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CORRELATION BETWEEN CHILDREN'S SEDENTARY AND PHYSICAL ACTIVITY WITH THEIR BMI AND BMI, PHYSICAL ACTIVITY AND DEMOGRAPHIC CHARACTERISTICS OF THEIR PARENTS

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Abstract

The aim of this research was to determine whether there is a correlation between children's sedentary and physical activity and the body mass index of children and parents, the parents' physical activity, and demographic characteristics. The research included 115 pupils aged 9 to 11 and their parents (mothers or fathers). Body mass index (BMI) was calculated based on children's and parents' height and weight. Parents' physical activity was determined according to whether they met the WHO guidelines for adults, and the sociodemographic characteristics included gender, age, and place of residence. Children's physical and sedentary activity was tested with C-PAQ (Children's Physical Activity Questionnaire). Children's physical activity (PA) was operationalized through four types of activity (organized PA, school-related PA, free-time PA, and total PA). Intercorrelations were calculated using Spearman's correlation coefficient. The results showed that girls spend significantly fewer minutes per week in organized and total PA. In the context of age, younger pupils spend significantly more min/week in organized and total PA. Parents' gender, age, and BMI were not statistically significantly related to any form of children's physical and sedentary activity. Furthermore, pupils with a higher BMI spend significantly fewer min/week in free PA, and pupils whose parents meet the WHO guidelines on PA spend significantly more min/week in free activity and significantly fewer in sedentary activities. Pupils who live in a house spend significantly more time per week in free and total PA.

Key words: *physical exercise, guidelines, body mass index, pupils, gender*

Introduction

In the last two decades, we have witnessed an increasing number of children with excess body weight and obesity; therefore, many experts and scientists warn daily about the risks of modern times and the negative consequences affecting children. Recently, the number of physically active people has been decreasing, while at the same time, the number of physically inactive people has been increasing (WHO, 2022). According to WHO data, 81% of children and adolescents are physically inactive, while this percentage in Croatia is 60% (Jurakić, 2015; WHO, 2022). In modern social conditions, appropriate physical exercise is an effective and irreplaceable means of improving and protecting health (Prskalo, 2004). Physical inactivity contributes to the increase and appearance of obesity, increases the risk of (premature) mortality, results in a decline in motor and functional abilities, and represents a risk for the appearance of various chronic and many other diseases (Jurakić & Pedišić, 2019). Physically inactive children have a greater chance of becoming obese or having excessive body mass and will be exposed to a greater risk of developing cardiovascular, chronic, and other diseases (Mišigoj-Duraković et al., 2018). Factors that may affect a person's physical activity or inactivity are mainly lifestyle, sociological factors, environment, genetic factors, personal attitude toward physical exercise, and biological and psychological factors (Mišigoj-Durakovićet al., 2018). Nahas, Goldfine, & Collins (2003) stated that personal characteristics (age, gender, body mass index, level of education, health status), psychological characteristics (self-motivation, self-efficacy), environmental factors (environmental social support, safety conditions), and physical activity characteristics (type of physical activity, intensity of physical activity) should be taken into consideration. During the pre-adolescent years, parental modeling plays an integral role in establishing the social norm regarding children's physical activity (PA). However, as the child

matures, the role of modeling declines, and peers become a more significant influence (Gustafson & Rhodes, 2006). Children's and adolescents' PA depends on the complexity of physiological, psychosocial, familial, and environmental factors and are potential determinants of PA behavior in early life (Kohl & Hobbs, 1998). Previous review studies have summarized evidence on the association of parental socioeconomic/sociodemographic factors, for example, educational level, employment status, number of parents in the family (Lim & Biddle, 2012) or parental behavioral and psychosocial support for children's PA, such as their parenting style, encouragement, and belief (Trost & Loprinzi, 2011; Edwardskon & Gorely, 2011). However, the results of these studies were mixed and inconclusive. Research on correlates (factors associated with activity) or determinants (those with a cause-and-effect relationship) has flourished in the past two decades but has largely focused on individual-level factors in high-income countries. In a more recent review paper (Matos et al., 2021), which included 32 scientific papers on the correlation between the PA of parents and children aged 6-12 years, the authors stated that there was a relevant importance of parents' PA as a role model (either explicitly or implicitly) to children's PA. In addition, the results revealed the importance of promoting PA in the family to improve children's PA. Moreover, considering the positive effect of practicing PA with children on children's PA, parents should spend more time practicing PA with their children, especially on moderate to vigorous intensities of PA (MVPA), and meeting the recommended guidelines for PA. Ecological models take a broad view of the causation of health behaviors, including social and the physical environment, as factors that contribute to physical inactivity, especially those outside the health sector, such as urban planning, transportation systems, and parks and trails (Bauman et al., 2012). In this context, children's PA also depends on the place of residence, that is, their access to parks and the size and configuration of private green areas around the house, which enables more unstructured active play than in public places (Fan & Khattak, 2009). In urban districts, however, the strongest correlates of children's PA have been the ability to walk, speed and volume of traffic, combination of land use (proximity to homes and destinations), and access to or proximity to recreational facilities (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011).

