



Association between parental physical activity and motor skills in their preschool children

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Abstract

Young children often observe and emulate the actions of adults, whom they look up to as role models. Considering that parents have an influence on their children at an early age, the aim of this study was to determine whether there is a correlation between the physical activity of parents and the motor skills of their children of preschool age. The study included 1212 boys and girls and their parents (N=2287) from Croatia. Parents completed the "Single item physical activity" questionnaire (SIPA) for research purposes which assessed their physical activity. Preschool children were tested with "Bruininks-Oseretsky Test of Motor Proficiency - Second Edition" (BOT-2) and "Test of Gross Motor Development - Second Edition" (TGMD-2), which assessed their motor skills. Multinomial regression analysis showed a significant association between paternal physical activity and score in the TGMD-2 of their children. It is up to parents to encourage their children in physical activity, and thus the development of motor skills. In this way, children will create healthy habits and have a greater chance of being active throughout their lives.

Keywords: kindergarten, motor abilities, maternal physical activity, paternal physical activity



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Introduction

Motor skills represent movement structures that are learned from birth and applied throughout life in different life situations and activities (Sekulić & Metikoš, 2007). During early childhood, the learning of new movement skills is affected by the overall development in different areas, which are in mutual interaction: physical, cognitive and socio-emotional (Krstulović, 2018). It is necessary to facilitate the learning of motor skills in different developmental stages, particularly in early childhood throughout enriched environments.

Physical activity and motor skills are connected by cause-and-effect relationships (Butcher & Eaton, 1989). Children

and adults with a higher level of motor skills consequently have more chances and confidence to engage in physical activity in the future compared to people and children with a lower level of motor skills and abilities (Wrotniak et al., 2006). This is why physical activity and the development of motor skills are extremely important for overall human development and health in life.

Young children often observe and emulate the actions of adults, whom they look up to as role models. Through imitation, children acquire valuable skills and behaviours through childhood. During early childhood, adults play a crucial role in shaping a child's behavior. Specifically, parents have the

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greatest influence on their child's motor development, physical activity levels, and formation of habits related to exercise (Kimiecik et al., 1996; Brustad, 1993; Kimiecik & Horn, 1998). This is because the family is the child's primary environment during their formative years, providing opportunities for parents to guide their child's actions (Kimiecik et al., 1996). Parents have control over their child's activities and are responsible for how their child spends their time (Shartaya et al., 2006). As such, parents should strive to model healthy habits and encourage physical activity to promote a healthy lifestyle for their child.

Previous research shows that various parental influences may play an important role in shaping physical activity of their preschool children. Two recent meta-analysis show various parental factors significantly related to child's physical activity such as parental support for physical activity (e.g., encouragement, facilitation, and modeling of physical activity), parental monitoring, parental physical activity and parental participation in physical activity with their children (Su et al., 2022; Arts et al., 2023).

Given the association between higher physical activity and better motor proficiency (Wrotniak et al., 2006; O'Neill et al., 2013; Xu et al., 2018), there is a possibility that the environmental factors that are associated with motor skill proficiency may be similar to those for physical activity. An older review by Sallis et al. (2000) showed that in 38%, of the 29 included studies, positive correlation was found between the physical activity of parents and the physical activity of their children 4-12 years of age. Cools and associates (2011) found in a large sample that fathers' physical activity level was positively associated with fundamental motor skills in preschool boys. Newer studies have failed to reproduce findings of parental physical activity relation to child's motor skills. The study of Barnett and associates (2013) found that none of the family factors (interaction, physical activity, confidence) were correlated with children's locomotor skills. Both studies found that environmental factors such as the having physical activity equipment at home was positively correlated with both locomotor and object control skills in children. In research of Paez and associates (2022) parental physical activity level does not appear to have a significant impact on their children's motor development level. On the other hand, physical activity level of parents was related to their children's body mass index and authors concluded that promoting physical activity among parents could be an effective way to prevent childhood obesity and to promote healthy lifestyle for both parents and children.

Given that previous research has established the connection between parental physical activity and their child's physical activity, it is assumed that the level of physical activity of parents will also affect the level of motor skills of children, the connection of which has not been sufficiently investigated so far.

Therefore, the aim of this research was to determine the association between the physical activity of parents and the motor skills of their preschool children.

Methods

Participants

1212 boys and girls aged 3 to 6 years and 2287 of their parents (1173 mothers and 1114 fathers) from different parts of Croatia participated in this research. Given that this research was part of a larger study, the sample is larger than the minimum recommended (Raosoft sample size calculator = 384).

