areas may be linked to eating habits transition characterized by increased intake of carbohydrates, added sugars, and fat. In urban residential areas across Serbia, one can find, more often than not, fast food restaurants in the vicinity of schools, where children often buy their meals. Furthermore, modern way of life has contributed to parents spending less and less time preparing healthy meals for children while food is frequently ordered for take-away from various restaurants. The results of Sylejmani at al., (2019), Albarwani et al., (2009), Tinazci, & Emiroglu (2009) research studies also suggest that the body mass index is statistically significantly higher in urban children. The situation in rural areas is somewhat different. Restaurants and fast-food places are practically nonexistent and there is a trend of consuming primarily traditional food characterized by highly varied, heavy, and spiced food, the ingredients of which are high in calories. Cooking food has a special place in the Serbian tradition and culture, especially in the countryside, thus accounting for the results obtained by evaluating the difference in body mass index between rural and urban children, which is also supported by the results of Tsimeas et al., (2005) study. The results of McMurray et al., (1999) suggest that children in rural areas are 54,7% more likely to suffer from obesity.

Strength and limitations

Our study has some unique limitations. These limitations refer to the size of the sample itself, as well as the relatively narrow geographical area covered by the research. Future research studies should assume the approach of testing the components of physical fitness as related to health in order to ascertain whether life in the city or in the countryside contribute to health benefits. Furthermore, future research should focus on the socioeconomic aspect in order to obtain a more comprehensive picture of the way the place of residence, combined with other environmental factors, affects the motor abilities in younger primary school-age children.

Conclusion

The obtained results emphasize the necessity of developing strategies which would enable the intensification of physical activity and adoption of main motor skills through regular school activities and extracurricular activities starting from the earliest grades. Bearing in mind that early school years represent extremely sensitive stage in the development of motor skills and bearing in mind the existing tendency towards decrease in physical activities among younger children, the place of residence should be taken into account when implementing effective measures aimed at promoting physical activity and health. It is important to note that well designed advanced PE classes may increase physical activity among the young and should be widely implemented in schools. What's more, it is necessary to raise awareness among schools and children regarding the importance of proper eating habits and physical activity.

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