This research aimed to determine whether there is a correlation between children's sedentary and physical activity with body mass index (children's and their parents' BMI), parents' physical activity, and demographic characteristics (children's and parents' gender and age, place of residence).

Material & methods

Participants

This research comprised a total of 115 pupils, aged 9 to 11 years, with an average age (9.76±0.70), enrolled in the third and fourth grades of elementary schools in the Varaždin and Međimurje counties. The sample consisted of 51% boys (N=59) and 49% girls (N=56). One hundred and fifteen parents also participated in the questionnaire, that is, 84% of mothers (N=97) and 16% of fathers (N=18), average age (40.22±5.35).

Procedure

Based on body height and weight, pupils' and parents' (mothers' or fathers') body mass index (BMI) was calculated. The parents' nutritional status was classified according to the recommendations of the World Health Organization (WHO, 2010), and the appropriate BMI was calculated for the age percentile for children and teenagers aged 2 to 19 years (CDC, 2023). The physical and sedentary activity of pupils was examined with C-PAQ (Children's Physical Activity Questionnaire). The questionnaire contains a list of the most common organized sports activities (aerobics, athletics, basketball, volleyball, dancing, football, gymnastics, martial arts, running, swimming, tennis/badminton/squash/table tennis, and other), leisure activities (bike riding, bouncing on the trampoline, bowling, household chores, playing in the garden, playing on children's playground, playing with pets, rollerblading, riding a scooter, skateboarding, skipping rope, dog walking, walking/hiking), school-related activities (extracurricular sports groups, walking or cycling to and from school), and sedentary activities (watching TV, arts and crafts, doing homework, imaginary play, listening to music, playing indoors with toys, board games/cards, computer games, playing a musical instrument, reading, talking/conversation, talking on the phone/cell phone, traveling by car/bus to school, using the computer/internet, other). In the questionnaire, the frequency (how many times) and duration of each activity during the working week (Monday to Friday) and the weekend (Saturday and Sunday), expressed in minutes, were filled out. By summarizing the weekly activities, the total time expressed in minutes (min/week) was calculated. Physical activity is operationalized through four variables.

At the beginning of the questionnaire, the sociodemographic data filled out by the parents were examined (child's first and last name, child's age, parents' age, parents' body height and weight) and it was necessary to indicate who filled out the questionnaire (the child's mother, father, grandmother/grandfather, legal guardian), place of residence (house/apartment), and to choose an answer (yes/no) to the question about meeting the recommendations of the WHO (2010) – for adults to exercise at least 150 min/week in moderate-intensity physical activities in their free time. In order to carry out the research, permission was sought from the school principal and teachers, who distributed the questionnaires to the pupils, and the consent to participate in the research. The parents filled out the questionnaire at home, and the children's height and weight were measured at school.

The research was conducted in accordance with the Code of Ethics for research with children, according to which every child participated in the research voluntarily and had the right to withdraw at any time without explanation; the data obtained were confidential, and the privacy of the participants was respected.

Statistical analysis

Frequencies and percentages of sociodemographic characteristics and nutritional status were calculated. Basic descriptive parameters (arithmetic mean, standard deviation, skewness and kurtosis) were calculated for the variables of physical and sedentary activity and body mass index (BMI), and the normality of the distribution was verified with the Kolmogorov-Smirnov test. Intercorrelations between the variables were calculated using Spearman's correlation coefficient. The research results were processed in the program Statistica 7.0.

Results

The housing variable indicates that 73.9% (N=85) live in a house and 26.1% in an apartment (N=30). When asked if they meet the WHO guidelines for adults to exercise at least 150 min/week in moderate-intensity PA in their free time, 51% (N=58) of parents maintained that they meet, and 49% (N=57) that they do not meet the aforementioned guideline. According to the parents' nutrition status, the largest share of 62.6% (N=72) have a normal body mass, 23.5% (N=27) an excessive body mass, 11.3% (N=13) are obese, and 2.6% (N=3) are malnourished. In children, the nutritional status indicates that 72.2% (N=83) have a normal body weight, 17.4% (N=20) are overweight, 8.7% (N=10) are obese, and 1.7% (N =2) are undernourished (Table 1).

