PHYSICAL ACTIVITY AND NUTRITIONAL STATUS AMONG SECONDARY SCHOOL GIRLS AND BOYS

(Original scientific paper)

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Abstract
The aim of this study was to examine the relationship between the overall level of physical activity and nutritional status based on the body mass index among secondary school girls and boys and to determine their prevalence at this age. The sample included 1033 boys and 807 girls from secondary schools in the Istrian Region. The results are presented as averages and standard deviations, as well as percentages, and the significance of differences was tested with the Student’s T-test for independent samples at the significance level of p < 0.05. We obtained a significant connection between physical activity and nutritional status (p=0.02 girls; p=0.00 boys), 70% of girls and 63% of boys are physically inactive, while only 72% of girls and 76% of boys fall into the category of normal weight. By introducing high-quality programs for physical activity which will contribute to increasing the physical activity of girls and boys of this age, we can also contribute to the optimization of their body weight. Considering the established prevalence of physical activity and the nutritional status, we should encourage the creation and testing of physical activity programs and choose the optimal ones for the implementation in the educational system. Such programs are a direct contribution to the health of young people.

Keywords: educational system, testing of physical activity programs, body mass index, girls, boys, secondary schools, health,

INTRODUCTION
Physical activity includes any movement of the human body in everyday life, including work, recreation and sports activities. (Pan American Health Organization, 2002). The numerous health benefits of physical activity have been scientifically determined (Blair & Morris, 2009). Physical inactivity, on the other hand, is a serious health risk factor considered to be the major public health problem of the 21st century (Blair, 2009). Unfortunately, the most alarming are the worldwide trends of high prevalence of physical inactivity among children and adolescents (Currie et al., 2012).

Beside the very negative trend of an increasing number of children with an insufficient level of physical activity, the number of overweight children increases as well and in the western countries it has increased by more than three times in the last twenty years. Doyle, Le Grange, & Goldschmidt (2007). Obesity is defined as abnormal and/or excessive accumulation of fat that poses a health risk (World Health Organization, 2006). There are one billion and 600 millions people with excessive body mass and 400 million obese on the planet, and 2.5 million people a year die from the consequences of overweight and obesity (World & Health Organization, 2006).

It is widely known today that an insufficient level of physical activity and excessive body mass are associated with almost all modern fatal diseases (cancer, diabetes etc.) (Petrić, 2011). However, the question is whether physical activity and excessive body mass are also interconnected. The studies so far indicate that different approaches to physical activity assessment among young people lead to results that are completely contradictory, from the absence to a very strong link between physical activity and excessive body mass (Hands & Parker, 2008). For this reason, such studies are extremely im-
portant, because, if we were able to identify a significant association, we could implement the necessary measures with much more certainty to contribute to the protection and improvement of human health.

Furthermore, the assessment of the physical activity level and the nutritional status are today considered to be the first stage of the implementation of interventional measures which can contribute to the health at the population level (Dishman, Washburn & Heath, 2004). Previous studies indicate that the secondary school age might be the right time for preventive actions aimed at reducing physical inactivity and overweight and above all, to diagnose their condition at this age (Petrić, 2011).

Therefore, the primary objective of this study was to determine the connection between the overall level of physical activity and nutritional status assessed on the basis of body mass index for secondary school girls and boys and to determine the prevalence of physical activity and the level of nutrition at this age.

METHODS

The sample of examinees for this study included 1033 boys and 807 girls from seven largest secondary schools (by number of students) in the Istrian Region. All the research methods were carried out during regular classes of physical and health education.

The sample was subsequently divided (Table 1) according to the criterion of age into 16-year-olds, 17-year-olds and 18-year-olds; according to tables recommended by International Obesity Task Force (Cole, Bellizzi, Flegal, Dietz, 2000) into those with normal body mass (NBM), overweight (OVE) and obese (OBE); and into physically active and inactive, according to Fels Physical Activity Questionnaire for Children (Treuth, Hou, Young, & Maynard, 2005).

