

# Differences in Physical Activity between Non-overweight, Overweight and Obese Children

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## ABSTRACT

*The purpose of the study was to find out differences in moderate to vigorous physical activity among non-overweight, overweight and obese children, and between boys and girls. The sample included 364 children (179 boys and 185 girls), aged 6.4 years ( $\pm 0.3$  SD). Physical activity was assessed by 7-day questionnaire. Age adapted BMI was used as overweight and obesity indicator. The children were divided into non-overweight, overweight and obese groups. It was found out, that there are significant differences in non-overweight, overweight and obese children ( $p < 0.05$ ). Boys were significantly ( $p < 0.05$ ) less moderate to vigorous physical active than girls, especially in indoor activities. There were also significant differences ( $p < 0.05$ ) in moderate to vigorous physical activity among non-overweight and obese boys and among overweight and obese boys in weekends and total weekly activity. In girls there are significant differences ( $p < 0.05$ ) in non-overweight, overweight and groups in weekends and total weekly activity. It is possible to conclude, that obese boys and overweight and obese girls, are prone to less physical activity.*

**Key words:** *physical activity, children, overweight, obese*

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## Introduction

Almost worldwide, obesity among children has been on the increase<sup>1</sup>. In some countries, more than 20% of children between four and twelve years of age are overweight<sup>2</sup>. Obesity is an important risk factor for increased blood pressure, hyperinsulinemia, type-2 diabetes, increased

LDL cholesterol, abnormal lipoprotein ratios, poor self-concept, low self-esteem, and cultural stigmatization<sup>2-8</sup>. There is a possibility that obesity from childhood may extend into the adult age, as it is a rather stable characteristics<sup>9</sup>.

Regular physical activity of different types is rather important for a child's development, health, and physical fitness and for the formation of such behavioural patterns that insure regular physical activity throughout life<sup>10,11</sup>. Physical activity proves useful as a form of prevention against obesity and for reducing body fat<sup>12</sup>. Health enhancing physical activity requires suitable intensity, duration, frequency and type. Children should be moderately to vigorously physically active for at least one hour a day<sup>13</sup>.

Connection between physical activity and body weight of children is known, on the other hand, findings are rather inconsistent. Sallis et al.<sup>14</sup> found out that studies prevail in which physical activity of children is negatively correlated to body mass index (BMI), but there is a number of studies where the correlation has not been proved. There are number of studies that state the significant differences in physical activity in non-overweight, overweight and obese groups. Taylor et al.<sup>15</sup> states that overweight girls are less physical active than non-overweight girls, but there were non-overweight differences in boys. Mota et al.<sup>16</sup> came to the same conclusions. Obese children show lower level of moderate to vigorous physical activity than non-overweight children<sup>17</sup>. It was found out, that obese participant's are less physical active than non-overweight and overweight<sup>18</sup>. Substantial meta-analysis showed that the correlation between physical activity and the amount of body fat in children is low to medium<sup>19</sup>. Among the most important reasons for overweightness and obesity is positive energy balance<sup>20</sup>, which is the result of too high calorie input and a lack of physical activity or more and more sedentary lifestyle<sup>21–23</sup>. Lower level of physical activity in children is the result of today's life style, mainly because of working habits of parents, watching television, the use of computer and other cultural factors, which

decrease the opportunity and motivation for physical activity<sup>24</sup>. Still, the question remains if younger overweight or obese children are indeed less physically active than their non-overweight counterparts.

Little is known about these relations in children younger than seven years, mainly due to various problems connected with measuring their activity. Measuring physical activity in younger children is problematic mainly because of the changing nature of the child's physical activity<sup>25</sup>. The more physical activity is changeable, spontaneous and non-organised, which is typical of younger children, the more difficult is its assessment.

The main purpose of the study is to find out if there are differences in moderate to vigorous physical activity among non-overweight, overweight and obese children. At the same time, we wanted to find out if there are differences in physical activity between boys and girls.

## Subject and Methods

### Subjects

The sample comprised 364 children, of which 179 were boys and 185 girls. The average age of children was 6.4 years ( $\pm 0.3$  SD). Children were chosen from among various parts of north-east Slovenia and were in first grade of primary school. The selection of children for the sample was random and children and their parents agreed to participate in this research. During the assessment, children were healthy and there were no other special reasons because of which their usual physical activity could have been impeded.

### Variables

*Assessment of physical activity.* A questionnaire for the assessment of physical activity of children aged between 4 and 8<sup>26</sup> was used. In comparison to other methods, the validity of results obtained by

questionnaires is low to medium<sup>27,28</sup>. On the other hand, questionnaires have some advantages and are most frequently used for larger samples of children and for epidemiological research. Filling in the questionnaires by children themselves is not recommended up to the tenth year of age<sup>27</sup>, therefore such questionnaires are used for younger children, which can be filled in by parents and teachers.

