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PREGLED
REVIEW

PREVALENCE OF INSUFFICIENT PHYSICAL ACTIVITY IN CHILDREN AND ADOLESCENTS: REVIEW

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The aim of this review is to summarize the results of recently published studies on physical activity prevalence among children and adolescents. Literature search was conducted through Academic Search Complete, CINAHL, ERIC, Health Source, Hrčak, PubMed/MEDLINE, SocINDEX, and Web of Science. A total of 32 articles (published 2001-2011) were reviewed. The prevalence rates of insufficient physical activity among girls ranged from 2.4% to 39.3% in the accelerometer-based studies, and from 19.5% to 95% in the questionnaire-based studies. The prevalence rates among boys in the accelerometer-based studies and questionnaire-based studies ranged from 2.6% to 18.1% and from 18.2% to 89%, respectively. Insufficient physical activity was more prevalent among high school students compared with primary school students. Prevalence rates of insufficient physical activity were by 5%-30% higher among girls than among boys. Lower prevalence rates of insufficient physical activity were determined in the accelerometer-based studies than in the questionnaire-based studies. The high prevalence of insufficient physical activity in children and adolescents addresses the need for systematic physical activity promotion. Taking into consideration that insufficient physical activity is most prevalent among girls and high school students, physical activity interventions should mainly target these groups.

Descriptors: CHILD; ADOLESCENT; MOTOR ACTIVITY; META-ANALYSIS

INTRODUCTION

More and more studies show that regular physical activity is beneficial for health and quality of life (1, 2). Nevertheless, the prevalence of insufficient physical activity in Croatia and worldwide is still extremely high (3, 4). Estimates show that insufficient physical activity is responsible for about 3.2 millions of deaths *per* year (5). In developed countries, insufficient physical activity is a major public health problem, not only in adults, but in children and adolescents as well (6). Moreover, in the past decades studies have shown a decrease in the level of physical activity in children and adolescents (7).

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Sufficient physical activity in childhood and youth is important because of: 1) short-term positive health effects that occur during childhood and youth; 2) long-term positive effects on health in adulthood; and 3) easier adoption of regular physical activity in adulthood.

According to the International Consensus Conference on Physical Activity Guidelines for Adolescents (8) published in 1993, to achieve the previously mentioned benefits, adolescents should be moderately to vigorously active for at least 20 minutes on three or more days *per* week. Three years later, the National Centre for Chronic Disease Prevention and Health Promotion published new recommendations (9) on at least 30 minutes of moderate-intensity physical activity on most, but preferably on all days of the week. In 2000, the U.S. Department of Health and Human Services supplemented these recommendations and stated that children and adolescents can achieve health benefits not only through moderate-intensity physical activity, but through vigorous activity as well (more than 20 minutes on at least 3 days *per* week) (10). During the last decade, based on current evidence, different relevant institutions have reached a consensus on physical activity recommendations for children and adolescents (11, 12). According to these most recent and globally accepted recommendations, children and adolescents should be moderately to vigorously active for at least 60 minutes on most, preferably all days of the week.

Since physical activity is an important public health issue, numerous countries track and monitor this health behavior in children and adolescents. For example, within the Youth Risk Behavior Surveillance System (YRBSS) (13), since 1991, the U.S. Centers for Disease Control and Prevention have been assessing physical activity level of approximately 15 thousand high school students every two years. Likewise, within the international large-scale survey named Health Behaviour in School-aged Children (HBSC) (14), physical activity of elementary school and high school students is assessed every four years. HBSC surveys have been con-

ducted since 1982, and the survey in 2006 included more than 200 000 students from 41 European and North American countries. Croatia has been taking part in the HBSC surveys since 2002. In addition, it is important to mention that the prevalence of insufficient physical activity of children and adolescents has been determined in a large number of separate studies conducted on national, regional, and smaller samples.

Results on physical activity of children and adolescents have been reviewed in several papers. Review articles by Rowlands (15), Dencker & Andersen (16), and Beets et al. (17) have focused only on studies in which physical activity was assessed using objective measures (e.g., accelerometers, pedometers or heart rate monitors). Since the previously mentioned reviews did not include questionnaire-based surveys, drawing final conclusions about physical activity of children and adolescents based on their results is somewhat limited. Although one recent review was not focused only on the objectively measured physical activity, it was limited to the studies conducted in preschool children aged 2-6 years (18). Finally, no review has focused on physical activity of children and adolescents in Croatia.

Therefore, the aim of this review was to summarize the results of recently published studies on the prevalence of physical activity among children and adolescents, with special emphasis on the studies conducted in Croatia.