The measurement was conducted in the period from 1st May to 1st June 2010 at the same time of day (+2 hours), one visit to each school. On that day, the girls and the boys enrolled and they were explained the research procedures. The members of the research team recorded the data about the chronological age and measured the weight and the height of the body, based on which the body mass index was calculated. The weight was measured by a medical scale, with participants standing on the scale dressed only in underwear. The body height was measured by anthropometer with an accuracy of 0.1 cm, with the barefoot participant standing upright on a flat surface. The obtained result is the distance from the base to the top of the head.

After that, the girls and the boys were given a questionnaire that measures the level of physical activity Fels Physical Activity Questionnaire for Children (Fels PAQ for Children) in order to gather information about their physical activity. The members of the research team were available for questions during the time of filling in the questionnaire. The Fels’ PAQ for Children is valid and reliable for the measurement of physical activity of girls and boys of secondary school age (Treuth et. al., 2005). It contains eight questions, of which three are “open” questions for which the activities are given by respondents. The data about the frequency of participation in each of these activities were also obtained. The Likert scale for assessment of physical activity was applied to the remaining five questions The physical activity level estimated in this way (type of physical activity x intensity x frequency) offers the possibility of comparison with predicted norms to be able to take the necessary steps aimed at preserving and improving the health and to compare it with the results of other populations.

The processing of data was carried out with STATISTICA program (data analysis software system), version 7.1., StatSoft, Inc. (2005). The results are presented as averages and standard deviations and the significance of differences was tested with Student’s t-test for independent samples at p < 0.05 significance level.

RESULTS

After examining the obtained results on the differences between inactive and active girls, it can be noticed that the inactive girls (Table 2) have a significantly higher body mass index than their physically active peers. Significant differences were found in all analyzed ages, as well as on the total sample of examinees in this study.

Furthermore, certain deviations from the total sample and other analyzed ages can be noticed in both inactive and active girls aged 17. The average body mass index results are slightly lower and the deviations are much larger, i.e. between 5 and 6 standard deviations.

After examining the obtained results on the differences between inactive and active boys according to body mass index, it can be noticed that the inactive boys (Table 3) have a much higher body mass index in comparison to their physically more active peers. Significant differences were found in all analyzed ages, as well as on the total sample.

The results of the physical activity prevalence

<table>
<thead>
<tr>
<th>Examinees</th>
<th>Girls</th>
<th>Boys</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16 yrs</td>
<td>17 yrs</td>
</tr>
<tr>
<td>Total</td>
<td>469</td>
<td>233</td>
</tr>
<tr>
<td>Inactive</td>
<td>308</td>
<td>157</td>
</tr>
<tr>
<td>Active</td>
<td>161</td>
<td>76</td>
</tr>
<tr>
<td>Normal BM</td>
<td>347</td>
<td>167</td>
</tr>
<tr>
<td>Overweight</td>
<td>90</td>
<td>49</td>
</tr>
<tr>
<td>Obese</td>
<td>32</td>
<td>17</td>
</tr>
</tbody>
</table>
among girls (Table 4) indicate that a total of almost 70% of girls do not meet the recommended level of physical activity. It can be noticed that, for girls, the percentage of those who fall into physically inactive increases with chronological age.

The results of the nutritional status prevalence for girls (Table 4) indicate that a total of 72% of girls have a normal body mass, almost 21% have are overweight and 7% of them obese. By analyzing according to the chronological age, a slight increase of overweight girls can be noticed with age.

The results of the physical activity prevalence in boys (Table 5) indicate that a total of 63% of boys do not fall into the recommended level of physical activity. The results obtained by chronological age are very similar or almost identical to the results in the total sample.

The results of the nutritional status prevalence in boys (Table 5) indicate that a total of almost 77% of boys falls into the category of normal weight, that almost 17% are overweight, and almost 7% are obese. The results by chronological age are very similar or almost identical.

