



ORIGINAL ARTICLE

Leisure-time Physical Activity of Polish White-collar Workers: A Cross-sectional Study



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Summary *Objective/background:* The aim of this study was to assess the leisure-time physical activity of Polish white-collar workers in relation to various health recommendations.

Methods: The study used a cross-sectional design with a convenience sample of 482 white-collar workers from Poland. Researchers recorded the leisure-time physical activity logs for 7 consecutive days of the week. Physical activity level was interpreted in relation to the World Health Organization and the American College of Sports Medicine recommendations.

Results: Among the workers, 42% of women and 53% of men declared moderate physical activity for at least 150 minutes per week, but only 23% of women and 18% men undertook activity in at least 5 days.

Conclusion: The results of the physical activity identified were significantly different from the American College of Sports Medicine and World Health Organization recommendations. The lower percentage of workers who met American College of Sports Medicine recommendations was caused by insufficient frequency of physical efforts.

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Conflicts of interest: All contributing authors declare that they have no conflicts of interest.

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Introduction

The health benefits of regular physical activity have been recognised and documented in numerous studies and scientific meta-analyses (Buffart et al., 2014; Li & Siegrist, 2012; Schmid et al., 2015; Stephens, Cobiac, & Veerman, 2014). They indicated that physical activity can be an effective tool in the prevention and treatment of the majority of noncommunicable diseases, which are the leading cause of death worldwide. The significant association between regular physical activity and all-cause mortality was also confirmed (Ekelund et al., 2015; Schmid, Ricci, & Leitzmann, 2015). Therefore, the diagnosis of the level of physical activity is an important task for the public health sector and enables precise identification of groups at high risk of hypokinetic diseases. Special attention should be given to the group of people whose level of physical activity at work is low. This group represents white-collar workers. It has been shown that white-collar occupations are important contributors to occupational sitting (De Cocker, Duncan, Short, van Uffelen, & Vandelanotte, 2014; Luyen, van der Ploeg, Bauman, Brug, & Lakerveld, 2016; Vandelanotte et al., 2015). In a study performed by Luyen et al. (2016), the odds ratio (OR) of sitting more than 7.5 hours per day was 5.00 for white-collar workers in comparison with manual workers (Hansen, Blangsted, Hansen, Sogaard, & Sjogaard, 2010). The other study by Hansen et al. (2010) found that white-collar workers who had been physically active at their leisure time perceived less stress and more energy.

The knowledge about health-related physical activity parameters (type, frequency, duration, and intensity) is disseminated in various physical activity recommendations. Currently, the recommendations disseminated by the World Health Organization (WHO) and the American College of Sports Medicine (ACSM) are the most popular in the world. In both recommendations mentioned above, a similar duration of weekly physical activity is promoted; however, the ACSM recommendations additionally contain the frequency criterion. One of the key differences between the discussed recommendations and the previously promoted recommendations (e.g., Instruction of International Physical Activity Questionnaire [IPAQ]) is to consider only moderate and vigorous physical activity. This is the result of numerous studies in which the health benefits of the activity of at least moderate intensity, especially vigorous physical activity, have been confirmed (Elliot et al., 2015; Gerber et al., 2014; Hupin et al., 2015; Loprinzi, 2015a).

It should be noted that the ACSM and WHO recommendations are related to the total physical activity. However, there is a need to separate the leisure-time physical activity from occupational physical activity. Many publications have shown that physical activity during work time might not be beneficial to health and may even be harmful. For example, Li, Loerbroks, and Angerer (2013), after analysing 23 epidemiological studies of adults ($n = 790,000$), proved that leisure-time physical activity is associated with a decreasing risk of cardiovascular disease, whereas moderate and vigorous occupational physical activity increases the risk of cardiovascular disease. In

addition, Harari, Green, and Zelber-Sagi (2015) emphasised that physical activity undertaken at work should not be treated as a substitute for leisure-time physical activity. Numerous studies have compared the level of leisure time and recreational physical activity with various health recommendations (Arem et al., 2015; Mynarski et al., 2014; Nawrocka, Pronczuk, Mynarski, & Garbaciak, 2012).

