

Physical Activity of Croatian Population: Cross-sectional Study Using International Physical Activity Questionnaire

Danijel Jurakić¹,
Željko Pedišić², Mirna
Andrijašević¹

¹Department of General and Applied Kinesiology, Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia

²Department of Kinesiological Anthropology and Methodology, Faculty of Kinesiology, University of Zagreb, Zagreb, Croatia

Aim To determine the physical activity level of the Croatian population in different domains of everyday life.

Methods A random stratified sample of 1032 Croatians aged 15 years and older was interviewed using the official Croatian long version of the International Physical Activity Questionnaire (IPAQ). Total physical activity and physical activity in each of the 4 life domains – work, transport, domestic and garden, and leisure-time – were estimated. Physical activity was expressed as metabolic equivalent-hours per week (MET-hour/week).

Results Median total physical activity for the whole sample was 58.2 MET-hour/week. Median physical activity in MET-hour/week was 30.4 for work, 5.0 for transportation, 13.1 for domestic and garden, and 6.0 for leisure-time domain. The lowest physical activity was found in the 15-24 age group (42.7 MET-hour/week) and the highest in the 55-64 age group (72.0 MET-hour/week). Multiple regression analysis showed a significant relationship of socio-demographic and health-related characteristics (size of settlements, household income, educational level, age, body mass index, self-rated physical health, and self-rated mental health) with physical activity in all domains ($P < 0.001$).

Conclusion Studies on physical activity in transition countries should include the domains of work and domestic and garden, since if only leisure-time domain is examined, the total physical activity level could be underestimated. As the lowest physical activity was reported by adolescents and young adults, strategies for increasing physical activity in this age group should be developed.

Received: June 16, 2008

Accepted: September 30, 2008

Correspondence to:

Danijel Jurakić
Faculty of Kinesiology, University
of Zagreb
Horvačanski zavoj 15
10000 Zagreb, Croatia
danijel.jurakic@kif.hr

Insufficient physical activity is related to the progress of different diseases (1-11), causing 1.9 million premature deaths per year globally (12). Furthermore, physical activity is closely related to mental health and well-being (13-17). Therefore, many strategies for promoting physical activity have been developed and implemented, such as "Global Strategy of Diet, Physical Activity and Health" (18) and "Healthy People 2010" (19). The development of these strategies created a need for standardization of physical activity measurements, which would allow the comparison between different studies from different countries. Although, there is no internationally accepted measure of physical activity (12), International Physical Activity Questionnaire (IPAQ) is widely used in physical activity studies across the world (20). The long form of IPAQ measures frequency, duration, and intensity of physical activity in 4 domains of life: work, transport, domestic and garden, and leisure-time. Studies have shown an acceptable validity and reliability of IPAQ for use in population-based studies of physical activity (21,22).

Although in the European Union and other developed countries a number of population-based studies on physical activity have been conducted, in transition European countries, such as Croatia, there is a lack of such data. In Croatia, there have been some studies on the prevalence of physical inactivity (23,24), but there has been no quantitative data on physical activity, especially with physical activity expressed as metabolic units (MET), which are the units that enable comparison between the studies. To the best of our knowledge, there has been no population-based study in Croatia which examined all 4 domains of physical activity. The aim of our study was to determine physical activity levels in a representative sample of Croatian population aged 15 years and older, using the long form Croatian version of IPAQ.

MATERIALS AND METHODS

Sample

The study was conducted in November 2007 on a random sample of Croatian inhabitants aged 15 years or older who lived in private households. The sample did not include people who lived in institutions (hospitals, nursing homes, etc.). The latest official 2001 census was used as a database for the selection of participants. The survey was conducted on a total of 1076 individuals. We used a double-stage stratified sample and the stratification was performed according to regions (6 Croatian regions) and the

size of settlements (4 categories: less than 2000 inhabitants; 2001-10000; 10001-100000; more than 100000 inhabitants). Households included in the survey, as well as participants within each selected household, were chosen randomly in the following way: 1) selection of cities and villages where the surveying was going to take place; 2) random selection of the starting point in each city/village; 3) random selection of households; 4) random selection of a participant within the household. If the members of the selected household refused to take part in the study or were not at home, the household with the next house number was selected. The interviewers collected the data on sex and date of birth of all the members of the household, starting from the oldest to the youngest. The first household members, 15 years old or older, who had birthday after the date of the survey was included in the sample. If the selected household member was not at home at the time, the interviewers tried to arrange the next possible date for an interview. If the interview could not be arranged, the interviewers repeated the procedure in the household with the next house number. The interviews were held in the afternoon hours during weekdays or at weekends.

All participants had given their written consent for participating in the research before they were interviewed. According to data cleaning rules (25), 44 participants were excluded from further analyses, so the final sample included 1032 participants. The study protocol was approved by Scientific and Ethics Committee of Faculty of Kinesiology, University of Zagreb.