METHODS

Literature search was conducted using the following bibliographic databases: Academic Search Complete, Arts & Humanities Citation Index (A&HCI), CINAHL, ERIC, Health Source: Nursing/Academic Edition, PubMed/MEDLINE, Science Citation Index Expanded (SCI-EXPANDED), Social Sciences Citation Index (SSCI), and SocINDEX. PubMed/MEDLINE were searched using the PubMed search engine, SCI-EXPANDED, SSCI, and A&HCI using the Web of Science search engine, and other bibliographic databases using EBSCOhost. The search of the SCI-EXPANDED database also included all journals indexed in the Science Citation Index (SCI) database. In addition, the search of the SCI-EXPANDED, SSCI and A&HCI encompassed all journals indexed in eight Current Contents editions. The database search was carried out on April 20, 2011 using the following search terms: "physical activity", "physical inactivity", "energy expenditure", exercise, "motor activity", children, child, adolescent*, youth*, prevalence and level. Additionally, a search of literature written in Croatian was conducted through the Hrčak portal of scientific journals of Croatia using the same search terms. The search was limited to articles published in the last 10 years.

All retrieved studies underwent further selection based on the title, abstract and/or full text. Inclusion criteria were as follows: (a) results regarding the prevalence of insufficient physical activity among children and/or adolescents were reported; (b) the purpose of the study was not the evaluation of physical activity intervention effects; (c) a disease or involvement in a rehabilitation program was not a general characteristic of the study sample; (d) school was not the only setting in which the level of physical activity has been assessed; (e) the paper was written in Croatian, English, Portuguese, Spanish, or Turkish; and (f) the results presented in the paper were original, i.e. have not been published previously in any of the articles meeting the inclusion criteria for our review.

RESULTS AND DISCUSSION

Database search using PubMed, Web of Science and EBSCOhost resulted in 32 articles that met our inclusion criteria (19-45). Based on the search carried out through the Hrčak portal of scientific journals of Croatia, one additional article was included (46). Additionally, 4 articles that were previously known to the authors were also included in the review (13, 14, 47, 48). The results of the studies on physical activity of children and adolescents published during the 2001-2011 period are summarized in Tables 1 and 2.

Sample size in the studies ranged between 60 and 204 534 subjects. The number of subjects was less than 500 in 21.9%, 500-999 in 12.5%, 1000-4999 in 40.6%, and 5000 or more in 25% of the studies. The overall number of subjects in the studies included in this review was 406 747. Eight studies were carried out in the USA, four in Brazil, three in Croatia, two in China and United Kingdom each, and one in Barbados, Belgium, Canada, Malaysia, New Zealand, Portugal, Russia, Saudi Arabia, Spain, Taiwan and Turkey each. Besides, two studies were international in scope. Only 12.5% of the studies were conducted on a convenience sample (26, 32, 39, 41). In the article by Kwok–Kei et al. (45), it is unclear which sampling method was used. Other studies (87.5%) used random sampling.

In the studies by Pate et al. (20), Riddoch et al. (24), Cardon&De Bourdeaudhuij (30), Troiano et al. (34) and Martinez–Gomez et al. (39), physical activity was measured by accelerometer, in the studies by Al–Hazzaa&Al–Rasheedi (28) and Duncan et al. (29) by pedometers, and in the study by Calvert et al. (19) by heart rate monitors. In the previously mentioned studies, physical activity was assessed over 3-7 days. In the studies by de Farias (31) and Gorely et al. (37), the participants kept physical activity diaries for 3 and 7 days, respectively. In other studies (68.8%), physical activity was assessed using interviews or self-administered questionnaires. In most of the questionnaire-based studies, the "last 7 days" or the "usual week" reference period was used.

In 40.6% of the studies, the prevalence was calculated as the percentage of participants who were moderately to vigorously physically active less than 60 minutes *per* day, i.e. in accordance with the recent physical activity recommendations for children and adolescents (11, 12). A somewhat different criterion of less than 60 minutes of moderate- to vigorous-intensity physical activity on 5 days *per* week was used in 15.6% of the studies. The criteria for calculating the prevalence of insufficient physical activity used in other studies (43.8%) were not in accordance with the current physical activity recommendations for children and adolescents.