Therefore, assessment of physical activity that is beneficial for health should include primarily leisure time activity. It refers especially to white-collar workers who, due to dominant sedentary work style, can undertake regular physical activity mostly in their nonoccupational time.

Furthermore, some studies indicated that low occupational physical activity significantly translates into a lower level of leisure time physical activity (Clemes, O'Connell, & Edwardson, 2014; JaKa, Haapala, Wolfson, & French, 2015). By contrast, it should be noticed that white-collar workers are usually people with high socioeconomic status, which significantly increases the level of physical activity (Biernat & Tomaszewski, 2015; Puciato, Rozpara, Mynarski, Los, & Krolikowska, 2013).

The aim of this study was to assess the level of leisure-time physical activity among Polish white-collar workers in relation to health recommendations disseminated by the WHO and ACSM. The second aim was to compare the differences between the percentage of workers meeting the ACSM recommendations and that of workers meeting the WHO recommendations, and identify which particular criteria of recommendations were not complied with.

Materials and methods

This study has been assessed by the Bioethical Commission of the Jerzy Kukuczka Academy of Physical Education in Katowice, Poland. It used a cross-sectional design with a convenience sample of 482 white-collar workers, including 256 women and 226 men (mean $[M]_{age} = 36.15$ years, standard deviation $[SD]_{age} = 12$; $M_{body\ mass\ index} = 24.5$, $SD_{body\ mass\ index} = 4.31$). Detailed characteristics of respondents are shown in Table 1.

Participants were recruited from purposely selected corporations in South Poland. The inclusion criteria for the study were: consent to participate in research and understand the full research programme, professional activity as a white-collar worker, work experience of at least 2 years, and full-time employment. Initially, 506 workers from selected corporations agreed to participate in the research; however, participants who did not meet all inclusion criteria and those with missing data were excluded from analysis. As a result, 482 male and female workers who met the inclusion criteria with completed data were analysed. Owing to a lack of time and reluctance to participate in time-consuming research among white-collar workers, physical activity logs were used as a research tool (B. Ainsworth, Cahalin, Buman, & Ross, 2015). The choice of the research tool was also dictated by the fact that most of the standardised questionnaires, designed to assess physical activity, are related to the total volume of the physical activity, while those that allow for evaluation of only leisure-time physical activity

Table 1 Characteristic of the Participants.

Variables	N	%
Sex		
Women	256	53.1
Men	226	46.9
Age (y)		
<30	21	6.8
30–50	207	66.6
>50	83	26.7
BMI		
Underweight	7	1.5
Normal weight	277	57.5
Overweight	153	31.7
Obesity	45	9.3
Education		
Higher education	149	30.9
Secondary education	320	66.4
Vocational training	13	2.7
Period of service (y)		
<5	149	30.9
5–15	204	42.3
>15	129	26.8
All participants	482	100

Note. BMI = body mass index; y = year.

(such as IPAQ long) are complicated and time consuming. Furthermore, the structure of the IPAQ questionnaire does not allow for a precise reference of the results to the ACSM recommendations.

In this study, the leisure-time physical activity for 7 consecutive days of the week was recorded. Participants determined and recorded everyday the log duration (time) and intensity (low, moderate, and vigorous) of all physical activities lasting continuously for at least 10 minutes. The level of moderate and vigorous physical activity was calculated separately. Prior to the study, participants received a detailed instruction on the proper completion of the logs. In order to facilitate the identification of the level of intensity of physical activity efforts, short definitions of physical activity and some typical activities with different levels of intensity based on the Compendium of Physical Activities were given to participants (Ainsworth et al., 2011).

