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LEISURE-TIME PHYSICAL ACTIVITY, CARDIORESPIRATORY FITNESS AND WORK ABILITY: A STUDY IN RANDOMLY SELECTED RESIDENTS OF ŁÓDŹ

DOROTA KALETA[1], TERESA MAKOWIEC-DĄBROWSKA[2], and ANNA JEGIER[3]

[1] Department of Preventive Medicine
Medical University of Łódź, Poland
[2] Department of Work Physiology and Ergonomics
Nofer Institute of Occupational Medicine Łódź, Poland
[3] Department of Sports Medicine
Medical University of Łódź, Poland

Abstract
Objectives: Low physical activity is a serious health problem in developed and developing countries. Much attention is also given to the role of physical activity in the modification of work ability in adults. The aim of this study was to assess leisure-time physical activity, cardiorespiratory fitness and their influence on the subjective work ability in a randomly selected group of professionally active residents of Łódź. **Materials and Methods:** The study was performed in the randomly selected group of professionally active persons (n = 198). Physical activity was determined by means of the Seven Day Physical Activity Recall (SDPAR). To determine cardiorespiratory fitness in the examined persons, the submaximal treadmill test was performed. Subjective work ability was evaluated using the work ability index (WAI). **Results:** Correlation coefficient for the WAI and leisure-time physical activity was high $r = 0.3$, $p < 0.0001$. Moreover, WAI, its compounds and cardiorespiratory fitness were highly correlated $r = 0.4$, $p < 0.0001$. **Conclusions:** Our analysis of leisure-time physical activity, cardiorespiratory fitness and WAI emphasizes a great, potential feasibility of improving the WAI and its components, e.g., through the development, promotion, and broad use of training schedules.

Key words:
Physical activity, Cardiorespiratory fitness, Work ability index

INTRODUCTION

Low physical activity is a serious health problem in developed and developing countries [1]. Numerous studies reveal that physical activity and cardiorespiratory fitness can significantly diminish the risk of cardiovascular diseases, obesity, diabetes and some neoplastic growths. The recently conducted studies have corroborated the influence of being fit on the prevention of cardiovascular and other chronic diseases [2,3]. Leisure-time physical activity is beneficial to health. However, it should be emphasized that only a meticulously planned schedule of physical activities can assure tangible advantages resulting from physical fitness. To promote health and prevent chronic diseases moderate intensity training (60% of max heart rate, HR) at least 3 times a week for 40 min is recommended. Ex-

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Address reprint requests to D. Kaleta MD, Department of Preventive Medicine, Medical University of Łódź, pl. Hallera 1, 90-647 Łódź, Poland.

penditure of energy on physical exertion should be higher than 1000 kcal/week and optimally 2000 kcal/week [4].

Much attention is also given to the role of physical activity in the modification of work ability in adults [5–9]. Work ability is a compound feature and its level reflects the interactions between occupational requirements (the volume of both physical and mental activities and functional capabilities of workers), their health and subjective assessment of their status in the given organizational and social conditions.

Work ability can be objectively assessed on the basis of the functional status of a given employee and his or her skills and capabilities. Subjective assessment performed by the examined person can be used for work ability analysis. This method is quite cheap, relatively not very complicated, which can be of some importance when conducting research on large populations. One of the tools used for subjective assessment of work ability is the work ability index (WAI). WAI was developed at the beginning of the 1990s by a specialist of the Institute of Occupational Health in Helsinki [10]. WAI was subsequently used to analyze differences between work abilities, depending on their type, volume and workload. WAI was also used in prospective studies of age-related fluctuations in work ability. The work ability index has been used and checked many times all over the world, including Poland [11,12].

The aim of this study was to assess leisure-time physical activity, cardiorespiratory fitness and their influence on the subjective work ability in a group of randomly selected working residents of Łódź.