It may be concluded that boys and girls who meet the recommended levels of physical activity have a significantly lower body mass index that those who do not comply, i.e. a significant negative correlation between physical activity and the nutritional status was obtained. On the total sample and by age, boys are physically more active than girls. Furthermore, boys have a generally better nutritional status than girls, i.e. there is a smaller percentage of overweight and obese.

<table>
<thead>
<tr>
<th>Years</th>
<th>Inactive AS±SD</th>
<th>Active AS±SD</th>
<th>t-value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 yrs</td>
<td>23,33 ± 2,80</td>
<td>21,30 ± 2,32</td>
<td>0,200</td>
<td>0,0315</td>
</tr>
<tr>
<td>17 yrs</td>
<td>20,91 ± 5,28</td>
<td>18,69 ± 6,11</td>
<td>2,354</td>
<td>0,0189</td>
</tr>
<tr>
<td>18 yrs</td>
<td>23,17 ± 2,65</td>
<td>20,90 ± 2,01</td>
<td>0,836</td>
<td>0,0038</td>
</tr>
<tr>
<td>Total</td>
<td>24,79 ± 2,59</td>
<td>20,04 ± 2,67</td>
<td>0,844</td>
<td>0,0190</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years</th>
<th>Inactive AS±SD</th>
<th>Active AS±SD</th>
<th>t-value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 yrs</td>
<td>24,93 ± 3,42</td>
<td>21,31±2,74</td>
<td>-1,324</td>
<td>0,0186</td>
</tr>
<tr>
<td>17 yrs</td>
<td>24,70 ± 3,71</td>
<td>21,21±2,26</td>
<td>1,044</td>
<td>0,0295</td>
</tr>
<tr>
<td>18 yrs</td>
<td>24,65 ± 3,33</td>
<td>21,12±2,24</td>
<td>1,148</td>
<td>0,0256</td>
</tr>
<tr>
<td>Total</td>
<td>24,66 ± 2,93</td>
<td>21,98±3,09</td>
<td>-4,671</td>
<td>0,0000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16 yrs</th>
<th>17 yrs</th>
<th>18 yrs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>65,5</td>
<td>67,2</td>
<td>68,6</td>
</tr>
<tr>
<td>Active</td>
<td>34,5</td>
<td>32,8</td>
<td>31,4</td>
</tr>
<tr>
<td>Normal BM</td>
<td>73,7</td>
<td>71,4</td>
<td>71,3</td>
</tr>
<tr>
<td>Overweight</td>
<td>19,5</td>
<td>21,4</td>
<td>21,0</td>
</tr>
<tr>
<td>Obese</td>
<td>6,8</td>
<td>7,2</td>
<td>7,7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16 yrs</th>
<th>17 yrs</th>
<th>18 yrs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inactive</td>
<td>62,7</td>
<td>64,1</td>
<td>62,4</td>
</tr>
<tr>
<td>Active</td>
<td>37,3</td>
<td>35,9</td>
<td>37,6</td>
</tr>
<tr>
<td>Normal BM</td>
<td>75,6</td>
<td>77,4</td>
<td>76,8</td>
</tr>
<tr>
<td>Overweight</td>
<td>17,7</td>
<td>15,6</td>
<td>16,4</td>
</tr>
<tr>
<td>Obese</td>
<td>6,7</td>
<td>7</td>
<td>6,8</td>
</tr>
</tbody>
</table>
DISCUSSION AND CONCLUSIONS

The analysis showed that there is a statistically significant association between physical activity and body mass index in both sexes, i.e. that a lower level of physical activity will affect a higher body mass index, and vice versa.

These research results confirm that the recommended level of physical activity have a significant impact on the prevention of overweight and obesity and they are consistent with the results of some similar studies that were conducted on secondary school students (Guerra et al., 2006; Sulema, Smolensky, & Lai, 2006; Hills, King, & Armstrong, 2007; Simon et al., 2008).