Physical activity level was interpreted in relation to the ACSM and WHO recommendations. Assessment of partial and overall recommendations classifies respondents as those who “meet” versus those who did “not meet” recommendations. The overall recommendations were met by the respondents who met at least one of the recommendation’s criteria. The following recommendations were adopted:

1. ACSM: criteria of moderate physical activity (at least 5 days/week, and at least 30 min/day) and vigorous physical activity (at least 3 days/week and at least 20 min/day)
2. WHO: criteria of moderate physical activity (at least 150 min/week) and vigorous physical activity (at least 75 min/week)

Statistical analysis

For the quantitative variables, the basic parameters of descriptive statistics were calculated: *M* and *SD*. To assess the differences of physical activity level between men and women, univariate analysis of variance was used for quantitative variables and chi-square tests for qualitative variables. Multivariate logistic regression was used to verify which particular physical activity parameters (time and frequency) determined that recommendations of ACSM were met. Analyses were performed using IBM SPSS 20 software (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp). A *p* value of <.05 was set at a significance level of 5%.

Results

Female white-collar workers significantly more declared physical activity of moderate intensity in their leisure time as compared with male workers ($p < .05$); however, its duration was significantly shorter ($p < .005$; Table 1). Women also declared a longer period of low-intensity activity. However, low physical activity was irrelevant in the context of the WHO and ACSM recommendations.

In total, 42% of women and 53% of men declared moderate physical efforts for at least 150 minutes per week, but only 23% of women and 18% men accumulated them in at least 5 days (Table 2). Recommendations of health-related physical activity by the ACSM were met by 41% of the respondents (39.7% women and 42.5% men), and the WHO recommendations were met by 68% of the respondents (63.4% women and 74% men). In reference to the ACSM recommendations, regardless of gender, a slightly higher percentage of employees met the criterion associated with vigorous physical activity than that associated with moderate physical activity. In the case of WHO recommendations, most participants met the criterion of moderate intensity.

In relation to both partial and total criteria of ACSM recommendations, there were no significant differences in physical activity between male and female workers. In the case of the WHO recommendations, it was found that men significantly more often met the criterion of moderate intensity (OR = 1.590; 95% confidence interval [CI] 1.109–2.279; $p < .05$) and overall recommendations (OR = 1.596; 95% CI 1.081–2.355; $p < .05$; Table 3).

Significant differences were noticed in the percentage of workers meeting the ACSM and WHO recommendations in both female and male workers (Figure 1). Regardless of similar recommended duration of physical activity, the WHO recommendations were met by a higher number of employees (68%) than the ACSM recommendations (41%). It was associated with the frequency criterion of physical effort recommended by the ACSM.

Multivariate logistic regression analysis confirmed that the most significant parameter in meeting the ACSM recommendations was frequency of moderate (OR = 2.330, 95% CI 1.681–3.231) and vigorous (OR = 11.863; 95% CI 5.889–23.899) physical activity (Table 4). Participants’ duration of the moderate and vigorous physical efforts, which is the main criterion of health recommendations

Table 2 Parameters of Leisure-time Physical Activity.

Physical activity parameters	Female workers (n = 256)			Male workers (n = 226)			Total (n = 482)		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
VPA (d/wk)	153	2.80	1.60	108	3.18	1.52	261	2.96	1.58
VPA (min/d)	153	65.25	52.67	108	63.26	32.31	261	64.43	45.31
VPA (min/wk)	153	194.1	234.5	108	206.1	162.2	261	199.1	207.4
MPA (d/wk)	225	3.47*	1.90	209	3.03*	1.68	434	3.26	1.81
MPA (min/d)	225	62.3**	58.47	209	79.83**	44.32	434	70.76	52.81
MPA (min/wk)	225	215.8	241.6	209	238.2	196.9	434	226.6	221.2
LPA (d/wk)	238	5.37	1.92	207	5.22	2.08	445	5.30	2.00
LPA (min/d)	238	107.6**	101.66	207	76.59**	67.79	445	93.16	88.81

Note. d = day; LPA = low physical activity; MPA = moderate physical activity; SD = standard deviation; VPA = vigorous physical activity; wk = week.

* $p < .05$. ** $p < .005$.