MATERIALS AND METHODS

The study was performed in the randomly selected group of professionally active persons. The selection was made by the Local Data Base in Łódź, which rendered the data available together with the proportional draw scheme. As an operator the personal identification number (PESEL) was used. Of the directly drawn 2000 persons, 1029 completed the questionnaire assessing physical activity. Subsequently, 825 individuals were systematically drawn and invited to take the treadmill test. Of this group, 317 persons reported and entered the study (attendance rate, 38%). Finally, 271 subjects (including 198 professionally active persons) were qualified for the treadmill test after physical examination performed by physicians. The study group composed of persons in good health, confirmed by the physical examination and treadmill test, comprised 103 males (mean age, 42.9 ± 11.2 years) and 95 females (mean age, 42 ± 11.5 years).

Physical activity was determined by means of the Seven Day Physical Activity Recall (SDPAR) [13,14]. Information was obtained during an interview conducted by adequately trained interviewers. The questionnaire permitted the collection of data concerning the frequency, intensity and length of both occupational and leisure-time physical activity 7 days prior to the examination. SDPAR also permitted the collection of data on the number of hours of physical activity with low (1.5 METs – metabolic equivalents), moderate (4 METs), high (6 METs) and very high (10 METs) intensity. SDPAR also included energy expenditure during sleep (1MET). Taking into consideration all the data, daily or weekly energy expenditure could be calculated (kcal/day, kcal/week) [15]. To determine cardiorespiratory fitness in the examined persons the submaximal treadmill test was performed. It was an essential prerequisite for the determination of peak oxygen uptake VO_{2max} ($ml \cdot kg^{-1} \cdot min^{-1}$) calculated indirectly according to Astrand-Ryhming. The treadmill test was instituted after an appropriate qualification, including physical examination and electrocardiogram at rest.

Subjective work ability was evaluated using the work ability index, a score composed of different items. Each of those items was determined according to different scales arranged in order of importance. Current work ability compared with the lifetime best was assessed from 0 to 10 points; work ability in relation to the demands of the job from 2 to 10 points; the number of current diseases diagnosed by a physician from 1 to 7 points; and estimated work ability impairment due to diseases from 1 to 6 points. Sick leave during past 12 months, self-estimated prognosis of work ability for two years on, and mental resources to work were determined from 1 to 5, 1, 4 or 7 and from 1 to 4 points, respectively. In each case the highest score was attributed to the most

favorable conditions, e.g. a lack of disease and sick leave, the highest capabilities. The work ability index is calculated by summing the estimated points for each item. The highest WAI reflects the best workers perception of his or her work ability. The range of the index is from 7 to 49 points. According to the classification worked out by the authors, four categories of work ability assessment could be distinguished: poor (WAI up to 27 points), moderate (WAI from 28 to 36 points), good (WAI from 37 to 43 points), or excellent (WAI from 44 to 49 points).

Statistical analysis

Chi-square test, Student's test (for normal distributions) and non-parametric Mann-Whitney test (for other distributions) was used for analyzing the difference between groups. The relations between work ability and maximal oxygen consumption and leisure time physical activity were analyzed using Spearman rank correlation. A level of statistical significance was established at a value of $p = 0.05$. The statistical analysis was performed with the use of STATGRAPHICS 5.0.

RESULTS

In the study group, we did not note any age-related significant differences between men and women (42.9 ± 11.2 vs. 42 ± 11.5 years of age). Table 1 summarizes the characteristics of the study population taking into consideration age, anthropometric indicators, educational level, marital status, and job characteristic.

In the study group, total weekly energy expenditure on leisure-time physical activity accounted approximately for 270 ± 520 kcal/week, and time spent on this activity was 1.4 ± 2.3 h/week, including low, moderate and high intensity (0.7 ± 1.4, 0.7 ± 1.6 and 0.02 ± 0.2 h/weekly, respectively). More than half of the population (53.5%) did not take part in any kind of sports or recreation. In the rest of the group the following values of energy spent on physical activity were obtained: 28.3% – 1 to 499 kcal/week; 8.1% – 500 to 999 kcal/week; 8.1% – 1000 to 1999 kcal/week; and 2% – 2000 kcal/week or more (Fig. 1).