The average age of preschool children included in this research was 5.2 years. The children of preschool age who were included in this research attended state kindergartens that were chosen randomly for the purposes of the research. All children from randomly selected kindergartens participated in the measurements. In addition to preschool children, their parents also participated in the research.

Considering the current population census before conducting this research and considering the number of children attending kindergartens in different parts of the Republic of Croatia, the kindergartens that participated in this research were chosen by random selection. Agreements for participation were signed with the directors of the kindergartens, after which agreements were also signed with the parents for their children's participation in the research.

Measurements

For research purposes, parents filled out "Single item physical activity" questionnaires (SIPA), which uses a single question to assess the level of their physical activity (Milton et al., 2011). Data were obtained on the number of days in the previous week when the person engaged in at least moderate physical activity for a minimum of 30 minutes. Accordingly, the maximum number of days was 7, and the minimum number of days was 0 in physical activity. For the purposes of this research, we specifically analyzed the physical activity of mothers, especially fathers, but also the average activity of both parents together. The reliability of this questionnaire is $r=0.72-0.82$, while the validity is $r=0.53$ (Milton et al., 2011).

Children were measured with two batteries of tests: "Bruininks-Oseretsky Test of Motor Proficiency – Second Edition" (BOT-2) (Bruininks & Bruininks, 2005) and "Test of Gross Motor Development – Second Edition" (TGMD-2) (Ulrich, 2000). A short version of the BOT-2 test battery was used, consisting of 14 separate tests. This battery of tests showed high reliability (0.86 to 0.89) (Cools et al., 2009). 860 children of preschool age were measured with the TGMD-2 battery of tests in all 12 tests of which the battery consists of. Previous research has confirmed that the TGMD-2 has very good metric characteristics (Cronbach alpha .82 to .94) (Ulrich, 2000).

For the purposes of statistical analysis, the results of preschool children measured in this research in the TGMD-2 and BOT-2 tests were divided into 3 categories. For the TGMD-2 test, the results are divided into: category 1 (69-80 - below average), category 2 (81-105 - average) and category 3 (106-116 - above average). For BOT-2 the results are also divided into: category 1 (32-40 - below average), category 2 (41-57 - average) and category 3 (58-66 - above average).

Data analysis

Statistical analyses were performed using TIBCO Statistica v.13 software (TIBCO Statistica Inc, OK, USA).

The influence of predictors (maternal physical activity, paternal physical activity, and average parental physical activity) on criteria (trinomial criteria: below average – average – above average TGMD-2/BOT-2) we calculated multinomial regression, with Odds Ratio (OR), and 95% Confidence Interval (95%CI) reported. In multinomial regression above average achievement group on TGMD-2/BOT-2 was used as reference group.

Results

Results of this research show that mothers were physically active for 2.78 days ($\sigma=1.97$) in a week. The most frequently obtained or dominant value for mothers was 2 days of moderate physical activity in the previous week. For fathers,

the average physical activity was 3.13 days ($\sigma=2.07$). The dominant value for fathers was 3 days of moderate physical activity in a week. Average values for both parents show that mothers and fathers were physically active for 2.92 ($\sigma=1.72$) days in a week.

Table 1. Descriptive statistics of physical activity mothers, fathers and both parents

	MEAN	MODE	STD.DEV.
PAM	2.77	2	1.97
PAF	3.11	3	2.08
PABP	2.92	3	1.75

PAM - physical activity of mothers; PAF - physical activity of fathers; PABP – average physical activity of both parents; MEAN; STD. DEV. -Standard Deviation

The average value of standardized results in the BOT-2 test of preschool children included in this research is 48.95 ($\sigma=8.61$). Average value of the Gross Motor Quotient (TGMD-2 test) was

93.56 ($\sigma=11.72$). When we divide the TGMD-2 battery of tests into Locomotor Subtests and Object Control Subtest, we get average values of 9.76 (SSLS, $\sigma=2.35$) and 8.05 (SSOCS, $\sigma=2.26$).

Table 2. Descriptive statistics of motor skill in preschool children

	SS(BOT-2)	GMQ (TGMD-2)
MEAN	48.95	93.56
STD.DEV.	8.61	11.72

SS(BOT-2) – Standard Score(BOT-2); GMQ(TGMD-2)- Gross Motor Quotient

Figure 1. presents results of the multinomial regression calculated for trinomial criteria BOT-2 (Figure A) and TGMD-2 (Figure B). Multinomial logistic regressions for variables of parental physical activity were not significant when BOT-2 was observed as criterion variable (PAM: OR = 0.99, 95%CI: 0.96-1.03; OR = 0.98, 95%CI: 0.94-1.03; PAF: OR = 1.00, 95%CI: 0.97-1.03; OR = 1.01, 95%CI: 0.96-1.05; PABP:

OR = 1.00, 95%CI: 0.98-1.02; OR = 0.99, 95%CI: 0.96-1.02) for below average and average group with in comparison to above average group, respectively (Figure A). Meanwhile, PAF was significantly related to TGMD-2 score in children, with lower likelihood of being groups in above average cluster for those children whose fathers were more physically active (OR = 0.94, 95%CI: 0.90-0.98) (Figure B).