Measures in instruments

For estimating the level of physical activity, the official long form Croatian version of IPAQ was used. For the purpose of this study, the original English version of IPAQ was translated to Croatian and a pilot study was carried out in the Croatian population according to the official IPAQ procedure (25). The questionnaire consists of 27 questions that cover 4 domains of physical activity (work, transport, domestic and garden, and leisure-time) and time spent sitting. The items in IPAQ are structured to provide separate domain-specific scores for walking, moderate-intensity, and vigorous-intensity activity. All questions refer to the previous 7 days. The results were presented as the estimation of energy expenditure in metabolic equivalent-minutes per week (MET hours/week). According to IPAQ scoring protocol (25), MET hour/week of specific activity (walking or moderate intensity activity or vigorous intensity activity) is computed by multiplying MET value of particular activity (3.3 for walk-

ing, 4.0 for moderate intensity activity, and 8.0 for vigorous intensity activity) with hours spent in that particular activity (eg, walking MET-minutes/week at work = 3.3 × walking hours × walking days at work). To calculate physical activity scores, only the activities lasting at least 10 minutes at the time were taken into account. Algorithms for calculating the continuous physical activity scores were used to estimate physical activity based on participants' answers (25). Total physical activity score was calculated, as well as separate scores for each of the 4 physical activity domains (25).

To investigate the parameters associated with physical activity, the following variables were additionally used: size of settlement, household income, educational level, body mass index (BMI, calculated using self-reported weight and height), and self-rated physical and mental health. Self-rated health was assessed using short-form health survey SF-36 (26). Summary measures of physical and mental health were calculated according to Ware et al (26).

Data analysis

Normality of distributions of variables was tested by Shapiro-Wilk W-test. Median, 95% confidence interval (CI) for median, and interquartile range were calculated for each domain of physical activity separately, as well as for total physical activity, for 6 age groups of participants (age: 15-24, 25-34, 35-44, 45-54, 55-64, and 65 and older). Differences between age groups in physical activity were tested using Kruskal-Wallis ANOVA. The analyses were performed on the total sample of participants and separately for men and women. Sex differences in physical activity were tested using Kruskal-Wallis ANOVA. Additionally, least squares multiple regression was conducted in order to identify so-

cio-demographic and self-rated health factors related to physical activity level. In the regression model, we used size of settlement (4 categories: fewer than 2000; 2001-10,000; 10,001-100,000; 100,000 inhabitants and more), household income, educational level (5 categories: 8 years and fewer, 9-12 years, 13-14 years, 15-18 years, 19 years and more), BMI (absolute values), and self-rated physical (scores: 0-100) and mental health (scores: 0-100) as independent variables. Furthermore, we used each of the 4 physical activity domain scores and total physical activity score as dependent variables. Since all physical activity variables were right-skewed and therefore not normally distributed, we conducted multiple regression based on Spearman rank correlation coefficients. The level of significance for all analyses was set at $P < 0.05$. Statistical analyses were performed by STATISTICA software, version 7.1 (StatSoft Inc., Tulsa, OK, USA.).

RESULTS

The sample included a total of 1032 participants (500 men and 532 women). The median (95% CI) of total physical activity for the whole sample was 58.2 (52.9-63.5) MET-hour/week (Table 1). Participants aged 55 to 64 years had the highest total physical activity score (72.0 [56.5-87.5] MET-hour/week), while participants aged 15 to 24 years had the lowest (42.7 [37.2-48.2] MET-hour/week). Croatian people are physically very active at work (30.6 [23.7-39.1] MET-hour/week) and in the domestic and garden domain (13.1 [11.6-14.6] MET-hour/week), as opposed to transportation (5.0 [4.3-5.6] MET-hour/week) and leisure (6.0 [5.2-6.8] MET-hour/week) domain. In the domestic and garden domain, physical activity scores increased with age, so the lowest were reported by participants aged 15 to 24 (4.5 [3.0-6.0]

TABLE 1. Physical activity in metabolic equivalents-hours per week (MET-hours/week) reported by participants aged 15 y and older (n = 1032) and test of differences between age groups

Age	Domains of physical activity and total physical activity (median* (95% CI [†]); IQR [‡])				
	work	transport	domestic and garden	leisure	total
15-24	39.8 (23.2-56.4); 17.9	6.6 (5.3-8.0); 12.1	4.5 (3.0-6.0); 12.0	9.6 (7.2-12.1); 19.3	42.7 (37.2-48.2); 52.0
25-34	28.5 (10.8-46.2); 80.0	3.3 (1.8-4.8); 11.0	12.0 (9.1-14.9); 25.5	6.6 (4.4-8.8); 15.7	59.2 (42.2-76.3); 142.8
35-44	40.0 (13.1-66.9); 98.4	3.3 (2.0-4.7); 9.9	15.5 (11.3-19.7); 38.5	3.5 (1.6-5.4); 16.0	65.1 (48.1-82.2); 147.1
45-54	17.9 (6.1-29.7); 35.3	5.0 (3.2-6.7); 13.6	21.0 (18.1-23.9); 40.0	4.4 (2.8-6.0); 11.6	65.5 (52.3-78.7); 120.2
55-64	40.7 (21.4-60.0); 60.0	5.5 (3.3-7.7); 18.0	24.0 (18.1-29.9); 42.0	6.6 (4.2-9.0); 16.3	72.0 (56.5-87.5); 118.7
>64		4.6 (2.1-7.0); 16.2	36.4 (23.2-49.6); 50.6	1.7 (0.0-6.6); 21.5	67.1 (48.3-85.9); 67.1
Overall	30.6 (23.7-39.1); 58.4	5.0 (4.3-5.6); 13.4	13.1 (11.6-14.6); 35.5	6.0 (5.2-6.8); 16.8	58.2 (52.9-63.5); 106.9
P^{\S}	<0.001	0.001	<0.001	<0.001	<0.001

*Median for MET-hours/week calculated according to International Physical Activity Questionnaire (IPAQ) scoring protocol (25).