Because of a large number of different criteria that had been used to estimate the prevalence of insufficient physical activity, it was impossible to combine the results of all studies. Therefore, to draw a conclusion on the prevalence of insufficient physical activity in children and adolescents, we considered only the prevalence rates that had been calculated in accordance with the recent physical activity recommendations (at least 60 minutes of moderate- to vigorous-intensity physical activity daily). The prevalence rates of insufficient physical activity among girls

Table 1. Description of studies on the prevalence of insufficient physical activity (PA) among children and adolescents

Study	Methods (sample/age or grade/measure of PA)	Definition of sufficient PA	Prevalence of insufficient PA
Calvert et al (22)	60 children (New Zealand)/10-13 yrs / Heart rate monitor	≥30 min of heart rate higher than 139 beats *per* minute on 3 or more days per week	47%
Pate et al (23)	375 children and adolescents (USA) /Grades 1-12/Accelerometer	≥60 min of moderate intensity PA *per* day on 5 or more days *per* week	30.7% (M – 27.6%, F – 33.7%)
Prochaska et al (24)	1579 children and adolescents (Barbados) /8-18 yrs/Self-administered questionnaire	≥60 min of moderate or vigorous intensity PA on the previous day	31%
Tudor-Locke et al (25)	1094 children and adolescents (Russia) /7-13 yrs/Self-administered questionnaire	≥7 hours of moderate or vigorous intensity PA *per* week	M – 45%, F – 51%
Centers for Disease Control and Prevention (CDC) (26)	3120 children (USA)/9-13 yrs /Telephone interview	Involvement in organized PA out of school	61.5%
Riddoch et al (27)	2185 children and adolescents (Denmark, Estonia, Norway, and Portugal)/9 and 15 yrs/Accelerometer	≥60 min of moderate intensity PA *per* day	9-yr-old: M – 2.6%, F – 2.4% 15-yr-old: M – 18.1%, F – 38%
Yiing-Mei and Li-Chi (28)	463 children and adolescents (Taiwan) /9-12 yrs/PA diary	≥420 min of moderate or vigorous intensity PA *per* week	M – 21.7%, F – 19.2%
Omar and Rager (29)	839 adolescents (USA) /Grades 6 and 9/Interview	≥20 min of vigorous intensity PA on 5 or more days *per* week	6th grade: M – 92%, F – 92% 9th grade: M – 37%, F – 54%
Janssen et al (30)	6684 adolescents (Canada) /11-15 yrs/Self-administered questionnaire	≥60 min of PA on 5 or more days *per* week	55.4%
Al-Hazzaa and Al-Rasheedi (31)	224 children (Saudi Arabia)/3-6 yrs/Pedometer	≥10,000 steps *per* day	77.6%
Duncan et al (32)	208 children (England)/8-11 yrs/Pedometer	M ≥15,000 steps *per* day F ≥12,000 steps *per* day	M – 71.3%, F – 53.3%
Cardon and De Bourdeaudhui (33)	76 children (Belgium)/4-5 yrs/Accelerometer	≥60 min of moderate or vigorous intensity PA *per* day	93%
de Farias (34)	2566 adolescents (Brazil)/14-18 yrs/PA diary	Energy expenditure during PA ≥37 kcal/kg/day	M – 45.5%, F – 64.2%
Mota et al (35)	1123 adolescents (Portugal) /Grades 7-12/Self-administered questionnaire	Physical activity index (PAI) lower than 11	M – 21.9%, F – 40.1%
Singh et al (36)	68,288 children and adolescents (USA) /6-17 yrs/Telephone interview	≥20 min of vigorous intensity PA 3 or more times *per* week	M – 21.6%, F – 31.6%
Troiano et al (37)	1778 children and adolescents (USA)/6-19 yrs /Accelerometer	≥60 min of moderate intensity PA on 5 or more days *per* week	Age 6-11: 58.0% (M – 51.1%, F – 65.3%) Age 12-15: 92.0% (M – 88.1%, F – 96.6%) Age 16-19: 92.4% (M – 90%, F – 94.6%)
World Health Organization (WHO) (17)	204,534 children and adolescents (41 European countries, USA and Canada) /11, 13, and 15 yrs Self-administered questionnaire	≥60 min of moderate or vigorous intensity PA *per* day	Age 11: 54-85% (M – 49-82%, F – 57-89%) Age 13: 58-88% (M – 49-85%, F – 65-95%) Age 15: 63-92% (M – 54-89%, F – 71-95%)
Aniza and Fairuz (38)	519 students (Malaysia)/14 and 16 yrs /Self-administered questionnaire	≥600 MET-minutes/week	20.8%
de Moraes et al (39)	991 adolescents (Brazil)/14-15 yrs /Self-administered questionnaire	≥300 min of moderate and vigorous intensity PA *per* week	56.9% (M – 55.7%, F – 57.9%)
Gorely et al (40)	561 adolescents (United Kingdom) /12.7-16.7 yrs/PA Diary	≥60 min of moderate intensity PA *per* day	80.9% on weekdays 62.6% on weekend days
Hoelscher et al (41)	15,164 children and adolescents (USA) /Grades 4, 8, and 11/Self-administered questionnaire	≥30 min of moderate intensity PA *per* day (4th grade), i.e. on 5 or more days *per* week (8th and 11th grade)	4th grade: 46.9% 8th grade: 67.4% 11th grade: 64.8%
Martinez-Gomez et al (42)	214 adolescents (Spain)/13-16 yrs /Accelerometer	≥60 min of moderate or vigorous intensity PA *per* day	28.9% (M – 17.8%, F – 39.3%)
Springer et al (43)	23,190 children and adolescents (USA) /9-18 yrs/Self-administered questionnaire	≥20 min of vigorous intensity PA 3 or more times *per* week	4th grade: M – 31.2-33.5%, F – 27.4-32.0% 8th grade: M – 14.4-18.6%, F – 24.1-28.4% 11th grade: M – 24.2-40%, F – 39.5-57.8%
Eaton et al (YRBSS) (16)	16,410 adolescents (USA)/Grades 9-12 /Self-administered questionnaire	≥60 min of moderate intensity PA *per* day	81.6% (M – 75.2%, F – 88.6%)
Dumith et al (44)	4325 adolescents (Brazil)/14-15 yrs/Interview	≥300 min of total PA *per* week	51.8% (M – 37.4%, F – 65.5%)
Lam et al (45)	1147 children and adolescents (Hong Kong, China)/9-13 yrs/Self-administered questionnaire	Involvement in PA outside-school	M – 35%, F – 33%
Santos et al (46)	4207 adolescents (Brazil)/14-19 yrs /Self-administered questionnaire	≥20 min of active commuting getting to and from school *per* day	43%
Erginoz et al (47)	5552 adolescents (Turkey) /11, 13, and 15 yrs/Telephone interview	≥60 min of PA *per* day	80% (M – 77.3%, F – 82.8%)
Kwok-Kei et al (48)	32,005 adolescents (Hong Kong, China) /13-18 yrs/Self-administered questionnaire	≥60 min of PA *per* day	During school days: M – 24.9%, F – 29.7% During holidays: M – 18.2%, F – 19.5%

