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Relationship between level of physical activity assessed by the GPAQ questionnaire and subjective lower limb complaints in medical students of the Silesian Medical University in Katowice, Poland

Związek pomiędzy poziomem aktywności fizycznej ocenianym kwestionariuszem GPAQ a subiektywnymi dolegliwościami kończyn dolnych u studentów medycyny Śląskiego Uniwersytetu Medycznego w Katowicach

Agnieszka Włodarczyk[1,A-D,F] ✉, Patrycja Dolibog[1,A,C,E-F], Tomasz Pryzwan[1,B-C,F], Kacper Kotyla[1,B]

[1] *Department of Medical Biophysics, Faculty of Medical Sciences, Medical University of Silesia, Katowice, Poland*
A – Research concept and design, B – Collection and/or assembly of data, C – Data analysis and interpretation, D – Writing the article, E – Critical revision of the article, F – Final approval of the article

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Abstract

Introduction. Physical activity plays a significant role in maintaining healthy circulatory system function, but its relation to subjectively experienced lower limb symptoms in young adults remains poorly understood. The aim of this study was to assess the relationhip between levels of physical activity as determined by the Global Physical Activity Questionnaire (GPAQ), and the occurrence and severity of subjective lower limb symptoms in young adults.

Materials and Method. The study included 194 medical students at the Medical University of Silesia in Katowice. Physical activity levels were assessed using the GPAQ questionnaire, and total activity was calculated in MET units according to WHO guidelines. Respondents were divided into four groups. The relationship between physical activity levels and the occurrence of lower limb pain, its severity after prolonged sitting, change after training, and change in leg appearance after a break in activity was analyzed. Statistical analysis was performed using Pearson's chi-square test and Fisher's exact test ($p<0.05$).

Results. No statistically significant correlations were found between the level of physical activity and the occurrence of lower limb complaints, worsening of symptoms after prolonged sitting, change in symptoms after training, or change in the appearance of the legs after a break from physical activity.

Conclusions. These results suggest the need to expand future research to include objective haemodynamic parameters and examination of lower limb muscle function, which may enable a more comprehensive assessment of the impact of physical activity on circulatory system function.

Key words

physical activity, Global Physical Activity Questionnaire (GPAQ), lower limb symptoms, lower limb pain, medical students

Streszczenie

Wprowadzenie i cel pracy. Aktywność fizyczna odgrywa istotną rolę w utrzymaniu prawidłowej funkcji układu krążenia, ale jej związek z subiektywnie odczuwanymi objawami ze strony kończyn dolnych u młodych dorosłych pozostaje słabo poznany. Celem niniejszego badania była ocena związku między poziomem aktywności fizycznej, określonym za pomocą Globalnego Kwestionariusza Aktywności Fizycznej (GPAQ), a występowaniem i nasileniem subiektywnych objawów ze strony kończyn dolnych u młodych dorosłych.

Materiał i metody. Badaniem objęto 194 studentów kierunku lekarskiego Śląskiego Uniwersytetu Medycznego w Katowicach. Poziom ich aktywności fizycznej oceniono z wykorzystaniem kwestionariusza GPAQ, a całkowitą aktywność obliczono w jednostkach MET zgodnie z wytycznymi Światowej Organizacji Zdrowia (WHO). Respondentów podzielono na cztery grupy, którymi były: grupa niewykazująca żadnej aktywności oraz grupy o niskiej, umiarkowanej i wysokiej aktywności fizycznej. Analizowano zależność pomiędzy poziomem aktywności fizycznej a występowaniem dolegliwości kończyn dolnych, ich nasileniem po długotrwałym siedzeniu, zmianą po treningu oraz zmianą wyglądu nóg po przerwie od aktywności. Analizę statystyczną przeprowadzono z wykorzystaniem testu chi^2 Pearsona oraz dokładnego testu Fishera ($p < 0,05$).