[†]Confidence interval (CI) for medians calculated based on the method proposed by Bonnett and Price (27).

[‡]Interquartile range (IQR) in MET-hours/week calculated according to IPAQ scoring protocol (25).

[§]Kruskal-Wallis ANOVA.

MET-hour/week) and the highest by participants aged 65 and older (36.4 [23.2-49.6] MET-hour/week).

Collected data were separately analyzed for male (Table 2) and female (Table 3) participants. The group of male participants aged 35 to 44 showed the highest total physical activity score (80.8 [51.6-109.9] MET-hour/week) and the highest physical activity score at work-place (61.0 [27.2-94.7] MET-hour/week). In the domestic and garden domain, physical activity score in men increased with age, so the lowest was reported by participants aged 15 to 24 (1.5 [0.0-3.0] MET-hour/week) and the highest by participants aged 65 and older (45.0 [22.5-67.5] MET-hour/week).

In the leisure-time domain, men aged 15 to 24 were most physically active (10.2 [5.8-14.6] MET-hour/week), while men aged 65 and older were least physically active (0.0

[0.0-10.2] MET-hour/week). In women, total physical activity and physical activity in domestic and garden domain increased with age. The lowest total physical activity was reported by women aged 15 to 24 (37.2 [32.0-42.4] MET-hour/week) and the highest by women aged 55 to 64 (78.9 [58.5-99.4] MET-hour/week). In the domestic and garden domain, the lowest physical activity was reported by women aged 15 to 24 (6.0 [3.8-8.2] MET-hour/week) and the highest in women aged 65 and older (33.5 [22.8-44.2] MET-hour/week). In total physical activity, there was no significant difference between men and women ($P=0.108$) (Table 4). Comparison of physical activity by sex through the domains revealed much higher physical activity at work in male participants (46.2 [32.3-60.1] MET-hour/week vs 16.5 [9.5-23.5] MET-hour/week for women, $P>0.001$). On the other hand, women were more active than men in the domestic and garden domain (17.5 [15.2-19.8] MET-

TABLE 2. Physical activity in metabolic equivalents-hours per week (MET-hours/week) reported by male participants aged 15 y and older (n = 500) and test of differences between age groups

Age	Domains of physical activity and total physical activity (median* (95% CI) [†] ; IQR [‡])				
	Work	transport	domestic and garden	leisure	total
15-24	49.1 (17.0-81.1); 39.6	6.3 (3.7-8.9); 12.6	1.5 (0.0-3.0); 9.5	10.2 (5.8-14.6); 22.0	52.9 (42.3-63.6); 53.0
25-34	48.2 (13.8-82.6); 133.5	2.2 (0.7-3.8); 9.9	8.4 (3.2-13.5); 29.0	6.6 (4.0-9.2); 16.0	79.5 (49.4-109.6); 163.5
35-44	61.0 (27.2-94.7); 117.5	2.2 (0.0-4.7); 11.6	9.5 (4.4-14.6); 35.0	3.3 (0.8-5.8); 18.6	80.8 (51.6-109.9); 161.1
45-54	10.8 (0.0-31.0); 32.0	3.3 (0.0-6.7); 16.5	19.0 (14.5-23.5); 36.0	3.7 (1.2-6.3); 11.9	55.9 (34.4-77.3); 167.4
55-64	46.2 (7.9-84.5); 109.0	3.6 (1.4-5.9); 11.6	13.5 (5.3-21.7); 33.5	6.2 (3.0-9.4); 16.5	64.4 (43.7-85.2); 146.9
>64		5.0 (0.0-15.2); 23.1	45.0 (22.5-67.5); 51.0	0.0 (0.0-10.2); 23.1	67.1 (32.9-101.2); 77.2
Overall	46.2 (32.3-60.1); 85.0	3.3 (2.6-4.0); 14.2	9.3 (6.7-11.8); 32.4	6.0 (4.3-7.7); 17.9	63.1 (55.4-70.7); 129.1
P^{\S}	<0.001	0.040	<0.001	0.002	0.113

*Median in MET-hours/week calculated according to International Physical Activity Questionnaire (IPAQ) scoring protocol (25).

[†]Confidence interval (CI) for medians calculated based on the method proposed by Bonett and Price (27).

[‡]Interquartile range (IQR) in MET-hours/week calculated according to IPAQ scoring protocol (25).

[§]Kruskal-Wallis ANOVA.