Participation in leisure-time physical activity to some extent depended on the type of work and its load. In male white-collar employees 67% (n = 32), in blue-collar workers 29%

Table 1. Characteristics of study population

Characteristics	Men (n = 103)		Women (n = 95)		P Men vs. women
	Mean	SD	Mean	SD	
Age (years)	42.9	11.2	42.1	11.5	$p > 0.05$
Hight (cm)	176.4	6.3	161.4	5.2	$p < 0.001$
Weight (kg)	81.9	10.8	62.1	10.6	$p < 0.001$
Body mass index – BMI (kg/m^2)	26.3	3.4	23.8	3.7	$p < 0.001$
	n	%	n	%	
Education level					
Primary	17	16.5	14	14.7	$p > 0.05$
Secondary	44	42.7	52	54.7	$p > 0.05$
University	42	40.8	29	30.5	$p > 0.05$
Marital status					
Married	69	67	58	61.1	$p > 0.05$
Not married	34	33.0	37	35.9	$p > 0.05$
Job characteristic					
Mental work	48	46.6	57	60	$p > 0.05$
Physical work	28	27.2	21	22.1	$p > 0.05$
Mixed physical and mental work	27	26.2	17	17.9	$p > 0.05$

$p < 0.01$ men vs. women

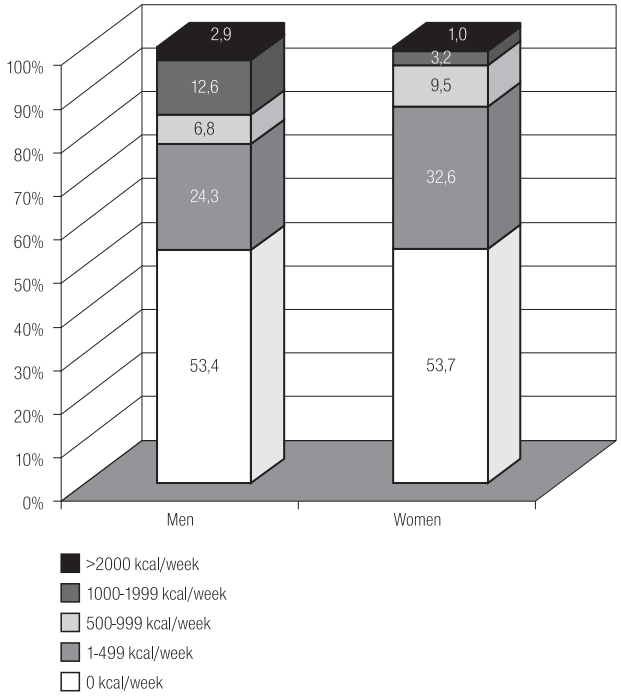

Fig. 1. Weekly energy expenditure (kcal/week) on leisure time physical activity among men and women.

(n = 8) and in the group with mixed activity 30% (n = 8) declared participation in leisure-time physical activity. In male white-collar employees, weekly energy expenditure was the highest 952 ± 853 kcal/week, in blue-collar workers the lowest – 142 ± 186 kcal/week and in man with mixed professional activity – 833 ± 508 kcal/week. In female white-collar workers – 32 (56%), in blue-collar workers – only 4 (19%) and in the group with mixed activity 8 (47%) persons participated in leisure time physical activity. In women, type of the work did not influence the level of leisure-time physical activity. In female white-collar workers this expenditure accounted for 484 ± 538 kcal/week, in blue-collar workers – 245 ± 183 kcal/week and in the group with mixed activity was 295 ± 171 kcal/week.

Energy expenditure on leisure-time physical activity diminished gradually with increasing workload. It was described as a percentage of VO_{2max} after calculation of energy expenditure at work and oxygen uptake, taking account of resting metabolism (1 MET). In the study group the workload was not very high because only 15 men and 8 women exceeded 30% of VO_{2max}, which means that they worked hard. In the male group with the workload up to 15% of VO_{2max} (n = 32), 15–30% of VO_{2max} (n = 13), and > 30% of VO_{2max} (n = 3) weekly energy expenditure on leisure-time physical activity amounted to 1017 ± 831 kcal, 420 ± 458 kcal and 90 ± 38 kcal, respectively. In the female group these values were at the levels of 489 ± 535 kcal (n = 31), 260 ± 251 (n = 22) and 321 kcal (n = 1), respectively.