✉ Address for correspondence: Agnieszka Włodarczyk, Department of Medical Biophysics, Faculty of Medical Sciences, in Katowice, Medical University of Silesia, Katowice, Poland
E-mail: awlodarczyk@sum.edu.pl

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Wyniki. Nie stwierdzono statystycznie istotnych korelacji między poziomem aktywności fizycznej a występowaniem dolegliwości kończyn dolnych, nasileniem objawów po długotrwałym siedzeniu, zmianą objawów po treningu ani zmianą wyglądu nóg po przerwie w aktywności fizycznej.
Wnioski. Wyniki te sugerują potrzebę rozszerzenia przyszłych badań o obiektywne parametry hemodynamiczne i badanie funkcji mięśni kończyn dolnych, co może umożliwić kompleksową ocenę wpływu aktywności fizycznej na funkcjonowanie układu krążenia.

Słowa kluczowe

aktywność fizyczna, Globalny Kwestionariusz Aktywności Fizycznej (GPAQ), objawy ze strony kończyn dolnych, ból kończyn dolnych, studenci kierunków medycznych

INTRODUCTION

The circulatory system plays a crucial role in maintaining normal haemodynamics, transporting blood from the heart to tissues via the arteries, and from tissues to the heart via the venous system, which also serves as the primary blood reservoir. Unlike arteries, whose primary function is to transport blood from the heart to tissues under high pressure generated by cardiac contraction, veins operate as a low-pressure system. Therefore, they have thinner walls, a larger lumen, and venous valves that prevent blood backflow, particularly in the lower limbs. This translates into the high susceptibility of veins to changes in diameter and allows for the storage of significant volumes of blood with only minor changes in pressure [1, 2]. In the standing position, venous blood in the lower limbs must overcome gravity, among other forces, therefore venous valves play a key role in maintaining unidirectional flow. Deep and superficial veins contain a series of unidirectional bicuspid valves that open to allow blood flow towards the heart but close to prevent backflow towards the feet [3]. Effective venous return also requires the activity of the calf muscle pump, which supports the transport of blood from the lower limbs towards the heart [4]. It is defined as the driving force of blood overcoming gravity [5]. Contractions of the muscle pumps, primarily in the calf, push blood towards the heart [3]. Muscle activity also increases shear stress on the vascular endothelium. This mechanism stimulates the production of nitric oxide (NO), which improves endothelial function and supports the regulation of vascular tone [6]. Prolonged standing increases venous blood retention in the lower limbs and increases hydrostatic pressure, which can lead to venous dilation [4]. Therefore, limited muscle activity may impair venous outflow and contribute to the development of functional symptoms such as heaviness and oedema [5].

Lack of exercise is therefore considered the main factor leading to morphological and functional venous abnormalities, i.e., chronic venous disease (CVD) [7]. Physical activity is defined as rhythmic movement of the body's muscles over a prolonged period of time. Aerobic (endurance) activity has been shown to improve cardio-respiratory fitness. Examples of aerobic activity include walking, running, swimming, and cycling [8]. Aerobic training in men who have been active since childhood has been shown to slow the aging of lower limb blood vessels. This demonstrates that practices that increase maximal oxygen uptake (O2max), initiated at a young age, may be effective in protecting the circulatory system from the negative effects of physical inactivity [9].

In 2020, for the first time, detailed WHO recommendations were presented for specific population groups, including pregnant and postpartum women and people living with chronic diseases or disabilities [8]. For the age group 18–64, 150–300 minutes of moderate activity per week or 75–150 minutes of vigorous activity are recommended. Additionally, muscle-strengthening activities performed two or more times per week provide evidence-based health benefits [8]. However, the WHO guidelines do not address sedentary thresholds or early, subclinical symptoms such as heaviness or fatigue in the lower limbs. Therefore, it is reasonable to conduct studies based on the assessment of subjective symptoms in relation to physical activity levels. This would allow for the individualized recommendation of the type and frequency of physical activity [10]. Despite numerous studies on physical activity and cardiovascular health, few studies have examined the relation between physical activity levels and subjectively experienced lower limb symptoms in young adults. Data on the medical student population are particularly limited.