TABLE 3. Physical activity in metabolic equivalents-hours per week (MET-hours/week) reported by female participants aged 15 y and older (n = 532) and test of differences between age groups

Age	Domains of physical activity and total physical activity (median,* (95% CI) [†] ; IQR [‡])				
	Work	transport	domestic and garden	leisure	total
15-24	24.5 (2.8-46.1); 4.8	6.6 (4.8-8.5); 10.2	6.0 (3.8-8.2); 10.6	6.6 (3.6-9.6); 16.5	37.2 (32.0-42.4); 46.7
25-34	3.3 (0.0-12.4); 31.8	5.5 (3.9-7.1); 13.2	13.5 (10.4-16.6); 18.0	6.3 (3.0-9.6); 14.6	45.2 (30.4-60.0); 94.5
35-44	24.8 (1.0-48.6); 87.6	4.4 (2.8-6.0); 9.9	21.0 (15.5-26.5); 35.0	5.0 (2.8-7.1); 15.3	57.8 (41.1-74.5); 134.7
45-54	20.3 (6.0-34.6); 41.7	6.1 (4.1-8.0); 9.9	24.5 (19.5-29.6); 51.0	5.0 (3.4-6.5); 11.6	70.8 (52.9-88.7); 108.2
55-64	33.0 (9.9-56.2); 33.0	6.7 (4.0-9.4); 20.4	30.0 (13.6-40.4); 49.5	7.0 (4.3-9.7); 20.9	78.9 (58.5-99.4); 110.9
>64		4.1 (1.1-7.2); 10.5	33.5 (22.8-44.2); 50.3	1.7 (0.0-7.8); 19.8	67.2 (44.0-90.4); 60.0
Overall	16.5 (9.5-23.5); 40.6	5.5 (4.7-6.3); 12.0	17.5 (15.2-19.8); 37.2	6.0 (5.2-6.8); 16.6	53.6 (45.7-61.4); 90.4
P^{\S}	<0.001	0.033	<0.001	0.013	<0.001

*Median in MET-hours/week calculated according to International Physical Activity Questionnaire (IPAQ) scoring protocol (25).

[†]Confidence interval (CI) for medians calculated based on the method proposed by Bonett and Price (27).

[‡]Interquartile range (IQR) in MET-hours/week calculated according to IPAQ scoring protocol (25).

[§]Kruskal-Wallis ANOVA.

hour/week vs 9.3 [6.7-11.8] MET-hour/week, $P < 0.001$). In the transport domain, women were also somewhat more active (5.5 [4.7-6.3] MET-hour/week) than men (3.3 [2.6-4.0] MET-hour/week, $P < 0.001$). In the leisure-time domain, men and women reported almost identical physical activity (6.0 [5.2-6.8] MET-hour/week vs 6.0 [4.3-7.7] MET-hour/week, $P = 0.907$).

Multiple regression analyses (Table 5) showed a significant relationship between socio-demographic and health-related characteristics with physical activity in all domains. The coefficient of multiple determination varied from 0.03 for physical activity in transport domain and work domain to 0.19 for physical activity in domestic and garden domain. Total physical activity was positively related to age and inversely related to the size of settlements. Physical activity in work domain was also inversely related to the size of

settlements. Furthermore, physical activity in transport domain was inversely related to BMI and household income, while physical activity in domestic and garden domain was positively related to age and inversely related to the size of settlements and educational level. Finally, physical activity in leisure-time domain was positively related to the size of settlements, household income, and self-perceived mental health, while it was inversely related to BMI.

DISCUSSION

Our study showed that total physical activity in the representative sample of Croatian population was 58.2 MET-hour/week, which is equivalent to approximately 3 hours of moderate or one and a half hour of vigorous physical activity 5 days a week. This means that the majority of respondents (74%) reached the level of at least 30 minutes of moderate physical activity 5 days a week, which could be considered as the lowest level of physical activity for achieving health benefits (28). However, in most studies recommended levels of physical activity have been determined in relation to leisure-time physical activity, while other domains (work, transport, domestic and garden) were not equally considered (29). Therefore, studies using new integrated approach of determining physical activity throughout 4 domains, as is IPAQ, could find considerably lower levels of physical inactivity.

If we want to compare this study with similar studies conducted in other European countries, we have to bear in mind that the recent studies in the European Union countries used the short version of IPAQ (29,30). Although comparative studies have shown that results obtained by different versions of IPAQ can be compared (21), physical

TABLE 4. Differences in physical activity domains and total physical activity (median* (95% CI[†]); IQR[‡]) according to sex

Physical activity	Men	Women	P^{\S}
Work	46.2 (32.3-60.1); 85.0	16.5 (9.5-23.5); 40.6	<0.001
Transport	3.3 (2.6-4.0); 14.2	5.5 (4.7-6.3); 12.0	<0.001
Domestic and garden	9.3 (6.7-11.8); 32.4	17.5 (15.2-19.8); 37.2	<0.001
Leisure	6.0 (4.3-7.7); 17.9	6.0 (5.2-6.8); 16.6	0.907
Total	63.1 (55.4-70.7); 129.1	53.6 (45.7-61.4); 90.4	0.108

*Median in metabolic equivalents (MET)-hours per week calculated according to International Physical Activity Questionnaire scoring protocol (25).

†Confidence interval (CI) for medians calculated based on the method proposed by Bonnett and Price (27).

‡Interquartile range (IQR) in MET-hours/week calculated according to IPAQ scoring protocol (25).

§Kruskal-Wallis ANOVA.