Mean values of maximum oxygen uptake, VO_{2max} ($l \cdot min^{-1}$) were 2.8 ± 0.6 in men (n = 103) and 2.1 ± 0.6 in women (n = 95; $p < 0.001$). Mean relative values of VO_{2max} ($ml \cdot kg^{-1} \cdot min^{-1}$) amounted to 35.2 ± 7.8 in men and 35 ± 11.1 in women ($p > 0.005$).

In the whole study group, WAI was 41.4 ± 5.9 and did not significantly differ between men and women. To-

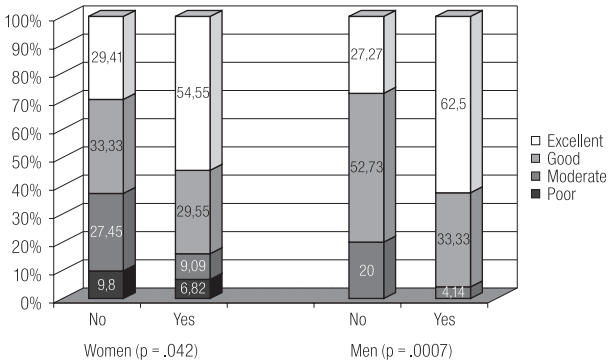

Fig. 2. Relationship between the work ability categories and participation in leisure-time physical activity.

Table 2. The work ablity index (WAI) and its item values in men and women

Items of work ability index	Men (n = 103)		Women (n = 95)		P Men vs. Women
	Mean	SD	Mean	SD	
Work ability compared with the lifetime best	8.3	1.5	7.9	1.1	p > 0.05
Work ability in relation to take up physical activity	4.3	0.8	4.2	0.0	p > 0.05
Work ability to mental effort	4.6	0.6	4.4	1.9	p < 0.05
Work ability to adjust to professional requirements	8.8	1.3	8.5	1.0	p > 0.05
The number of current diseases diagnosed by a physician	5.5	0.8	5.2	1.9	p = 0.05
Sick leave during the past year	4.0	1.0	4.0	0.1	p > 0.05
Estimated work impairment due to disease	6.5	1.0	6.3	0.8	p < 0.05
Self-estimated prognosis of work ability for two years on	6.3	0.9	5.8	2.0	p < 0.05
Mental resources	3.0	0.8	2.5	3.8	p < 0.0001
Work ability index	42.5	4.7	40.3	1.9	p > 0.05

tally, 42.4% of the examined persons obtained excellent and 38.9% – good assessment of the work ability index, whereas moderate and poor assessments were achieved by 16.2% and 4.6% of the participants, respectively. It should be emphasized that among persons who obtained poor assessment of the WAI there were only women. Table 2 presents the WAI values in men and women.

To answer the question whether leisure-time physical activity is associated with the level of work ability, the correlations between the general WAI, its items and leisure-time physical activity were calculated. Spearman rank correlation coefficient was used. This analysis indicated that correlations were positive and frequently high (Table 3). Correlation coefficient for the WAI and leisure-time physical activity was $r = 0.3$, $p < 0.0001$. The level of leisure-time physical activity had a significant impact on current work ability compared with the lifetime best, work ability to adjust to professional requirements, the number of current diseases diagnosed by a physician, sick leaves during the past year, and mental resources to work. Among persons who declared participation in leisure-time physical activity, the percentage of individuals with excellent work ability was significantly higher as compared with persons who did not take up any physical exercises (in the female group it was 54.5% vs. 29.4 $p = 0.04$, in the male group 62.5% vs. 27.3%; $p = 0.0007$; Fig. 2).

The correlation between WAI, its items and cardiorespiratory fitness was analyzed. It was noted that in the examined group these features were highly correlated. Correlation coefficient of WAI and maximal oxygen uptake ($ml \cdot kg^{-1} \cdot min^{-1}$) was $r = 0.4$, $p < 0.0001$ (Table 3).