Furthermore, given the results of some previous studies, it can be said that appropriate programs for increasing the level of physical activity on this sample could prevent the occurrence of many diseases such as mild arterial hypertension, diabetes, elevated blood fats, diseases of the cardiovascular system based on atherosclerosis and especially coronary heart diseases (Caprio & Weiss, 2005). Among people who fall into the recommended levels of physical activity, there is a lower incidence of malignant diseases, especially colon cancer and breast cancer. We can prevent the development of osteoporosis and thus bone fractures in old age, especially in women. Physical activity, among other modern diseases in adolescent age, may distinctly reduce depression (Caprio & Weiss, 2005). It can be clearly concluded that an adequate physical activity is an extremely important and indispensable factor in the protection and improvement of health i.e. in the reduction of morbidity and mortality due to various diseases.

The results of some previous studies on participation in physical activities which were conducted on a representative sample for the European Union indicate that the inhabitants of northern European countries are more involved in physical activity in their leisure time that the residents of southern European states (Martinez – Gonzalez et al., 2001). The highest percentage of participation in physical activities was reported in Finland (91.9%) and the lowest in Portugal (40.7%). The conclusion indicates that the global level of physical activity is low and very different for each country and that habits have a significant impact on physical activity levels (Martinez – Gonzalez et al., 2001). If we compare the results of this study with European countries, it can be noticed that this sample of respondents falls into the worst results with only 33% of physically active girls and 36.9% of physically active boys. This is certainly a fact indicating that we must quickly react and begin to find and implement appropriate procedures which will have an impact on changing past habits with the aim of improving the quality of life and therefore health as soon as possible.

The results obtained for inactive secondary school students are almost entirely consistent with the current global trends. Physical inactivity is a serious health risk factor considered to be the major public health problem of the 21st century (Blair, 2009). Unfortunately, the most alarming are the worldwide trends of high prevalence of physical inactivity among children and adolescents (Currie et al., 2012). Namely, according to the latest (2009/2010) report of the international Health Behavior in School-aged Children (HBSC) survey, only 19% of the 11-year-old girls and 31% of the 11-year-old boys in Croatia engage in at least one hour of moderate to vigorous physical activity daily, meaning that as high as 81% of the girls and 69% of the boys of that age are insufficiently active (Currie et al., 2012). The prevalence of insufficient physical activity among 13-year-olds is 85% for girls and 69% for boys, and among 16-year-olds these numbers rise to 92% for girls and 78% for boys (Currie et al., 2012). The data on sedentary behavior (reported as watching television for two or more hours every weekday) are equally alarming. Among the Croatian, 11-year-olds, 69% of both girls and boys watch television for two or more hours on weekdays; among 13-year-olds the percentages are 77% for girls and 76% for boys, while the proportions of sedentary 16-year-olds are 67% for girls and 71% for boys (Currie et al., 2012).

It is known that lately students’ physical activity decreases significantly, partly because of many hours spent in a sitting position and partly because of a lot of homework and learning which require some time in a sitting position at home as well (Sulema et al., 2006). Furthermore, it is well known that sports activities in school are extremely important for children and adolescents in school age and that it requires special attention (Sulema et al., 2006). In addition to everything mentioned so far, we must emphasize the disheartening fact that none of the secondary schools that participated in this research holds extra-curricular sports regularly. One of the reasons could definitely be the overloaded school schedule and the introduction of many new subjects in Croatian schools, such as more foreign languages etc. Another reason is the lack of sport halls or arranged closed spaces for exercise in general (Petric, 2011). Each school, regardless of consequences, should ensure the uninterrupted conduct of extra-curricular sporting activities, because it could be one of the first and fundamental steps which would influence on increasing the levels of physical activity and on achieving an optimal body weight in children of school age. It could be said that the regular teaching classes of physical and health education are almost the only time in school when the participants in this research are physically active. Since the PE classes are performed up to two times a week for 45 minutes (in some schools once a week), we can conclude that this is far from the recommended criteria.