Table 2. *Description of studies on the prevalence of insufficient physical activity (PA) among children and adolescents in Croatia*

Study	Methods (sample/age or grade/ measure of PA)	Definition of sufficient PA	Prevalence of insufficient PA
Kuzman et al (50)	4397 children and adolescents (Croatia)/11, 13, and 15 yrs /Self-administered questionnaire	≥60 min of PA *per* day	Age 11: M – 53.7%, F – 67.7% Age 13: M – 55.8%, F – 74.6% Age 15: M – 66.5%, F – 83.2%
Kuzman et al (51)	4968 children and adolescents (Croatia)/11, 13, and 15 yrs /Self-administered questionnaire	≥60 minutes of PA *per* day	Age 11: M – 64%, F – 74% Age 13: M – 69%, F – 85% Age 15: M – 80%, F – 90%
Jureša et al (49)	2869 children and adolescents (Croatia)/1st and 8th grade of primary school and 3rd grade of high school /Self-administered questionnaire	≥4 times of vigorous intensity PA *per* week	Primary school 1st grade: M – 54.0%, F – 71.1% Primary school 8th grade: M – 49.9%, F – 78.3% High school 3rd grade: M – 66.8%, F – 86.2%

PA = physical activity

ranged from 2.4% to 39.3% in the accelerometer-based studies and from 19.5% to 95% in the questionnaire-based studies. The prevalence rates among boys in the accelerometer-based studies and in the questionnaire-based studies ranged from 2.6% to 18.1% and from 18.2% to 89%, respectively. The large variation in prevalence rates reported in different studies was expected because of: (a) methodological differences between the studies, especially regarding the physical activity assessment tools; and (b) a real difference in physical activity of children and adolescents in different countries. The first reason is well supported by studies which have determined that the type of measure and scoring protocol significantly affects physical activity prevalence estimates (49). On the other hand, the extent of the real between-country differences in prevalence rates can be clearly seen in the international report from the 2005/2006 HBSC survey (14). For example, within this survey, the prevalence of insufficient physical activity of 11-year-old children varied between 54% in Slovakia and 85% in Switzerland. Furthermore, several studies included in our review showed the insufficient physical activity to be more prevalent among high school students compared with primary school students (14, 24, 34, 38). Besides, the prevalence rates determined in different studies were by 5%-30% higher among girls than among boys (14, 20, 22, 24, 27, 31-34, 39-41, 44, 45).