The questionnaire<sup>26</sup> is divided into two parts; one is intended for parents, the other one for teachers. The filling in of questionnaires lasted for seven days, from Monday till Sunday. Parents reported on the duration of the child's indoor and outdoor activity, for the time when the child wakes up and comes to school and for the time when the child leaves school until going to bed. Teachers reported on the time when children come to school until the time when they leave for home, once again with respect to their indoor and outdoor activities. Parents provided answers to questions on Saturday and Sunday. Therefore the type and duration of activities were monitored and assessed for the time span of the whole day and week. Intensity of physical activity was divided in the questionnaire into light physical activity (LPA) and moderate to vigorous physical activity (MVPA), which was assessed by parents and teachers on the basis of the same criteria. A characteristics of LPA is that non-overweight heavy breathing is noticed during the activity, whereas MVPA causes hard breathing of the child, e.g., running, jumping, dancing, various dynamic games, etc.<sup>26</sup>. On the basis of data from the questionnaire average daily LPA and MVPA were calculated, expressed in minutes. Further processing of data took into account only MVPA, which brings numerous beneficial effects for the children. The validity of the questionnaire was checked with two accurate techniques<sup>26</sup>. It was found out that the degree of validity of the questionnaire

was satisfactory and can be classified as most adequate.

*Anthropometry.* For measuring body height Martin's anthropometer was used, with the accuracy of 0.1 cm, for measuring the body mass a calibrated medical balance scale was used, with the accuracy of 0.1 kg. On the basis of obtained measures BMI ( $\text{kg}/\text{m}^2$ ) was calculated. Measuring was carried out by skilled and verified measurers.

*Criterion for definition of overweight and obesity.* For determining overweight and obesity of children BMI<sup>25</sup> is suitable. Despite the fact that BMI is less accurate than other methods, it is most often used for determining overweight and obesity, especially for larger samples, where other methods are practically unsuitable<sup>29</sup>. Adults are overweight if their BMI reaches 25 ( $\text{kg}/\text{m}^2$ ), they are obese at 30 ( $\text{kg}/\text{m}^2$ )<sup>30</sup>. During childhood BMI values are different than in adults and change with age<sup>31</sup>. In our research, the criterion proposed by Cole et al.<sup>31</sup> is used. Cut-off point for definition of non-overweight, overweight and obese groups is calculated according to the age of the children with one month accuracy. And only afterwards, the children were separated in groups.

#### *Procedures*

Measuring was carried out in autumn. Parents and teachers were well acquainted with the filling in of the questionnaire and with the criteria for defining intensity of physical activity. Because of incorrect filling, 23 questionnaires were eliminated. One teacher was monitoring five to maximum seven children.

#### *Statistics*

SPSS was used for data processing. Descriptive statistics was calculated for all variables, separately for boys and girls and for groups non-overweight, overweight and obese. For determining differences in physical activity between boys and girls

and between weight groups, t-test and one-way analysis of variance (ANOVA) was used. Two-way ANOVA with both, gender and weight status, and their interaction were used to examine differences in weekdays, weekends and total physical activities. A post-hoc Sheffe test was applied to localize significant differences. Statistical significance was set at an a level of 0.05. Differences between groups were looked after only for MVPA.

### Results

Table 1 shows descriptive statistics of age and anthropometrics characteristics of boys and girls. It can be noticed that there are significant differences ( $p < 0.05$ ) between non-overweight, overweight and obese children with regard to their body weight and BMI, in boys and girls. Post-hoc analyses revealed significant differences among non-overweight, overweight and obese groups in body weight and BMI for both genders ( $p < 0.05$ ), but there are no significant differences with regard to their height and age. 13.4% of boys and 19.4% of girls are overweight, 7.2% of boys and 8.1% of girls are obese.

In Table 2 the comparison of physical activity between boys and girls is shown. During weekdays and during weekend girls have a significantly higher indoor MVPA than boys ( $p < 0.05$ ). There is no difference between sexes with regard to outdoor MVPA. The results for weekdays and weekend show that girls have a higher MVPA than boys ( $p < 0.05$ ).

Results in Table 3 indicate, that here are significant differences in gender in weekdays, weekends and total physical activity. Girls are more physical active than boys ( $p < 0.05$ ). In non-overweight, overweight and obese groups there are significant differences ( $p < 0.05$ ) in weekend and in total weekly physical activity. A significant interaction was found between gender and BMI for weekend and total physical activity. In boys are significant differences among non-overweight and obese groups and among overweight and obese groups ( $p < 0.05$ ) during weekend and in total physical activity. In girls differences are significant ( $p < 0.05$ ) among non-overweight and overweight groups, among non-overweight and obese groups and among overweight and obese groups in weekends and total weekly activity.