TABLE 5. Results of multiple regression analysis between socio-demographic characteristics and self-rated health (independent variables) and physical activity (PA, dependent variables) – standardized regression coefficients and multiple determination coefficients

Independent variable	Dependent variable ((β^* , P))				
	Work PA	Transport PA	Domestic and garden PA	Leisure PA	Total PA
Size of settlements	-0.12 (0.001)	0.01 (0.871)	-0.21 (<0.001)	0.10 (0.004)	-0.19 (<0.001)
Household income	0.04 (0.256)	-0.13 (0.001)	-0.06 (0.094)	0.10 (0.010)	-0.03 (0.375)
Educational level	-0.07 (0.070)	0.01 (0.707)	-0.09 (0.007)	0.06 (0.097)	-0.08 (0.022)
Age	0.02 (0.730)	-0.04 (0.433)	0.34 (<0.001)	0.00 (>0.950)	0.12 (0.009)
Body mass index [†]	0.06 (0.124)	-0.10 (0.016)	-0.06 (0.117)	-0.10 (0.013)	0.00 (>0.950)
Self-rated physical health [‡]	-0.02 (0.704)	-0.09 (0.028)	-0.05 (0.161)	0.08 (0.038)	-0.07 (0.054)
Self-rated mental health [‡]	0.06 (0.131)	0.07 (0.061)	-0.02 (0.510)	0.16 (<0.001)	0.08 (0.026)
Multiple determination ($R^{2\S}$, P)	0.03 (<0.001)	0.03 (<0.001)	0.19 (<0.001)	0.10 (<0.001)	0.08 (<0.001)

*Standardized regression coefficient (β).

†Body mass index was calculated using self-reported weight and height.

‡Summary measures of self-rated physical and mental health calculated according to Ware et al (26).

§Coefficient of multiple determination.

activity estimated using the long version of IPAQ may be higher because the short version systematically underestimates physical activity level (31), since it consists of fewer questions (7 questions in the short version compared with 27 questions in the long version). European Activity Surveillance System (EUPASS) project encompassed physical activity research in 8 countries of the European Union, with the following median physical activity scores: Belgium – 67.0 MET-hour/week, Finland – 70.2 MET-hour/week, France – 63.8 MET-hour/week, Germany – 84.5 MET-hour/week, Italy – 19.6 MET-hour/week, the Netherlands – 56.4 MET-hour/week, Spain – 39.3 MET-hour/week, and the Great Britain – 27.6 MET-hour/week (29). Median physical activity score for all the countries together was 49.5 MET-hour/week (29), which is 8.7 MET-hour/week lower than the median physical activity score in Croatia. This indicates that the physical activity level in Croatia does not differ considerably from average physical activity in the European Union countries.

Total physical activity scores alone do not give us a complete understanding of the physical activity pattern in the Croatian population. Although total physical activity in Croatia did not differ from the total physical activity in the countries of the European Union, we assume that the pattern of physical activity would differ because it has been shown that living conditions and life-style, especially in the work domain, depend on the standard of living (32). It is therefore important to identify the contribution of each physical activity domain to the total physical activity. For example, health studies that determine the level of physical activity only in the domain of leisure, while ignoring the domain of work, could possibly lead to flawed conclusions. This is supported by the studies that found a correlation of physical activity at work to specific aspects of health. For example, Norfolk prospective population study showed a significantly decreased risk of death and cardiovascular diseases in persons who were physically active at work (33) and other studies showed an inverse correlation between work-related physical activity and cardiovascular mortality (34,35). Studies that determine only total physical activity and do not examine physical activity throughout domains neglect the fact that physical activity in the domain of leisure and in the domain of work has different influence on certain aspects of health. Gutierrez-Fisac et al (36) found that physical activity at work was not related to obesity, while Fung et al (37) found that there was a relation between physical activity in leisure time and obesity. Furthermore, Ruzic et al (38) found that an increased physical activity at work was not relat-

ed to the improvement in physical fitness because it does not have adequate intensity and duration to affect positive changes. On the other hand, Tuero et al (39) showed a positive correlation between physical activity in leisure time and physical fitness. This was the reason why we analyzed physical activity of Croatian population in different life domains.

The distribution of physical activity throughout domains indicated considerably lower physical activity of Croatian participants in the domains of leisure-time and transport than in the domains of work and domestic and garden. When compared with the domains of work and domestic and garden, the domains of leisure-time and transport have been more often discussed in studies showing positive relation between physical activity and health (40,41). Therefore, the distribution of physical activity throughout domains in Croatia indicates the importance of creating physical activity interventions with the emphasis on leisure time and transportation domain. Our finding that physical activity scores increase with advancing age are contrary to our expectations and the results of other studies (42,43). The highest physical activity was reported by participants aged 55 to 64 and this was mainly due to high physical activity in the domains of work and domestic and garden. This corroborates the assumption that in transition countries, men of that age still perform physically demanding work (different kinds of manual labor), while women of that age traditionally work a lot in the house and in the garden. On the other hand, young participants (15 to 24 years) reported the lowest physical activity, mainly due to a very low level of physical activity in the domestic and garden domain. Decreased physical activity in young people in Croatia was an expected finding, since their workplace lifestyle is becoming more and more sedentary, which is similar to the recent trends in the developed countries (32). Although participants aged 15 to 24 reported the highest physical activity score in the leisure-time domain, this was obviously insufficient to increase their total physical activity scores.

Comparison of physical activity by sex revealed that Croatian men were physically more active than women, which was in accordance with previous studies (43,44). Additionally, it is important to notice that patterns of physical activity were also considerably different for men and women. Namely, men reported more physical activity at work, while women reported more physical activity in the domestic and garden domain. These results suggest that it is necessary to examine both work and domestic and garden

domains if sex differences in the patterns of physical activity are to be discussed.