Table 1. Basic characteristics of the sample

Variables		*F*	%
Gender children	boys	59	51
	girls	56	49
Gender parents	fathers	18	84
	mothers	97	16
PA (WHO) parents	meets	58	51
	does not meet	57	49
Housing	apartment	30	261
	house	85	73.9
Nutritional status children	malnourished	2	1.7
	normal	83	72.2
	excessive	20	17.4
	obese	10	8.7
Nutritional status parents	malnourished	3	2.6
	normal	72	62.6
	excessive	27	23.5
	obese	13	11.3

The results of the descriptive parameters (Table 2) show that pupils spend an average of 204 min/week in organized PA, 396 min/week in free PA, 58 min/week in school-related PA, and 659 min/week in total PA. They spend an average of 2,967 min/week in sedentary activities during their free time. Positive asymmetry in all variables indicates the grouping of participants in the zone of lower values with a few extremely high results. The values of the kurtosis coefficients in the variables free PA and sedentary activity

indicate a platykurtic distribution, that is, a heterogeneous distribution of results. The Kolmogorov-Smirnov test shows a significant deviation from the normal distribution in all variables.

Table 2. Basic descriptive parameters of physical activity variables and body mass index

	Mean	SD	Skew	Kurt	K-S test
BMI children	18.39	3.21	1.559	2.961	.001
BMI parents	24.23	3.93	.888	.448	.000
ORGPA (min/week)	204.06	182.34	.777	-.078	.000
FREEPA (min/week)	396.72	315.37	1.682	3.864	.000
SCHOOLPA (min/week)	58.55	60.06	1.238	2.445	.000
TOTALPA (min/week)	659.33	383.11	1.124	2.090	.038
SEDENTACT (min/week)	2967.30	2001.87	1.998	6.710	.000

Table 3. Correlation of physical and sedentary activity with body mass index, parents' PA, and demographic characteristics

Variables	ORG PA	FREE PA	SCHOOL PA	SEDENT ACT	TPA
Gender children	-.201*	-.091	.053	.113	-.184*
Gender parents	-.144	.074	.054	.119	.000
Age children	-.220**	-.065	-.104	.092	-.156*
Age parents	.090	-.015	.013	.072	.016
BMI children	.020	-.233**	.042	.081	-.142
BMI parents	-.130	-.054	-.089	.121	-.141
WHO PA parents	.237**	.002	-.052	-.258**	.038
Apartment/house	-.028	.225**	.037	-.077	.171*

Legend: ** p < 0.01; *p <0.05

Statistically significant negative correlations (Table 3) were obtained between pupils' gender and organized (r=-.201) and total PA (r=-.184), in the sense that girls spend significantly fewer min/week in organized and total PA. The pupils' age is significantly negatively related to organized (r=-.220) and total PA (r=-.156), which indicates that younger pupils spend significantly more min/week in organized and total PA. Parents' gender, age, and BMI were not statistically significantly related to any form of children's PA. Statistically significant negative correlation between BMI and free PA (r=-.233) shows that pupils with a higher BMI spend significantly fewer min/week engaged in free PA. Parents' PA is significantly positively related to children's organized PA (r=.237) and negatively related to children's sedentary activity (r=-.258). The above connections show that children whose parents meet WHO guidelines on PA spend significantly more time during the week in leisure activities and less in sedentary activities. Significantly positive correlations were obtained between housing (apartment/house) and organized PA (r=.225) and total PA (r=.171), and reveal that pupils who live in a house spend significantly more time per week in free and total PA (Table 3).

Discussion

Children's total time spent in sedentary activities and physical activities (organized, free, school-related, and total PA) was analyzed through their parents' self-assessments, as well as through the relationship with BMI, parents' PA, and demographic characteristics such as housing, gender, and age of parents and pupils. The obtained research results have confirmed that boys are significantly more active in organized and total PA, which is in line with previous research carried out by Vidaković Samaržija & Mišigoj Duraković (2016) on a sample of 10-year-old pupils, where boys participated more frequently in organized PA than girls. Significant gender differences in favor of boys in the field of sports were found in a study that included 189 first- and second-grade pupils (Roca, 2019). According to research by Kunješić (2015), boys are more active in sports; this is further supported by international research (Pearce et al., 2012; Telford, M., Telford, D., Olive, Cochrane, & Davey, 2016; Ekelund et al., 2012). Longitudinal research that looked at differences in PA between genders (Telford et al., 2016) showed that girls are less active because they have less support in physical education classes and less family support and participate less in organized sports activities.