OBJECTIVE

The aim of the study is to assess the relationship between physical activity levels, as determined by the GPAQ questionnaire, and the occurrence and severity of subjective lower limb symptoms in the study population. This study is an introduction to a series of studies examining the relationship between physical activity levels, haemodynamic parameters of the lower limbs, muscle strength, and subjectively perceived lower limb symptoms in young adults. Specific objectives:

1) Assessment of the level of physical activity of the surveyed persons based on the results of the GPAQ questionnaire.
2) Assessment of the frequency and severity of subjective lower limb complaints.
3) Comparison of the severity of symptoms between groups with different levels of physical activity (high, moderate, low).
4) Assessment of the relationship between the level of physical activity and the frequency of lower limb symptoms.

MATERIALS AND METHOD

The Global Physical Activity Questionnaire (GPAQ) was used to assess respondents' levels of physical activity. This test provides a protocol for monitoring physical activity engagement at the population level with self-assessment and interview modes [11]. It was developed by the World Health Organization (WHO) in response to increased interest in the role of physical activity in health in 2002 [11].

Medical students were selected for screening because they are exposed to a sedentary lifestyle related to their studies, periodic prolonged standing due to clinical duties, high levels

of stress, and an irregular lifestyle. The combination of these factors may contribute to venous circulation disorders in young adulthood, even before the onset of clinical symptoms of chronic venous disease, making this group particularly important for early diagnosis and prevention.

The study included 194 medical students at the Medical University of Silesia in Katowice. The first part used the standardized Global Physical Activity Questionnaire (GPAQ) to assess the participants' level of physical activity. The second part collected data on subjectively experienced lower limb circulatory complaints. The obtained results were statistically analyzed to determine the relation between physical activity levels and the subjectively assessed condition of the lower limb circulatory system. One MET is defined as the energy expenditure during quiet sitting and is equivalent to a calorie expenditure of 1 kcal/kg/hour [12].

Based on the Global Physical Activity Questionnaire (GPAQ), the total weekly physical activity (MET) was calculated, thanks to which the subjects were divided into 4 groups characterized by: no activity, low activity, moderate activity, high activity. Physical activity level was calculated based on metabolic equivalent (MET) values, in accordance with the WHO guidelines included in the GPAQ. A value of 4.0 METs was assumed for moderate work-related activity, mobility-related activity (walking and cycling), and moderate recreational activity. A value of 8.0 METs was assumed for vigorous work-related activity and vigorous recreational activity [13].

Statistics. The data obtained in the study were statistically analyzed using Statistica 13.0 software. Fisher's exact test and Pearson's chi-square test were used for comparisons between groups. Results were presented in tables and graphs, allowing for a clear visualization of the identified relations and differences. Results with a p-value less than 0.05 were considered statistically significant.

RESULTS

The study involved 194 medical students (Fig. 1), of whom (48.45%) showed moderate levels of MET activity, 67 (34.54%) showed high levels, and 20 (10.31%) showed low levels, and 13 (6.7%) showed no activity.

119 participants did not experience any lower limb symptoms, including 58 participants (48.74%) with moderate activity and 44 participants (36.97%) with high activity. The highest percentage of symptoms occurred in participants with low activity (30%; 6 out of 20 participants), while the lowest in those with moderate activity (22.3%; 21 out of 94 participants). However, the differences between the groups were small and did not reach statistical significance (p = 0.803; Pearson's chi-square test) (Tab. 1). Twenty-nine respondents selected the 'difficult to say' response, indicating a lack of certainty regarding their answer.

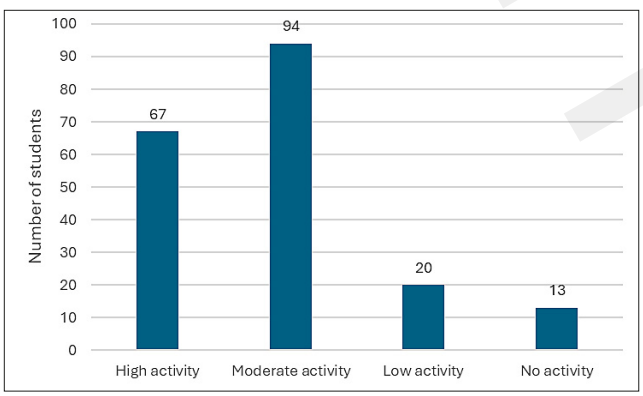


Figure 1. MET physical activity levels among the medical students

Table 1. Analysis of the relationship between the level of MET activity and occurrence of lower limb complaints