We found that total physical activity score and physical activity in work domain were inversely associated with the size of settlements, which implies that people who live in smaller settlements are more likely to be physically active. This was mainly due the fact that Croatian people in smaller settlements more often perform physically demanding work as opposed to bigger towns where there are more sedentary jobs. This is in accordance with the study by Sjöström et al (30), who found that people living in large towns were less likely to be sufficiently active than those living in small towns.

Educational level showed the expected inverse associations with the total score of physical activity and positive associations with physical activity in leisure-time domain. People with lower educational level and lower income often perform more physically demanding work and probably do not have enough time and financial resources for leisure-time physical activity. On the other hand, people with higher educational level have more sedentary jobs and tend to be more physically active in leisure-time probably due to greater need for physical activity and greater knowledge about its health benefits. Positive relation of educational level and leisure-time physical activity has also been shown in other studies (30,45). Physical activity in leisure-time domain was also associated with self-rated mental health. These findings are in accordance with the findings of other studies, which suggest that physical activity can be useful in treating and avoiding depressive illnesses, and can be used as a means of reducing stress and anxiety on a daily basis (46).

Regression analysis showed that socio-demographic and health-related characteristics were significantly related to physical activity in different domains, although this relationship was not very strong. These variables explained only from 2% to 8% of the variance in physical activity at different domains. Thus, more parameters, like enjoyment in activities, knowledge of exercise health benefits, barriers to physical activity, social support, and access to sport facilities, should be included in future analyses in order to more comprehensively determine physical activity correlates in Croatia.

The major advantages of this study are the methods used. First, IPAQ is designed in order to standardize measurement of physical activity in different independent studies, so our

results are comparable with other physical activity studies based on this widely used questionnaire. Second, the long version of IPAQ allowed us to determine the level of physical activity in each of 4 physical activity domains, which is very important in order to get a complete insight into the pattern of physical activity in transitional countries.

Our study also has several limitations. One of them is the fact that complex nature of physical activity was investigated with the use of self-report questionnaire, which may have led to overreporting of physical activity by participants with low capacity for physical activity, such as the elderly. Although, there are more precise physical activity measures as activity monitors, questionnaires are most often used in population based studies of physical activity. Another limitation of our study is the validity of IPAQ in the elderly (age 65 and older), which has not yet been determined. Therefore, the results for participants in this age group could have differed from the actual results. Our survey was conducted in November, so another possible limitation arises from the assumption that the level of physical activity can vary throughout different seasons. Although Croatia is a typical example of a post-communist country in social and economic transition, generalization of our results on other transitional countries is not completely accurate. Further studies of physical activity in Croatia should investigate differences according to education, personal and household income, size of settlements, and other socio-economic characteristics in order to develop more adequate physical activity promoting strategies.

Based on the comparison with similar data, we may conclude that physical activity in Croatia does not differ considerably from average physical activity in the European Union countries. However, it is necessary to mention that the domains that contributed most to the total physical activity among Croatians were work and domestic and garden. Therefore, studies of physical activity in transition countries should include the domains of work and domestic and garden, because if only leisure-time domain is examined, physical activity level could be notably underestimated. Moreover, for a more complete insight into the pattern of physical activity, studies in transition countries should separately analyze each physical activity domain. It is important to emphasize that the lowest level of physical activity was reported by participants aged 15 to 24 years. Therefore, strategies for increasing physical activity in Croatia should mostly be aimed at the population of adolescents and young adults.

Acknowledgments

The authors thank Nevenka Hendrih, Marijana Plovanić and all employees of Henda for a great assistance in data collection.