Significant negative correlations between age and PA are consistent with research on a sample of children showing a significant linear decline in average min of MVPA per day between the ages of 9 and 15 (Bradley et al., 2011). Also, a three-year longitudinal study found that MVPA systematically begins to decrease from the age of 5 to 10 in both boys and girls, except that boys remain more active than girls throughout the entire age range (Pereira et al., 2022). The same was confirmed by an eight-year longitudinal study, where the total volume of PA starts to decrease from the age of 7, and there was no evidence to suggest that the decline in PA began in adolescence or that the decline in PA in adolescents was significantly greater than the decline in childhood (Farooq et al., 2018). The above results indicate that the trend of decreasing is already present at an earlier age, that is, in the primary education of pupils. The correlation between the pupils' BMI and PA in their free time indicates a negative correlation, which is in line with other research that determined their correlation on a sample of elementary-school children (Dolley et al., 2023; You, Tan & Mat Ludin, 2020). We assume that overweight and obese children do not have the habit of spending their free time in spontaneous PA during their free time, such as playing with peers, riding a bicycle, or walking. On the other hand, due to subcutaneous fat tissue, it is more difficult for obese children to move their body mass against gravity (Riddiford, 2000), and they are also more likely to have orthopedic complications, such as flat feet (Riddiford-Harland, Steele, & Storlien, 2000), which can lead to greater pain when performing PA, leading ultimately to them avoiding it.

The results of this research also show that children of physically active parents, that is, those who meet the WHO guidelines (2010), spend significantly more time in organized PA and less in sedentary activities. In accordance with previous findings, the correlation confirms that parental modeling plays an integral role in establishing social norms regarding children's PA. Thus, research (Fuemmeler, Anderson, & Mâsse, 2011) has shown a positive connection between the PA of parents and their children; that is, a higher moderate to high PA of the parents was associated with a higher moderate to high PA of the child. In addition, having two parents with higher levels of moderate PA was associated with higher activity levels in children. The authors stated that to increase the level of activity in childhood, it could be useful to improve the PA of the parents because they can significantly influence their child's PA; therefore, parents are often encouraged to be more active with their child. A positive correlation of the total PA, measured with daily step counting, between parents and children aged 7 to 8 years was stated by Stearns et al. (2016). In a sample of Portuguese children aged 6-10 years, PA of both parents was significantly correlated to the organized PA of the children (Rodrigues, Padez, & Machado-Rodrigues, 2018). Interesting results were obtained in a three-year longitudinal study of preschool-aged British children (Jago et al., 2017) in which the correlation between physical and sedentary activity of parents and their children was examined when the children were ages 5-6 and 8-9. Parents who were more physically active when their child was 8-9 had a child who was also more active, but the size of the correlation was generally small. So far, findings have shown that parents have an important influence on children's physical behavior because in addition to their PA with which they model the children's active behavior, important predictors are also that the parent is active with the child and that they helps/provides the child with support when engaging in PA (Jago, Fox, Page, Brockman, & Thompson, 2010).

The positive correlation between the place of residence and PA indicates that children who live in an apartment spend significantly fewer min/week in PA during their free time. This correlation can be explained by previous research, which stated that children who live in urban areas have a high risk of a decrease in PA in their free time because they have fewer available public green spaces, while on the other hand, the size of the yard around the child's residence is positively correlated to their current and future level of PA (Miller, Fan, Sherwood, Osypuk, & French, 2020). Two studies found a positive association between yard availability or yard size and parent-reported children's PA or outdoor play (Marino, Fletcher, Whitaker, & Anderson, 2012; Spurrier, Magarey, Golley, Curnow, & Sawyer, 2008). Furthermore, in urban neighborhoods, the neighborhood itself and public outdoor parks and recreation areas were the only location categories associated with outdoor PA (Kneeshaw-Price et al., 2013). In other studies, parents stated that free outdoor play depends on neighborhood safety, access to recreational facilities (Kurka et al., 2015), traffic density, a lack of safety structures for pedestrians (crosswalks), and the proximity to safe play areas (Tappe, Glanz, Sallis, Zhou, & Saelens, 2013). Many parents do not allow their children to go out alone due to fear of crime and traffic (Loukaitou-Sideris & Sideris, 2010). Safety has also been found to be a

more important aspect for girls than boys (Douglas, Lennon, & Scott, 2017). From the above, it can be discerned that improved environmental security could support better use of PA leisure time outdoors.

Conclusions

Parents, the school, and the environment are the most important factors in a child's life and are important in creating a child's attitude towards physical activity and nutrition. Parents should react and encourage and guide children towards a healthy and balanced diet from an early age, as well as encourage them to engage in sports and PA in their free time. In the context of promoting PA, schools certainly have the responsibility of promoting a physically active lifestyle because it is the only environment that reaches all children regardless of their socioeconomic background. Schools should enable pupils to exercise daily by increasing the hours of physical education and extracurricular sports activities, as well as enabling active breaks, as these are reasonable factors for reducing sedentary behavior and promoting physical activity.

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