MET activity	Do you experience any discomfort in your lower limbs?			
	No	Yes	Difficult to determine	Total
High activity	44	16	7	67
%	36.97%	34.78%	24.14%	
Moderate activity	58	21	15	94
%	48.74%	45.65%	51.72%	
Low activity	10	6	4	20
%	8.40%	13.04%	13.79%	
No activity	7	3	3	13
%	5.88%	6.52%	10.34%	
Total	119	46	29	194

Due to the fact that the 'not applicable' response referred to 53 individuals who did not report lower limb symptoms, they were excluded from the analysis, and one respondent who did not respond was also excluded. The observed differences did not reach statistical significance (p = 0.08; Pearson's chi-square test) (Tab. 2). More than half of the moderately active group reported worsening symptoms after prolonged sitting (53.7%; 36 of 67 individuals), while in the low-activity group, this percentage was 46.2% (6 of 13 individuals). In 54 individuals, symptoms did not worsen after prolonged sitting.

Table 2. Analysis of the relationship between level of MET activity and the severity of symptoms after prolonged sitting

MET activity	Do symptoms worsen after prolonged sitting?			
	No	Difficult to determine	Yes	Total
High activity	24	10	17	51
%	44.44%	38.46%	28.33%	
Moderate activity	22	9	36	67
%	40.74%	34.62%	60.00%	
Low activity	4	3	6	13
%	7.41%	11.54%	10.00%	
No activity	4	4	1	9
%	7.41%	15.38%	1.67%	
Total	54	26	60	140

The Pearson chi-square test (p=0.518) did not show a statistically significant relation between the level of physical activity and the change in symptoms after training (Tab. 3). Participants who showed a lack of physical activity (13 people) and 73 who marked the answer 'not applicable' were excluded from the analysis. In 32 participants, the symptoms disappeared after a few days of physical activity, including 13 (40.62%) with high activity and 15 (46.88%) with moderate activity. 35 respondents marked the answer

Table 3. Analysis of the relationship between MET activity level and post-training complaints

MET activity	How do the discomforts you experience change after training?					
	Subside after a few days of activity	Difficult to determine	No change	Worsen	Stop immediately after training	Total
High activity	13	7	8	3	5	36
%	40.62%	20%	44.44%	42.86%	31.25%	
Moderate activity	15	21	8	4	10	58
%	46.88%	60%	44.44%	57.14%	62.5%	
Low activity	4	7	2	0	1	14
%	12.5%	20%	11.11%	0.00%	6.25%	
Total	32	35	18	7	16	108

'difficult to say', which may suggest that they were not sure whether the symptoms occurred after training.

Pearson's chi-square test (p=0.537) did not reveal a statistically significant relationship between the level of physical activity and changes in leg appearance after at least a three-week break from physical activity (Tab. 4). The analysis excluded 13 participants who were physically inactive and 76 who selected 'not applicable'. Eighty-nine participants did not notice changes in leg appearance after a longer break from physical activity, including 51 (57.3%) who were moderately active and 26 (29.21%) who were highly active. Swelling increased in 10 participants, and decreased in 6.

Table 4. Analysis of the relationship between the level of MET activity and change in the appearance of the legs after a break from physical activity

MET activity	Have you noticed a change in the appearance of your legs after a longer break (at least 3 weeks) from physical activity?			
	Do not see the difference	More swollen	Less swollen	Total
High activity	26	2	2	30
%	29.21%	20.00%	33.33%	
Moderate activity	51	5	4	60
%	57.30%	50.00%	66.67%	
Low activity	12	3	0	15
%	13.48%	30.00%	0.00%	
Total	89	10	6	105

DISCUSSION

The study assessed the relationship between physical activity levels determined using the GPAQ questionnaire and the occurrence of subjective lower limb symptoms. The study did not demonstrate a statistically significant relation between physical activity levels (METs) and the occurrence of lower limb symptoms. The results partially correspond to a 2021 article that also found no significant relation between physical activity levels and the severity of lower limb symptoms in the study group [14]. The results suggest that the lack of correlation between physical activity levels and subjective lower limb symptoms observed in this study may be due to the fact that the symptoms experienced are influenced by many factors, not just those related to the circulatory system. This indicates the need to supplement future research with objective parameters assessing vascular and muscular function of the lower limbs. Additionally, it should be noted that symptoms often attributed to venous diseases may not be specific for these conditions, and the correlation between the severity of symptoms and the advancement of the disease may be weak [14, 15]. These observations are also confirmed by studies conducted among athletes, which showed that a more frequent occurrence of dilated superficial veins and reflux segments was not associated with a greater severity of venous symptoms, indicating that changes in the venous system are not always reflected in subjectively experienced symptoms [10].