It should be pointed out that secondary school aged boys are generally much more involved in sports than girls of the same age (Guerra et al., 2006). This is probably one of the reasons why the boys in this study are also generally more active than the girls, as in almost all previous studies (Macera et al., 2005; Muntner et al., 2005).

One of the health threatening consequences of the insufficient level of children and youths’ physical activity is certainly the high prevalence of overweight and
obesity, since the misbalance between the energy intake and expenditure is among the major causes of these disorders (Lobstein, Baur, & Uauy, 2004). The results of this study indicate that almost 28% of girls and 24% of boys fall into categories of overweight or obese, which is almost identical with the outcomes of some other researches conducted worldwide (Ekelund et al., 2002; Elgar, Roberts, Moore, & Tudor-Smith, 2005; Mota et al., 2008). The overweight is followed by the development of many chronic diseases, as well as an increasing incidence and overloaded health care because of cardiovascular illnesses (Hubert, Feinleib, McNamara, Castelli, 1983), malignant neoplasm (Chow, Blot, & Vaughan, 1998), diseases of the musculoskeletal system (Must, Spadano, & Coakley, 1999) and definitely diabetes (Hu, Manson, Stampfer, 2001). The correlation between diabetes and obesity is evident as the impact of obesity on the incidence of diabetes, as well as its subsequent regulation (Tomić, Poljčanin, Pavlič-Renar, & Metelko, 2003), and thus the development of complications. The combination of diabetes and obesity is considered the larges epidemic the world faces (Tomić et al., 2003). It is estimated that the number of patients with diabetes in the world will increase from estimated 171 millions in 2000 to 366 millions in 2030, even if the prevalence of overweight remains constant (Wild, Roglic, Green, 2004).

According to the 2009/2010 HBSC report, 15% of the Croatian 11-year-old girls and 21% of 11-year-old boys are overweight or obese according to BMI (Currie et al., 2012). The prevalence of overweight and obesity among 13-year-olds is 12% for girls and 22% for boys, while among 16-year-olds it is 10% for girls and 23% for boys (Currie et al., 2012). In the period from 2005 to 2010 the number of obese children living in the urban areas in Croatia has almost doubled (Ministry of Health and Social Welfare of the Republic of Croatia, 2010).

All these facts indicate that the competent authorities must do a lot more to solve this problem.

Secondary school could be the right time for preventive actions for many reasons, especially because studies around the world show that, in the adolescence, the excessive body mass decreases (Vieno, Santinello & Vieno, 2009). Studies also indicate that among adolescent girls, the older they are, the smaller the percentage of overweight is, while among boys the nutritional status with respect to age varies (Mota et al., 2008; Wang & Lobstein, 2006; Vieno et al., 2005). This is also confirmed by the results of this study. One of the reasons for this could nevertheless be that girls in general care more about their physical appearance and, by entering into adolescence, they begin to notice their body and try more to reduce and maintain their weight than boys.

Among secondary school students, changes are more significant in boys than in girls (Vieno et al. 2005). Although changes among girls in this age are almost imperceptible and among boys vary, this is a very unpredictable age (US Department of Health and Human Services, 2000) and it should be given a lot of attention in future studies in order to minimize the unpredictable nature of the results.

The authors believe that future studies should be focused on creating programs which will have an impact on increasing the levels of physical activity and reducing overweight and obesity. One of the fundamental starting points for the creation of the above mentioned programs must certainly be that they can be implemented in the school system of a particular country without major difficulties.

It can be concluded that in this study a significant connection between the physical activity and the nutritional status in this population of secondary school girls and boys has been proved. Their prevalence of physical activity and nutritional status has been determined. The results of this study may be used as a basis for taking intervention measures to preserve and improve their health. By implementing high-quality programs of physical activity in secondary schools which will contribute to increasing the physical activity of girls and boys of this age, we can also contribute to optimization of their body mass. Considering the established prevalence of physical activity and nutritional status, we should encourage the creation and testing of physical activity programs and determine the optimal ones for the implementation in the educational system. Such programs are a direct contribution to the health of young people.

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