**TABLE 2**  
MODERATE TO VIGOROUS PHYSICAL ACTIVITY (MVPA) ON WEEKDAYS, WEEKEND AND TOTAL

Variables	Boys		Girls	p
	Mean ± SD	Mean ± SD		
MVPA – Weekday (min/day)				
Indoor	35.8 ± 20.3	53.4 ± 23.6		<0.05
Outdoor	44.6 ± 20.7	42.4 ± 19.3		ns
MVPA – Weekend (min/day)				
Indoor	31.6 ± 14.1	52.8 ± 21.9		<0.05
Outdoor	73.8 ± 35.5	69.6 ± 37.8		ns
MVPA – Total (min/day)				
Indoor and Outdoor	87.5 ± 34.2	103.4 ± 30.8		<0.05

ns = not significant

**TABLE 1**  
AGE AND ANTHROPOMETRIC CHARACTERISTICS OF BOYS AND GIRLS

Variables	Boys			Girls			p
	Non-overweight (n=142)	Overweight (n=24)	Obese (n=13)	Non-overweight (n=134)	Overweight (n=36)	Obese (n=15)	
	Mean±1SD	Mean±1SD	Mean±1SD	Mean±1SD	Mean±1SD	Mean±1SD	
Age (y)	6.4±0.3	6.5±0.2	6.2±0.5	6.5±0.3	6.2±0.3	6.3±0.4	ns
Height (cm)	120.5±15.4	120.8±13.6	119.1±8.2	121.2±16.1	120.2±14.3	119.7±9.6	ns
Weight (kg)	22.3±5.1	27.2±5.6	31.2±4.7	21.9±6.2	26.3±5.9	30.4±4.2	<0.05
BMI (kg/m <sup>2</sup> )	15.3±1.9	18.6±1.5	23.1±2.3	14.9±2.1	18.5±1.4	22.5±2.2	<0.05

ns = not significant

**TABLE 3**  
PHYSICAL ACTIVITY OF NON-OVERWEIGHT, OVERWEIGHT AND OBESE CHILDREN

Variables	Boys			Girls			p-value
	Non-overweight (n=142)	Overweight (n=24)	Obese (n=13)	Non-overweight (n=134)	Overweight (n=36)	Obese (n=15)	
	Mean±1SD	Mean±1SD	Mean±1SD	Mean±1SD	Mean±1SD	Mean±1SD	
MVPA – weekdays (min/day)	80.7±36.9	79.7±38.1	78.1±35.6	98.1±41.5	91.9±38.2	84.6±36.7	<0.05 ns
MVPA – weekend (min/day)	107.4±42.8	104.9±43.3	83.9±39.5	127.0±45.7	117.3±42.3	93.5±33.2	<0.05 <0.05
MVPA – total (min/day)	88.3±38.6	86.9±39.6	79.7±36.7	106.4±42.7	99.2±41.4	87.1± 36.0	<0.05 <0.05

ns = not significant

## Discussion

The level of MVPA in non-overweight, overweight and obese children was compared in our study. There are significant differences in the amount of weekly physical activity among non-overweight, overweight and obese children. The most active are children in non-overweight group, and the least active are children in obese group. In this respect, the results are in accordance with findings in some other researches<sup>17</sup>. Additional analyses revealed that there are no significant differences in weekday activity in non-overweight, obese and overweight groups, but there are significant differences in weekend and in total weekly activity. In boys there are no significant differences in non-overweight and overweight groups, but the differences in non-overweight and obese groups and in overweight and obese groups are significant, whereas in girls the differences are significant for all three groups. Findings revealed in some studies, that the differences in physical activity among non-overweight and overweight/obese groups are smaller, or they are not significant in boys, but they are significant in girls<sup>16,17</sup> were partly confirmed. It seems that obese boys and overweight and obese girls are prone to less physical activity than non-overweight children. There are many reasons for less physical activity of obese boys and overweight and obese girls. Taylor et al.<sup>15</sup> mention the perception of various barriers, less supportive parents, fewer activity choices, less athletic coordination and taking less enjoyment of physical activity. Zabinski et al.<sup>32</sup> count the following among the most important limitations causing less physical activity in overweight and obese children: body-related barriers, social barriers, lower level of parents support, especially for overweight and obese girls. That confirms the presumption, that bigger differences in girls than in boys in our research are not coincidental. Taylor et

al.<sup>15</sup> believe that body weight in boys may not be an important factor, which determines the level of their physical activity and also state that there are no significant differences among overweight and non-overweight boys with regard to a number of psycho-social variables.