The level of WAI in persons who took and did not take leisure-time physical activity was analyzed in relation to the type of workload (e.g., physical, mixed and mental). The obtained results indicated that blue-collar workers mostly benefited from participation in leisure-time physical activity (Fig. 3). The analyses of the level of WAI, depending on the workload presented as the percentage of VO_{2max}, also confirmed the above-mentioned hypothesis (Fig. 4). Similarly, in the previous analysis, individuals who worked hard mostly benefited from leisure-time physical activity, however, the differences were not statistically significant due to the small number of participants. Moreover, among women whose work was physically demanding, only one

Table 3. Statistically significant correlations between work ablity index (WAI), its items and the level of leisure-time physical activity (kcal/week) and maximal oxygen uptake VO_{2max} ($ml \cdot kg^{-1} \cdot min^{-1}$)

Items of work ability index	WAI and the leisure-time physical activity		WAI and maximal oxygen uptake	
	Men (n = 103)	Women (n = 95)	Men (n = 103)	Women (n = 95)
	r Spearman	r Spearman	r Spearman	r Spearman
Work ability compared with the lifetime best	0.199	0.291	0.318	0.482
Work ability in relation to take up physical activity	0.218		0.301	0.430
Work ability to mental effort	0.214	0.157	0.248	0.300
Work ability to adjust to professional requirements	0.300	0.220	0.357	0.392
The number of current diseases diagnosed by a physician	0.254	0.228	0.237	0.317
Sick leave during the past year	0.256	0.308		0.269
Estimated work impairment due to disease			0.222	
Self-estimated prognosis of work ability for two years on	0.252		0.246	0.357
Mental resources	0.250	0.241	0.205	0.266
Work ability index	0.310	0.302	0.368	0.465

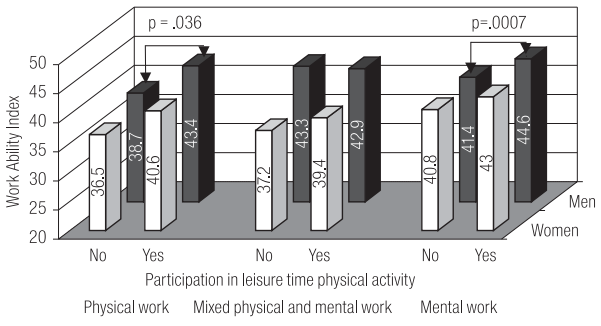

Fig. 3. WAI in persons who take and do not take up leisure-time physical activity in relation to the type of workload: physical, mixed (physical and mental), and mental.

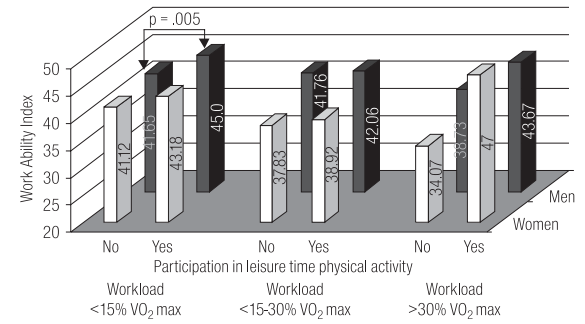

Fig. 4. WAI in persons who take and do not take up leisure-time physical activity in relation to difficulty of work presented as the percentage of VO_{2max}.

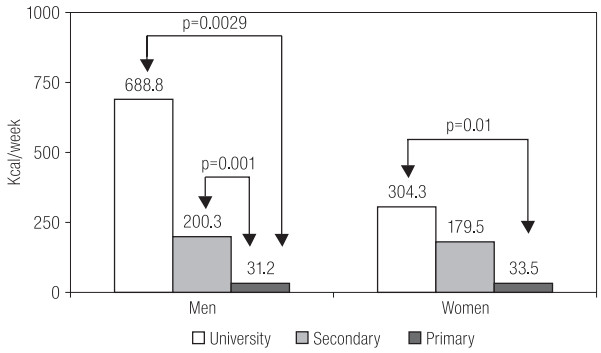

Fig. 5. Weekly energy expenditure (kcal/week) on leisure time physical activity in men and women with different levels of education.

of them admitted having practiced leisure-time physical activity.