Table 3 Sex Differences of Meeting Partial and Total Criteria of Physical Activity Recommended by the ACSM and WHO.

Meeting of recommendations	Female workers (n = 256)		Male workers (n = 226)		Total (n = 482)		Chi	OR women/men (95% CI)	p	
	N	%	N	%	N	%				
ACSM										
VPA criteria	No	194	75.5	160	70.8	354	73.3	1.351	1.270 (0.848–1.902)	.258
	Yes	63	24.5	66	29.2	129	26.7			
MPA criteria	No	197	76.7	184	81.4	381	78.9	1.637	0.749 (0.481–1.167)	.220
	Yes	60	23.3	42	18.6	102	21.1			
Total recommendation	No	155	60.3	130	57.5	285	59.0	0.387	1.122 (0.78–1.614)	.578
	Yes	102	39.7	96	42.5	198	41.0			
WHO										
VPA criteria	No	143	55.6	138	61.1	281	58.2	1.452	0.800 (0.556–1.15)	.231
	Yes	114	44.4	88	38.9	202	41.8			
MPA criteria	No	149	58.0	105	46.5	254	52.6	6.397	1.590 (1.109–2.279)	.014
	Yes	108	42.0	121	53.5	229	47.4			
Total recommendation	No	94	36.6	60	26.5	154	31.9	5.567	1.596 (1.081–2.355)	.019
	Yes	163	63.4	166	73.5	329	68.1			

Note. ACSM = American College of Sports Medicine; CI = confidence interval; MPA = moderate physical activity; OR = odds ratio; VPA = vigorous physical activity; WHO = World Health Organization.

disseminated by the WHO, did not play a significant role in meeting the ACSM recommendations.

Discussion

Leisure-time physical activity is an important occupation in the prevention and treatment of noncommunicable diseases, especially among white-collar workers whose level of occupational activity is low. In this study, we assessed leisure-time physical activity of white-collar workers in relation to the ACSM and WHO health recommendations, and identified the differences between the type of recommendation and the percentage of respondents undertaking health-related physical activity.

The results indicated that the percentage of white-collar workers meeting the criteria of the ACSM (41%) was significantly different from that meeting the criteria of the WHO (68%). Such a large variation may be surprising due to the

similarities of the compared recommendations, especially the recommended duration (time) of weekly moderate and vigorous physical activity. However, in the ACSM recommendations, there is also a criterion of frequency for both moderate activity (>5 days/week) and vigorous activity (>3 days/week). The decrease in frequency was significantly in white-collar workers who met the ACSM recommendations.

Similar results were obtained by [Scheers, Philippaerts, and Lefevre \(2013\)](#). They found that 87.2% of men and 68.1% women undertook moderate to vigorous physical activity for at least 150 minutes per week (WHO), but only 57.6% and 37.3% of them accumulated efforts for at least 30 min/day on ≥ 5 days/week (ACSM). Similar differences were found in the criterion of vigorous intensity—27.9% of men and 15.7% women met the WHO criteria, and only 12.8% and 7% of them met the ACSM criteria. The frequency criterion, on average, reduced the percentage of persons meeting the recommendations by half. Similar tendencies can be noticed in our study. A total of 42% of women and