We can presume there are many reasons why obese boys and overweight and obese girls are significant less physically active during weekend, and some are likely to be connected with the way of family life. Physical activity of children is positively related with physical activity of parents, especially their father<sup>17</sup>. Because children spend more time with their families during weekend, it can be hypothesised that families with overweight/obese children are less physical active. The possibility that a child will become obese is lower in children who participate in exercises, and much larger in children who spend more time watching TV<sup>33</sup>.

It is necessary to point out that girls in our research are significant more active than boys, which is in contradiction with other findings<sup>16,34</sup>. It was found out that boys were less MVPA than girls in indoor activities, but there are no significant differences in outdoor activities. We can presume that participation in organized free-time activities (such as dance and aerobic classes) is the main reason, why are girls more indoor active. Girls participate in those activities in greater number. Similar conclusions were also made by some other researchers<sup>26,35</sup>.

Interestingly, none of the groups of children show to low MVPA (Table 3). It is recommended that children should participate in physical activity of at least moderate intensity for 1 hour per day<sup>13</sup>. In our research, obese boys are least active with 78 min of physical activity per day. It should be taken into account that the duration of MVPA is perhaps slightly overestimated in questionnaire, which was also pointed out by Harro<sup>26</sup>, therefore we

should be a bit wary about the results. The fact is that overweight and obese children are less active. Relatively large standard deviations can be noticed in average physical activity, which points towards larger differences among children, which, consequently, indicates that there are also children who are not active enough.

As it is generally known that physical activity brings numerous beneficial effects for the health and well-being of children, and because it was proved that obesity is a risk factor for our health<sup>36</sup>, in Slovenia it would be necessary to start thinking about intervention programmes to encourage everyday physical activity of not enough active children, especially overweight and obese children. In doing this, it is necessary to decrease limiting factors and to increase parent support<sup>32</sup>. Trost et al.<sup>37</sup> state that children have limited understanding of the role of physical activity; therefore it is necessary to help them by giving them various explanations. Children should participate in health education programmes<sup>38</sup> that would encourage healthy life style. It is proofed, that with school-based intervention programmes, based on encouraging moderate

and vigorous physical activity, we can influence on decreasing of obesity<sup>39</sup>. Longitudinal studies shows, that an increase of physical activity can influence on decreasing BMI in overweight girls and boys<sup>40</sup>. Physical activity is one of the most important factors, which can increase energy cost and indirectly to lowering body weight<sup>20,23,41</sup>. Reduced MVPA is only one of the reasons for increased body weight and obesity, but it is much easier to increase MVPA and consequently decrease body weight, than to influence on any other reason or factor that is also responsible for body weight<sup>22</sup>.

In future, we should pay more attention to longitudinal monitoring of children's physical activity and BMI. Younger children should also be included, because increased body weight and reduced physical activity are present in all age groups. At the same time, it is necessary to check if intervention programmes, that encourage physical activity, have any influence on the weight status of young children. It is also necessary to find an answer to the question if less physical activity is a result of increased weight and obesity, or its cause, which is presently not clear.

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## **RAZLIKE U FIZIČKOJ AKTIVNOSTI IZMEĐU DJECE NORMALNE TEŽINE, DJECE S POVEĆANOM TEŽINOM I PRETILE DJECE**

### **SAŽETAK**

Svrha istraživanja bila je detektirati razlike u umjerenoj i težoj fizičkoj aktivnosti između djece s normalnom tjelesnom težinom, povećanom tjelesnom težinom i pretile djece, te između dječaka i djevojčica. Uzorak se sastojao od 364 djeteta (179 dječaka i 185 djevojčica), prosječne starosti 6,4 godine ( $SD \pm 0,3$ ). Fizička aktivnost procijenjena je na temelju sedmodnevnog upitnika. Kao indikator povećane težine i pretilosti korišten je BMI adaptiran za dob. Djeca su podijeljena u grupe s normalnom težinom, povećanom težinom ili u grupu pretile djece. Pronađeno je da postoje statistički značajne razlike između pojedinih grupa ( $p < 0,05$ ). Dječaci su bili značajno manje umjereni do teže fizički aktivni od djevojčica ( $p < 0,05$ ), posebno u zatvorenom prostoru. Također je pronađena statistički značajna razlika u umjerenoj i težoj fizičkoj aktivnosti između dječaka s normalnom težinom i pretilih dječaka, te između dječaka s povećanom težinom i pretilih dječaka, za vrijeme vikenda i preko cijelog tjedna. Kod djevojčica je pronađena značajna razlika u aktivnosti preko vikenda i cijelog tjedna ( $p < 0,05$ ), između onih normalne tjelesne težine, povećane težine i pretilih djevojčica. Mogući zaključak bio bi da su pretili dječaci, djevojčice povećane tjelesne težine i pretile djevojčice sklone smanjenoj fizičkoj aktivnosti.