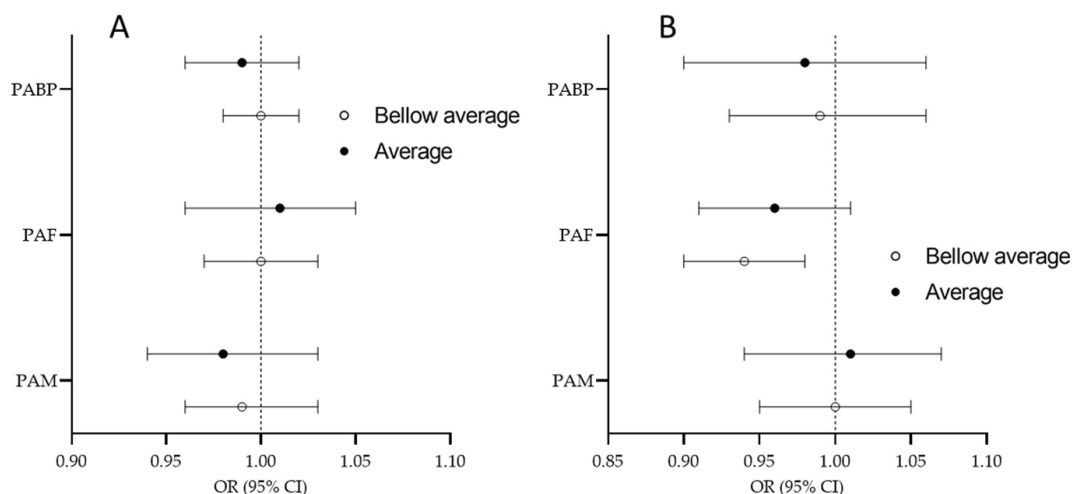


Figure 1. Multinomial logistic regression results for trinomial criteria BOT-2 (Figure A) and TGMD-2 (Figure B)
 Legend: PABP – average physical activity of both parents, PAF – physical activity of fathers, PAM – physical activity of mothers

Discussion

Multinomial regression analysis showed a significant association between fathers physical activity and children’s score in the TGMD-2 battery of tests (trinomial criteria) (Figure 1).

Previous research shows that the level of parental physical activity can strongly influence their children’s behavior (Xu et al., 2018) as well as significant positive correlation between parent’s physical activity and children’s physical activity and motor skills (Zecevic et al., 2010; Krmpotić & Stamenković,

2014; Shartaya et al., 2006). Also, a week but positive relationship between parents and child physical activity (PA) was found in review Petersen et al. (2020). Furthermore, earlier research showed that there is a positive correlation between children’s basic motor skills and fathers’ physical activity (Cools et al., 2011) as obtained by multinomial regression from this research.

Based on the obtained results, we can ask ourselves why there is a association between fathers physical activity and childrens

motor skills, and why is not the same with mothers. And the other question is why was the association shown only in the TGMD-2 and not in the BOT-2 test?

The reasons for that can be searched in the research of Krmpotić and Stamenković (2014), which showed that an equal percentage of mothers and fathers of the children involved in their research have participated in some sports in the past, however, mothers played sports on average for 6.29 years in their lifetime and fathers for 9.96 years in their lifetime. Therefore, mothers were more involved in dance, rhythmic gymnastics and handball, while fathers mentioned football and basketball as the most common activities.

If we know that the TGMD-2 battery of tests is more intended for the assessment of gross motor skills (such as running, galloping, throwing and catching the ball, kicking the ball with the foot, etc.) and if we also consider that mothers are throughout the day and during growing up of the children in general probably more busy in household work than the fathers, it is to be assumed that the physical activity of the fathers has a greater influence on the development of the children's motor skills, especially the gross ones, since we can also assume that fathers carry out activities with their children which are known to themselves.

Furthermore, the research Kamionka et al. (2023) also showed a greater influence of the fathers physical activity (PA) on the children's PA compared to the mothers. Namely, if mothers are active, children are 2.0 more likely to be active, and if fathers are active, then they are 3.5 more likely to be active.