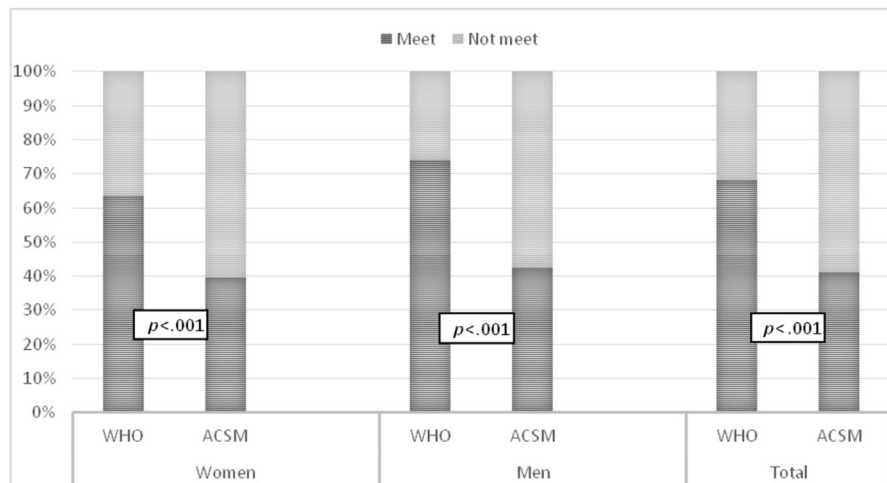


Figure 1 Differences between white-collar workers meeting the ACSM recommendations and those meeting the WHO recommendations. *Note.* ACSM = American College of Sports Medicine; WHO = World Health Organization.

Table 4 Multivariate Logistic Regression of Variables Associated with Meeting ACSM Recommendations.

		B	SE	Wald	p	OR	(95% CI)	
						Lower		Upper
Step 1 ^a	VPA (d/wk)	2.510	.365	47.191	<.001	12.303	6.012	25.178
	VPA time (min/d)	0.007	.007	0.899	.343	1.007	0.993	1.020
	MPA (d/wk)	0.906	.178	26.044	<.001	2.475	1.748	3.506
	MPA (min/d)	0.002	.005	0.126	.722	1.002	0.993	1.011
Step 2 ^a	VPA (d/wk)	2.473	.357	47.905	<.001	11.863	5.889	23.899
	MPA (d/wk)	0.846	.167	25.748	<.001	2.330	1.681	3.231

Note. ACSM = American College of Sports Medicine; B = coefficient; CI = confidence interval; d = day; MPA = moderate physical activity; OR = odds ratio; SE = standard error; VPA = vigorous physical activity; wk = week.

^a Variables entered on Step 1: VPA (days/week), VPA time (min/day), MPA (days/week), MPA (min/day).

53% men reported moderate physical activity for at least 150 min/week, but only 23% of women and 18% men accumulated the activity in at least 5 days. However, in comparison to other studies, the percentage of participants meeting the WHO and ACSM recommendations in our study is much lower in both women and men. This is probably due to the effect of including, in our study, only leisure-time physical activity was counted and specificity of the study group was consisted exclusively of white-collar workers. Many studies have indicated that people who have a sedentary job rarely undertake regular leisure-time physical activity (Clemes et al., 2014; JaKa et al., 2015).

It may be noticed from our results that the frequency is an important parameter of physical activity. A lot of studies indicated the relationship between the frequency of physical effort and the health condition (Brown, Riddell, Macpherson, Canning, & Kuk, 2013; McDonnell et al., 2013). Loprinzi (2015b), on the basis of objective monitoring of physical activity as part of The National Health and Nutrition Examination Survey (NHANES) ($N = 2,330$ adults, ≥ 20 years of age), found that the frequency of moderate physical activity is more associated with the reduction of the inflammation expressed in C-reactive

protein than the total moderate and vigorous physical activity volume per week.

Study limitations

The main limitation of this study was using the subjective methods of physical activity assessment (self-assessment), which might result in overestimation of physical activity level. The second limitation was a small sample of convenience and a lack of precise information about occupations, work tasks, and sociodemographic situations.

Conclusions and implication for further research

Assessment of physical activity level and verification of meeting global recommendations for health helps to monitor insufficient physical activity which is one of the main non-communicable disease risk factors. Owing to the occupational sitting, white-collar workers belong to the study group are at high risk of insufficient physical activity. Although recommendations disseminated by the WHO and ACSM

promote the minimal dose of physical activity beneficial for health, the level of health-related physical activity in the study group of white-collar workers was low. The lower percentage of workers who met the ACSM recommendations was due to insufficient frequency of physical efforts.