Three physical activity surveys have so far been conducted on representative samples of Croatian children and adolescents. Two of them were part of the HBSC survey (47, 48), and one was individual (46). These surveys showed that most of the children and adolescents in Croatia did not reach the recommended level of physical activity. The most worrying fact is that during the 2002-2006 period, the prevalence rates increased by 12.6% and 7.4% in boys and girls, respectively (47, 48). Besides, surveys showed the prevalence rate of insufficient physical activity to be higher among high school students compared with primary school students (46-48). It could be assumed that the decline in physical activity from primary school to high school is, to some extent, related to lower participation rates of high school students in sports clubs. Namely, the previously mentioned drop-out of sports clubs occurs due to selection focused mainly on the most talented athletes and due to the loss of interest in sports caused by puberty. Furthermore, the prevalence of insufficient physical activity in Croatia was by 10% to 20% higher among girls than among boys.

In order to compare Croatian children and adolescents with their peers from other countries, we examined the latest HBSC data (14). As mentioned above, Croatia was one of the countries included in the latest HBSC survey (14). According to the percentage of the participants who were moderately to vigorously active more than 60 minutes *per* day, among 41 countries, Croatian 11-, 13- and 15-year-olds ranked 7th (31%), 10th (23%) and 22nd (15%), respectively. Overall, Croatia was ranked in the top third, i.e. among the countries with the highest physical activity of children and adolescents.

CONCLUSION

Since insufficient physical activity prevalence rates among children and adolescents differ significantly between countries, physical activity should be tracked and monitored both internationally and nationally. The methodological differences between the studies, especially regarding the physical activity assessment tools and criteria used to estimate the prevalence of insufficient physical activity, complicate comparison of their results. Therefore, future studies should consider using objective measures of physical activity or internationally recognized and validated questionnaires (50). Besides, prevalence rates should be estimated in accordance with the recent physical activity recommendations for children and adolescents (11, 12).

The high prevalence of insufficient physical activity in children and adolescents addresses the need for a systematic physical activity promotion in Croatia, as well as in other countries. Taking into consideration that insufficient physical activity is most prevalent among girls and high school students, physical activity interventions should mainly target these groups.

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S a ž e t a k

PREVALENCIJA NEDOVOLJNE RAZINE TJELESNE AKTIVNOSTI KOD DJECE I ADOLESCENATA: PREGLED

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Cilj je rada bio sažeti rezultate novijih istraživanja o razini tjelesne aktivnosti djece i adolescenata. Pregled literature proveden je putem sljedećih baza: Academic Search Complete, CINAHL, ERIC, Health Source, Hrčak, PubMed/MEDLINE, SocINDEX i Web of Science. U pregled su uključena 32 rada objavljena od 2001.-2011. godine. Prevalencija nedovoljne razine tjelesne aktivnosti djevojčica kretala se između 2,4% i 39,3% (u istraživanjima u kojima je mjerenje provedeno akcelerometrima), odnosno između 19,5% i 95% (u istraživanjima u kojima su primijenjeni upitnici tjelesne aktivnosti). Prevalencija nedovoljne tjelesne aktivnosti dječaka kretala se između 2,6% i 18,1% (u istraživanjima u kojima je mjerenje provedeno akcelerometrima), odnosno između 18,2% i 89% (u istraživanjima u kojima su primijenjeni upitnici tjelesne aktivnosti). Viši udio nedovoljno aktivnih utvrđen je među srednjoškolcima u odnosu na osnovnoškolce. Udio nedovoljno aktivnih u većini istraživanja bio je između 5% i 30% viši kod djevojčica nego kod dječaka. U istraživanjima u kojima su rabljeni akcelerometri prevalencija nedovoljne razine tjelesne aktivnosti bila je niža nego u anketnim istraživanjima. Utvrđeni udjeli nedovoljno aktivnih upućuju na potrebu za sustavnom promocijom tjelesne aktivnosti. Pritom posebnu pozornost treba posvetiti djevojčicama i srednjoškolcima, jer je baš u navedenim skupinama utvrđena najviša prevalencija nedovoljne razine tjelesne aktivnosti.

Deskriptori: DJECA; ADOLESCENTI; TJELESNA AKTIVNOST; META-ANALIZA

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