References

- Kohl HW III. Physical activity and cardiovascular disease: evidence for a dose response. *Med Sci Sports Exerc.* 2001;33(6 Suppl):S472-83. [Medline:11427773](#)
- Richardson CR, Kriska AM, Lantz PM, Hayward RA. Physical activity and mortality across cardiovascular disease risk groups. *Med Sci Sports Exerc.* 2004;36:1923-9. [Medline:15514508](#) [doi:10.1249/01.MSS.0000145443.02568.7A](#)
- Conroy MB, Cook NR, Manson JE, Buring JE, Lee IM. Past physical activity, current physical activity, and risk of coronary heart disease. *Med Sci Sports Exerc.* 2005;37:1251-6. [Medline:16118569](#) [doi:10.1249/01.mss.0000174882.60971.7f](#)
- Meisinger C, Lowel H, Thorand B, Doring A. Leisure time physical activity and the risk of type 2 diabetes in men and women from the general population. The MONICA/KORA Augsburg Cohort Study. *Diabetologia.* 2005;48:27-34. [Medline:15616798](#) [doi:10.1007/s00125-004-1604-3](#)
- Villegas R, Shu XO, Li H, Yang G, Matthews CE, Leitzmann M, et al. Physical activity and the incidence of type 2 diabetes in the Shanghai women's health study. *Int J Epidemiol.* 2006;35:1553-62. [Medline:16984936](#) [doi:10.1093/ije/dyl209](#)
- Fujii T, Ohsawa I, Nozawa A, Mori K, Kagaya M, Kajio T, et al. The association of physical activity level characteristics and other lifestyles with obesity in Nagoya University alumni, Japan. *Scand J Med Sci Sports.* 1998;8:57-62. [Medline:9502312](#)
- Blair SN, Brodney S. Effects of physical inactivity and obesity on morbidity and mortality: current evidence and research issues. *Med Sci Sports Exerc.* 1999;31(11 Suppl):S646-62. [Medline:10593541](#)
- Bernstein MS, Costanza MC, Morabia A. Association of physical activity intensity levels with overweight and obesity in a population-based sample of adults. *Prev Med.* 2004;38:94-104. [Medline:14672646](#) [doi:10.1016/j.ypmed.2003.09.032](#)
- Singh RB, Pella D, Mechirova V, Kartikey K, Demeester F, Tomar RS, et al. Prevalence of obesity, physical inactivity and undernutrition, a triple burden of diseases during transition in a developing economy. The Five City Study Group. *Acta Cardiol.* 2007;62:119-27. [Medline:17536599](#) [doi:10.2143/AC.62.2.2020231](#)
- Bassett DR Jr, Fitzhugh EC, Crespo CJ, King GA, McLaughlin JE. Physical activity and ethnic differences in hypertension prevalence in the United States. *Prev Med.* 2002;34:179-86. [Medline:11817913](#) [doi:10.1006/pmed.2001.0969](#)
- Hernelahti M, Kujala U, Kaprio J. Stability and change of volume and intensity of physical activity as predictors of hypertension. *Scand J Public Health.* 2004;32:303-9. [Medline:15370771](#) [doi:10.1080/14034940410024167](#)
- World Health Organization. The world health report 2002: reducing risk, promoting health life. Geneva: World Health Organization; 2002. p. 61.
- Abu-Omar K, Rutten A, Lehtinen V. Mental health and physical activity in the European Union. *Soz Präventivmed.* 2004;49:301-9. [Medline:15497649](#)
- Backmand H, Kaprio J, Kujala U, Sarna S. Influence of physical activity on depression and anxiety of former elite athletes. *Int J Sports Med.* 2003;24:609-19. [Medline:14598199](#) [doi:10.1055/s-2003-43271](#)
- Schnohr P, Kristensen TS, Prescott E, Scharling H. Stress and life dissatisfaction are inversely associated with jogging and other types of physical activity in leisure time – The Copenhagen City Heart Study. *Scand J Med Sci Sports.* 2005;15:107-12. [Medline:15773865](#) [doi:10.1111/j.1600-0838.2004.00394.x](#)
- Andrijašević M, Paušić J, Bavčević T, Ciliga D. Participation in leisure activities and self-perception of health in students of the University of Split. *Kinesiology.* 2005;37:21-31.
- Sjogren T, Nissinen KJ, Jarvenpaa SK, Ojanen MT, Vanharanta H, Malkia EA. Effects of a physical exercise intervention on subjective physical well-being, psychosocial functioning and general well-being among office workers: a cluster randomized-controlled cross-over design. *Scand J Med Sci Sports.* 2006;16:381-90. [Medline:17121639](#) [doi:10.1111/j.1600-0838.2005.00516.x](#)
- World Health Organization. The world health report 2003: global strategy on diet, physical activity and health. Geneva: World Health Organization; 2003. p. 90.
- US Department of Health and Human Services. Healthy people 2010, understanding and improving health. Washington (DC): US Government Printing Office; 2000. p. 26.
- Ainsworth BE, Macera CA, Jones DA, Reis JP, Addy CL, Bowles HR, et al. Comparison of the 2001 BRFSS and the IPAQ Physical Activity Questionnaires. *Med Sci Sports Exerc.* 2006;38:1584-92. [Medline:16960519](#) [doi:10.1249/01.mss.0000229457.73333.9a](#)
- Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc.* 2003;35:1381-95. [Medline:12900694](#) [doi:10.1249/01.MSS.0000078924.61453.FB](#)
- Deng HB, Macfarlane DJ, Thomas GN, Lao XQ, Jiang CQ, Cheng KK, et al. Reliability and validity of the IPAQ-Chinese: the Guangzhou Biobank Cohort study. *Med Sci Sports Exerc.* 2008;40:303-7. [Medline:18202571](#) [doi:10.1249/mss.0b013e31815b0db5](#)
- Misigoj-Durakovic M, Heimer S, Matkovic BR, Ruzic L, Prskalo I. Physical activity of urban adult population: questionnaire study. *Croat Med J.* 2000;41:428-32. [Medline:11063768](#)
- Misigoj-Durakovic M, Heimer S, Gredelj M, Zeljko H, Soric M. Physical inactivity in Croatia [in Croatian]. *Acta Med Croatica.* 2007;61:253-8. [Medline:17629099](#)
- International Physical Activity Questionnaire (IPAQ). IPAQ Research Committee, 2005. Available from: <http://www.ipaq.ki.se/scoring.pdf>. Accessed: May 12, 2008.
- Ware JE, Kosinski M, Keller S. SF-36 physical and mental summary scales: a user manual. Boston (MA): The Health Institute, New England Medical Center; 1994.
- Bonett DG, Price RM. Statistical inference for a linear function of medians: confidence intervals, hypothesis testing,