Further studies should focus more on assessing the impact of individual parameters of physical activity on health, and above all, on frequency and various intensity of physical activity, rather than the total weekly volume of moderate and vigorous physical activity.

In this study, we identified the criteria of physical activity recommendations that are mostly not complied with by white-collar workers in the study population in Poland. This can be a guideline for employers and occupational therapists to design and implement health programmes for promoting physical activity for white-collar workers. In these programmes, frequency of physical activity (regular activity in the week), in particular, should be promoted.

References

- Ainsworth, B., Cahalin, L., Buman, M., & Ross, R. (2015). The current state of physical activity assessment tools. *Progress in Cardiovascular Diseases, 57*, 387–395.
- Ainsworth, B. E., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R., Jr., Tudor-Locke, C., et al. (2011). Compendium of physical activities: a second update of codes and MET values. *Medicine and Science in Sports and Exercise, 43*, 1575–1581.
- Arem, H., Moore, S. C., Patel, A., Hartge, P., Berrington de Gonzalez, A., Viswanathan, K., et al. (2015). Leisure time physical activity and mortality: a detailed pooled analysis of the dose–response relationship. *JAMA Internal Medicine, 175*, 959–967.
- Biernat, E., & Tomaszewski, P. (2015). Association of socio-economic and demographic factors with physical activity of males and females aged 20–69 years. *Annals of Agricultural and Environmental Medicine, 22*, 118–123.
- Brown, R. E., Riddell, M. C., Macpherson, A. K., Canning, K. L., & Kuk, J. L. (2013). The association between frequency of physical activity and mortality risk across the adult age span. *Journal of Aging and Health, 25*, 803–814.
- Buffart, L. M., Singh, A. S., van Loon, E. C., Vermeulen, H. I., Brug, J., & Chinapaw, M. J. (2014). Physical activity and the risk of developing lung cancer among smokers: a meta-analysis. *Journal of Science and Medicine in Sport, 17*, 67–71.
- Clemes, S. A., O'Connell, S. E., & Edwardson, C. L. (2014). Office workers' objectively measured sedentary behavior and physical activity during and outside working hours. *Journal of Occupational and Environmental Medicine, 56*, 298–303.
- De Cocker, K., Duncan, M. J., Short, C., van Uffelen, J. G., & Vandelandotte, C. (2014). Understanding occupational sitting: prevalence, correlates and moderating effects in Australian employees. *Preventive Medicine, 67*, 288–294.
- Ekelund, U., Ward, H. A., Norat, T., Luan, J., May, A. M., Weiderpass, E., et al. (2015). Physical activity and all-cause mortality across levels of overall and abdominal adiposity in European men and women: the European Prospective Investigation into Cancer and Nutrition Study (EPIC). *American Journal of Clinical Nutrition, 101*, 613–621.
- Elliot, C., Lang, C., Brand, S., Holsboer-Trachsler, E., Puhse, U., & Gerber, M. (2015). The relationship between meeting vigorous physical activity recommendations and burnout symptoms among adolescents: an exploratory study with vocational students. *Journal of Sport & Exercise Psychology, 37*, 180–192.
- Gerber, M., Brand, S., Herrmann, C., Colledge, F., Holsboer-Trachsler, E., & Puhse, U. (2014). Increased objectively assessed vigorous-intensity exercise is associated with reduced stress, increased mental health and good objective and subjective sleep in young adults. *Physiology and Behavior, 135*, 17–24.
- Hansen, A. M., Blangsted, A. K., Hansen, E. A., Sogaard, K., & Sjogaard, G. (2010). Physical activity, job demand-control, perceived stress-energy, and salivary cortisol in white-collar workers. *International Archives of Occupational and Environmental Health, 83*, 143–153.
- Harari, G., Green, M. S., & Zelber-Sagi, S. (2015). Combined association of occupational and leisure-time physical activity with all-cause and coronary heart disease mortality among a cohort of men followed-up for 22 years. *Occupational and Environmental Medicine, 72*, 617–624.