That's why in this research we probably obtained exactly the association between fathers physical activity and children's results in the TGMD-2 battery of tests and not in the BOT-2 battery of tests, which more covers a part of fine motor skills.

Contrary to this study in the research by Paez et al. (2022) no significant correlations were found between the level of physical activity of parents and the motor skills of their children, but this research was conducted with children aged 8 to 10 and their parents, also using the same test (TGMD-2) to assess children's motor competence. We can assume that the results of Paez et al. (2022) differ from our results due to the age of the children involved in the research, namely, according to Sallis et al. (2002), as the child's age increases, parental influence decreases and the influence of their peers on physical activity increases.

Based on acquired knowledge, parents are one of the key models for the acquisition and improvement of children's healthy behavior. In fact, parents serve as role models for an active lifestyle and therefore it is important to highlight the importance of the role of parenting in connection with physical activity and basic motor skills during early childhood (Agard i sur., 2021).

Although parents are one of the main links in the process of forming and guiding a child in development, Hands (2012) points out that parents and educators sometimes react wrongly and do not focus enough to mother issues, if they exist, but simply classify the child as "non-sporty" type, lazy or clumsy, which in the long run can lead to problems of a physical, emotional, social or health nature. Piek et al. (2012) point out that early identification of possible problems in motor skills is crucial, not only because of work on improving motor skills but also because of health, intellectual, and psychosocial problems that can arise due to low motor skills with which the mentioned problems are related. Research by Liang et al. (2015),

which dealt with the difference between the perception of children and parents and the actual performance of motor skills by children, showed that boys evaluate their actual performance well, while parents only evaluate manipulative skills in boys and locomotor skills in girls well. The authors, therefore, suggest interventions aimed at parents in order to learn how to recognize the good or bad performance of motor skills and thereby react in time and provide help to their child.

The authors point out that the period from the 2nd to the 7th year of life (the period of infancy and most of early childhood) is the period when basic motor skills develop the most (Gallahue, 1982; Sanders, 1992), and the stages of development can be divided into the initial, basic and mature stage. At the same time, a child at the age of 6 should reach the mature stage, for some fundamental motor skills like walking or running, moving accurately, efficiently, and coordinated (Božanić, 2011).

Children who have reached the mature stage of development move to the first stage of learning specific motor skills, while children who have not reached this stage have a limited possibility of progress in later stages (Gallahue & Donnelly, 2003) as well as problems in interaction with the environment and with the quality of physical manipulation. (Pišot, 2018). Lippincott (2004), on the other hand, points out that parents must let the child learn motor skills when he or she is ready for it because sometimes rushing can cause frustration in the child. This is why it is necessary to educate parents to recognize a possible problem and to know what a child should be able to do at what age. Karković (1998) lists 15 types of parents and how each of these types, and their behavior, affect the child's attitude towards sports and the subsequent continuation of involvement in various sports and recreational activities throughout life. A common mistake of parents is interfering with the work of trainers and kinesiologists and placing high expectations on their child (Karković, 1998). Accordingly, Cools et al. (2011) found a negative correlation between preschool children's basic motor skills and parental perception of the importance of winning in physical activity.

From the above, it can be concluded that emphasizing winning and thereby creating pressure from parents toward children, creates children's aversion to physical activity, and if children do not acquire the habit of regular physical activity from an early age, this habit will be more difficult to take root at a later age. That is why it is important to take serious steps in solving this problem, starting with motivating and directing children to physical activity from the earliest age, when there is the greatest chance of adopting healthy lifestyle habits, and thus learning basic motor skills.

Limitation of this study is that the physical activity of the parents was assessed with a questionnaire. We believe that in some future research, more objective and accurate measuring instruments should be used to assess parents' physical activity, such as an accelerometer, which we believe would provide better information (level and intensity of parents' physical activity).

Conclusions

Parents undoubtedly have a strong influence on their children in the earliest stages of their growth and development. Parents are one of the most important people who serve as a „model“ for children's behavior and learning. If a child acquires the habit and need for regular physical exercise in the

earliest stages of his life, it is more likely that he will remain active in the later stages of his life. Also, if we know that physical activity and motor skills are connected by causal relationships (Butcher & Eaton, 1989; Graf et al., 2004; Wrotniak et al., 2006; Fisher et al., 2005; Williams et al. 2008; Kambas et al., 2012), then it is to be expected that more active children will have more opportunities to develop their motor skills to the level that is expected of them at a certain stage of life. Furthermore, an adequate level of motor skills will be useful to them throughout their lives, therefore it is extremely important to encourage children to be physically active from an early age, and parents certainly have one of the most important roles in this effort.

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