- and sample size requirements. *Psychol Methods*. 2002;7:370-83. [Medline:12243307](#) [doi:10.1037/1082-989X.7.3.370](#)
- 28 Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*. 2007;116:1081-93. [Medline:17671237](#) [doi:10.1161/CIRCULATIONAHA.107.185649](#)
- 29 Rutten A, Ziemainz H, Schena F, Stahl T, Stiggelbout M, Auweele YV, et al. Using different physical activity measurements in eight European countries. Results of the European Physical Activity Surveillance System (EUPASS) time series survey. *Public Health Nutr*. 2003;6:371-6. [Medline:12795825](#)
- 30 Sjostrom M, Oja P, Hagstromer M, Smith B, Bauman A. Health-enhancing physical activity across European Union countries: the Eurobarometer study. *J of Publ Health*. 2006;14:291-300. [doi:10.1007/s10389-006-0031-y](#)
- 31 Hallal PC, Victora CG. Reliability and validity of the International Physical Activity Questionnaire (IPAQ). *Med Sci Sports Exerc*. 2004;36:556. [Medline:15076800](#) [doi:10.1249/01.MSS.0000117161.66394.07](#)
- 32 Monda KL, Gordon-Larsen P, Stevens J, Popkin BM. China's transition: the effect of rapid urbanization on adult occupational physical activity. *Soc Sci Med*. 2007;64:858-70. [Medline:17125897](#) [doi:10.1016/j.socscimed.2006.10.019](#)
- 33 Khaw KT, Jakes R, Bingham S, Welch A, Luben R, Day N, et al. Work and leisure time physical activity assessed using a simple, pragmatic, validated questionnaire and incident cardiovascular disease and all-cause mortality in men and women: The European Prospective Investigation into Cancer in Norfolk prospective population study. *Int J Epidemiol*. 2006;35:1034-43. [Medline:16709620](#) [doi:10.1093/ije/dyl079](#)
- 34 Hu G, Eriksson J, Barengo NC, Lakka TA, Valle TT, Nissinen A, et al. Occupational, commuting, and leisure-time physical activity in relation to total and cardiovascular mortality among Finnish subjects with type 2 diabetes. *Circulation*. 2004;110:666-73. [Medline:15277321](#) [doi:10.1161/01.CIR.0000138102.23783.94](#)
- 35 Hu G, Jousilahti P, Antikainen R, Tuomilehto J. Occupational, commuting, and leisure-time physical activity in relation to cardiovascular mortality among Finnish subjects with hypertension. *Am J Hypertens*. 2007;20:1242-50. [Medline:18047912](#) [doi:10.1016/j.amjhyper.2007.07.015](#)
- 36 Gutierrez-Fisac JL, Guallar-Castillon P, Diez-Ganan L, Lopez Garcia E, Banegas Banegas JR, Rodriguez Artalejo F. Work-related physical activity is not associated with body mass index and obesity. *Obes Res*. 2002;10:270-6. [Medline:11943836](#) [doi:10.1038/oby.2002.37](#)
- 37 Fung TT, Hu FB, Yu J, Chu NF, Spiegelman D, Tofler GH, et al. Leisure-time physical activity, television watching, and plasma biomarkers of obesity and cardiovascular disease risk. *Am J Epidemiol*. 2000;152:1171-8. [Medline:11130623](#) [doi:10.1093/aje/152.12.1171](#)
- 38 Ruzic L, Heimer S, Misigoj-Durakovic M, Matkovic BR. Increased occupational physical activity does not improve physical fitness. *Occup Environ Med*. 2003;60:983-5. [Medline:14634193](#) [doi:10.1136/oem.60.12.983](#)
- 39 Tuero C, De Paz JA, Marquez S. Relationship of measures of leisure time physical activity to physical fitness indicators in Spanish adults. *J Sports Med Phys Fitness*. 2001;41:62-7. [Medline:11317149](#)
- 40 Vuori IM, Oja P, Paronen O. Physically active commuting to work – testing its potential for exercise promotion. *Med Sci Sports Exerc*. 1994;26:844-50. [Medline:7934757](#)
- 41 Andersen LB, Schnohr P, Schroll M, Hein HO. All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work. *Arch Intern Med*. 2000;160:1621-8. [Medline:10847255](#) [doi:10.1001/archinte.160.11.1621](#)
- 42 Al-Hazzaa HM. Health-enhancing physical activity among Saudi adults using the International Physical Activity Questionnaire (IPAQ). *Public Health Nutr*. 2007;10:59-64. [Medline:17212844](#) [doi:10.1017/S1368980007184299](#)
- 43 Hallal PC, Victora CG, Wells JC, Lima RC. Physical inactivity: prevalence and associated variables in Brazilian adults. *Med Sci Sports Exerc*. 2003;35:1894-900. [Medline:14600556](#) [doi:10.1249/01.MSS.0000093615.33774.0E](#)
- 44 Burton NW, Turrell G. Occupation, hours worked, and leisure-time physical activity. *Prev Med*. 2000;31:673-81. [Medline:11133334](#) [doi:10.1006/pmed.2000.0763](#)
- 45 Droomers M, Schrijvers CT, Mackenbach JP. Educational level and decreases in leisure time physical activity: predictors from the longitudinal GLOBE study. *J Epidemiol Community Health*. 2001;55:562-8. [Medline:11449013](#) [doi:10.1136/jech.55.8.562](#)
- 46 Fox KR. The influence of physical activity on mental well-being. *Public Health Nutr*. 1999;2:411-8. [Medline:10610081](#) [doi:10.1017/S1368980099000567](#)