Participation in leisure-time physical activity also depended on the education level in the study participants (Fig. 5).

A correlation between the general work ability index, age, and body mass index was also analyzed. A negative correlation between the age ($r = -0.6$, $p < 0.0001$), BMI ($r = -0.3$, $p < 0.0001$), and the general WAI was confirmed.

A correlation between leisure-time physical activity and cardiorespiratory fitness was also analyzed. Statistically significant correlation between leisure-time physical activity and cardiorespiratory fitness in men ($r = 0.5$, $p < 0.0001$) and women ($r = 0.4$, $p < 0.0001$) was confirmed.

DISCUSSION

The SDPAR questionnaire and subsequent calculations of energy expenditure in the study group were conducted in accordance with the formula [13]. The calculated amount of energy expenditure on leisure-time physical activity in the study group of the residents of Łódź did not significantly differ from the values expected in the properly designed study. The level of leisure-time physical activity in the examined group was significantly lower as compared with the study conducted by Makowiec-Dabrowska et al. [12]. In the presented study, 53.5% of participants did not take part in any leisure-time physical activity compared with 4% of individuals revealed in the aforesaid study [12]. In our study, 2% of persons expended 2000 kcal/week on leisure-time physical activity versus 20.6% of individuals examined by Makowiec-Dabrowska et al. [12]. The difference between characteristic features of the examined groups, various tools and measurement methods used by different authors could bring about a wide range of discrepancies in the results obtained. In the described study the level of physical activity was also lower than that reported by Kaleta et al. [16]. It applied particularly to participants with energy expenditure of 2000 kcal/week or more. In the study conducted by Kaleta et al. [16], 15.4% of participants (26.7% of males and 4% of females) expended 2000 kcal or more weekly on leisure-time physical activity. However, it should be emphasized that in both studies the groups were small and despite their random selection none appeared to be a representative sample for Łódź.

The mean WAI in the whole group was 41.4 ± 5.9 and the percentage of participants with excellent work ability amounted to 42.4%, which represented comparable values with those achieved by Ilmarinen [17] in workers from western countries.

Apparently the level of leisure-time physical activity shaped subjective work ability. The results of the present study, like those of other studies revealed that subjective assessment of work ability was highly correlated with the level of physical activity of the examined individuals. Moreover, the results of the previous studies indicated that the introduction of an adequately selected training schedule improved both physical endurance and WAI [8,9].

Our research confirmed that among blue-collar workers, especially those working hard, a certain reluctance to lei-

sure-time physical activity was common. In 2004, Kaleta et al. [18] revealed that 11.5% of the residents of Łódź reported physical work as a major reason for not taking up leisure-time physical activity. Our research confirmed that the blue-collar workers mostly benefited from leisure-time physical activity as compared with white-collar employees. In fact, a statistically significant difference could be observed only in men. There was also a significant difference between two groups ("yes" and "no") of white-collar employees, but the value was lower than that in blue-collar workers (Fig. 4). These data emphasize the need for focusing training schedules on blue-collar workers. It is crucial, in view of numerous unquestionable advantages of leisure-time physical activity among blue-collar workers reported in the medical literature, manifested not only by the increased subjective work ability but also by the declined risk for cardiovascular diseases [19].

CONCLUSIONS

1. The results of the present study reveal that in approximately 78% of the study subjects, physical activity was too low and did not reach the level recommended for the prevention of chronic diseases, especially cardiovascular diseases.
2. Despite the fact that the presented study comprises a small population (n = 198), the analysis of leisure-time physical activity and the work ability index emphasize the potential feasibility of improving the WAI and its items e.g., through the development, promotion, and broad use of training schedules. In the light of the previous studies, much attention should be given to the rationally selected type, volume and intensity of physical activity because this schedule can greatly contribute to the improvement of work ability through the increase in cardiorespiratory fitness.
3. Preventive schedules focused on the improvement of work ability through the increase in leisure-time physical activity should be addressed to employees at large, and to blue-collar workers, in particular.
4. In Poland and also in other member states of the European Union, workplace should play a significant role in the promotion of leisure-time physical activity. It is mandatory to diminish social and economic consequences of low physical activity in our country.

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