- Hupin, D., Roche, F., Gremeaux, V., Chatard, J. C., Oriol, M., Gaspoz, J. M., et al. (2015). Even a low-dose of moderate-to-vigorous physical activity reduces mortality by 22% in adults aged ≥ 60 years: a systematic review and meta-analysis. *British Journal of Sports Medicine, 49*, 1262–1267.
- JaKa, M. M., Haapala, J. L., Wolfson, J., & French, S. A. (2015). Describing the relationship between occupational and non-occupational physical activity using objective measurement. *Preventive Medicine Report, 2*, 213–217.
- Li, J., Loerbroks, A., & Angerer, P. (2013). Physical activity and risk of cardiovascular disease: what does the new epidemiological evidence show? *Current Opinion in Cardiology, 28*, 575–583.
- Li, J., & Siegrist, J. (2012). Physical activity and risk of cardiovascular disease—a meta-analysis of prospective cohort studies. *International Journal of Environmental Research and Public Health, 9*, 391–407.
- Loprinzi, P. D. (2015a). Dose–response association of moderate-to-vigorous physical activity with cardiovascular biomarkers and all-cause mortality: Considerations by individual sports, exercise and recreational physical activities. *Preventive Medicine, 81*, 73–77.
- Loprinzi, P. D. (2015b). Frequency of moderate-to-vigorous physical activity (MVPA) is a greater predictor of systemic inflammation than total weekly volume of MVPA: implications for physical activity promotion. *Physiology and Behavior, 141*, 46–50.
- Loyen, A., van der Ploeg, H. P., Bauman, A., Brug, J., & Lakerveld, J. (2016). European sitting championship: prevalence and correlates of self-reported sitting time in the 28 European Union member states. *PLoS One, 11*, e0149320.
- McDonnell, M. N., Hillier, S. L., Hooker, S. P., Le, A., Judd, S. E., & Howard, V. J. (2013). Physical activity frequency and risk of incident stroke in a national US study of blacks and whites. *Stroke, 44*, 2519–2524.
- Mynarski, W., Grabara, M., Nawrocka, A., Niestroj-Jaworska, M., Wolkowycza, B., & Cholewa, J. (2014). Physical recreational activity and musculoskeletal disorders in nurses. *Medycyna Pracy, 65*, 181–188. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/25090847>.
- Nawrocka, A., Pronczuk, A., Mynarski, W., & Garbaciak, W. (2012). Physical activity of top level managers in the context of the public health recommendations. *Medycyna Pracy, 63*(3), 271–279. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/22880449>.
- Puciato, D., Rozpara, M., Mynarski, W., Los, A., & Krolikowska, B. (2013). Physical activity of adult residents of Katowice and selected determinants of their occupational status and socio-economic characteristics. *Medycyna Pracy, 64*, 649–657. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/24502128>.
- Scheers, T., Philippaerts, R., & Lefevre, J. (2013). Compliance with different physical activity recommendations and its association with socio-demographic characteristics using an objective measure. *BMC Public Health, 13*, 136.

- Schmid, D., Behrens, G., Keimling, M., Jochem, C., Ricci, C., & Leitzmann, M. (2015). A systematic review and meta-analysis of physical activity and endometrial cancer risk. *European Journal of Epidemiology*, *30*, 397–412.
- Schmid, D., Ricci, C., & Leitzmann, M. F. (2015). Associations of objectively assessed physical activity and sedentary time with all-cause mortality in US adults: the NHANES study. *PLoS One*, *10*, e0119591.
- Stephens, S. K., Cobiac, L. J., & Veerman, J. L. (2014). Improving diet and physical activity to reduce population prevalence of overweight and obesity: an overview of current evidence. *Preventive Medicine*, *62*, 167–178.
- Vandelanotte, C., Short, C., Rockloff, M., Di Millia, L., Ronan, K., Happell, B., et al. (2015). How do different occupational factors influence total, occupational, and leisure-time physical activity? *Journal of Physical Activity and Health*, *12*, 200–207.