The introduction of calf muscle exercises was shown to normalize parameters of calf muscle pump function, but no changes were observed in the severity of reflux or in the severity assessment results. Therefore, the introduction of appropriate exercises for venous insufficiency should be considered an adjunct to pharmacological or surgical treatment, not the primary therapy [3].

The study also found no statistically significant relationship between physical activity level (METs) and the worsening of symptoms after prolonged sitting. So far, it has been shown that prolonged sitting can negatively impact the circulatory system of the lower limbs [1]. The authors emphasize that prolonged sitting will soon be considered a behavioural health risk, similar to other environmental risk factors, such as passive smoking. Although prolonged sitting can negatively impact the circulatory system of the lower limbs, in the current study, higher levels of physical activity were not associated with reduced symptoms after prolonged sitting. This suggests that physical activity alone may not be sufficient to reduce symptoms associated with prolonged sitting. Other lifestyle factors, such as the duration of sitting, the frequency of breaks from sitting, and the methods of recovery used, may also play a role. The lack of a relationship between the level of physical activity and the severity of symptoms after prolonged sitting indicates that further research is necessary to more fully assess the factors influencing the occurrence of these symptoms.

No statistically significant relationship was found between level of physical activity (METs) and changes in symptoms experienced after training. However, this result does not rule out the beneficial effects of exercise on the venous system. Research indicates that physical training in patients with chronic venous insufficiency can improve calf muscle pump function, muscle strength, and ankle range of motion [16]. These differences may result from different characteristics of the study groups and the fact that the MET index does not reflect the type of exercise performed.

Furthermore, in the current study, no statistically significant correlation was found between physical activity level (MET) and changes in leg appearance after a prolonged break from physical activity. This may indicate that subjective assessment of lower limb appearance depends on many factors related to the functioning of the venous system, not solely on physical activity level. This is supported by the fact that the literature emphasizes the multi-factorial nature of venous disorders, which are also influenced by body weight, diet, type of work, time spent sitting or standing, and other lifestyle factors [4]. This suggests that interventions aimed at improving venous health should include not only physical

activity, but also appropriate nutritional interventions and lifestyle modifications. However, it should be noted that the analysis was based on subjective assessment of lower limb symptoms and self-reported physical activity levels assessed using the GPAQ questionnaire, which may be associated with a risk of self-report bias. Furthermore, the lack of correlation between physical activity levels and reported symptoms does not rule out the occurrence of negative consequences of insufficient physical activity, even in young individuals [17]. These consequences may remain asymptomatic due to the body's high compensatory abilities and become apparent only later in life. Therefore, it seems reasonable to extend the diagnostic process to include assessment of haemodynamic parameters of the lower limbs and the strength of selected muscle groups to confirm the obtained results.

CONCLUSIONS

The results obtained in the current study demonstrate that assessing physical activity using the GPAQ alone may be insufficient to identify the relation between physical activity levels and subjective lower limb symptoms in young adults. The results indicate the need to supplement physical activity assessment with objective measurement methods and assessment of functional parameters of the lower limbs, such as joint range of motion, muscle strength, motor coordination, balance, and postural control.

SUMMARY

In the study population, the level of physical activity was not a significant factor influencing the occurrence and severity of subjective lower limb symptoms. The obtained results indicate that the relationship between physical activity and subjectively assessed lower limb condition may be modified by other factors not included in this analysis. The lack of correlation found between physical activity level and self-reported symptoms indicates the need to supplement subjective assessment with objective measurements of lower limb haemodynamic parameters and muscle strength, particularly in the population of young individuals with high adaptive potential.

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