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J. Szew. Działdowo (maj 2020)

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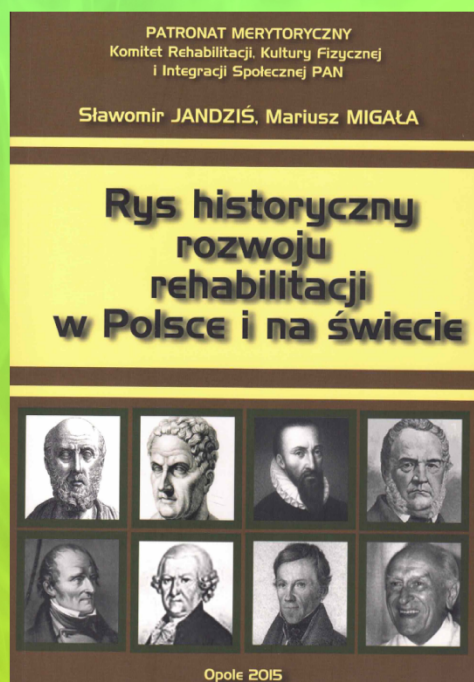


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Monitoring of physical activity of patients with essential hypertension by the Actigraph accelerator – the influence of the environment

Monitorowanie aktywności fizycznej pacjentów z nadciśnieniem tętniczym pierwotnym za pomocą akceleratora Actigraph – wpływ środowiska

Gabriela Škrečková^(A,B,C), Eva Lukáčová^(C,E,F)

Department of Physiotherapy, Faculty of Health Care, University of Prešov, Prešov, Slovak Republic

Abstract

Background. The environment is an important determinant of physical behaviour and also affects the quality of life. A healthy lifestyle is considered to be the simplest form of hypertension prevention and therapy.

Objective. The aim of our study was to find the correlation of physical behaviour of patients with essential hypertension depending on the environment.

Method: We monitored the physical activity (PA) of 60 hypertensive patients from urban (n: 30) and rural (n: 30) environments with Actigraph accelerator. The average blood pressure values of the respondents were SBP 147 mmHg (± 8.24) and DBP 92.08 mmHg (± 8.08). Actigraph evaluated physical behaviour in the form of: sitting during the day, light, moderate and high physical activity (min/week) and steps (steps/week). The quality of life of the respondents was assessed by the Quality-of-Life SF36 – short version questionnaire.

Results. We confirm the statistically significant difference between hypertensive patients from urban and rural environments in the following categories: sitting during the day ($p = 0.000052$), light PA ($p = 0.022009$), medium PA ($p = 0.0012$ steps ($p = 0.006993$)). Comparing the Quality-of-Life SF 36 questionnaire data, we find a worse quality of life in hypertensive patients living in rural areas ($\bar{x} 74.40$) than in hypertensive patients living in urban areas ($\bar{x} 78.57$).

Conclusion. Hypertensive patients living in rural areas have better physical behaviour than hypertensive patients living in urban areas, but larger population studies are needed to confirm the influence of the environment on physical activity and quality of life.

Key words:

hypertension, Actigraph, environment

Streszczenie

Informacje wprowadzające. Środowisko jest ważnym wyznacznikiem zachowań fizycznych, a także wpływa na jakość życia. Zdrowy styl życia uważany jest za najprostszą formę profilaktyki i terapii nadciśnienia tętniczego.

Cel. Celem pracy było określenie korelacji między zachowaniami fizycznymi pacjentów z nadciśnieniem tętniczym pierwotnym w zależności od środowiska.

Metoda. Za pomocą akceleratora Actigraph monitorowaliśmy aktywność fizyczną (PA) 60 pacjentów z nadciśnieniem tętniczym ze środowisk miejskich (n: 30) i wiejskich (n: 30). Średnie wartości ciśnienia tętniczego uczestników badania wyniosły: ciśnienie skurczowe SBP 147 mmHg ($\pm 8,24$) i ciśnienie rozkurczowe DBP 92,08 mmHg ($\pm 8,08$). Actigraph oceniał następujące zachowania fizyczne: siedzenie w ciągu dnia, lekka, umiarkowana i duża aktywność fizyczna (min/tydzień) oraz liczba kroków (kroki/tydzień). Jakość życia badanych oceniano za pomocą kwestionariusza Quality-of-Life SF36 – wersja skrócona.

Wyniki. Potwierdzamy istotną statystycznie różnicę między pacjentami z nadciśnieniem tętniczym ze środowiska miejskiego i wiejskiego w następujących kategoriach: siedzenie w ciągu dnia ($p = 0,000052$), lekka aktywność fizyczna ($p = 0,022009$), średnia aktywność fizyczna ($p = 0,0012$) i liczba kroków ($p = 0,006993$). Porównując dane kwestionariusza Quality-of-Life SF 36 stwierdzamy gorszą jakość życia pacjentów z nadciśnieniem tętniczym mieszkających na wsi ($\bar{x} 74,40$) niż pacjentów z nadciśnieniem mieszkających w miastach ($\bar{x} 78,57$).

Wniosek. Pacjenci z nadciśnieniem tętniczym mieszkający na wsi wykazują lepsze zachowania fizyczne niż pacjenci z nadciśnieniem tętniczym mieszkający w miastach, jednak potrzebne są badania populacyjne prowadzone na szerszą skalę, aby potwierdzić wpływ środowiska na aktywność fizyczną i jakość życia.

Słowa kluczowe:

nadciśnienie, Actigraph, środowisko

Introduction

Hypertension is a lifelong disease and the treatment is multifactorial. Lifestyle changes are preferred to eliminate the risk factors that increase of blood pressure, in addition to pharmacological treatment. It is important to implement strategies to promote healthy habits and therefore avoid accumulation of risk factors for hypertension: sedentary lifestyle, stress, low quality of lifestyle, smoking, obesity... [1, 2]. One of the risk factors, that can control hypertension is safe exercise (PA). It is the simplest, most economical and most effective form of cardiovascular disease (CVD) prevention, but very little used – only 10–15% of patients carry out adequate exercise to the extent needed to meet CVD prevention criteria [3]. Regular, adequate exercise reduces systolic blood pressure by an average of 5–10 mmHg and diastolic by 5–8 mmHg (WHO, 2020). A more recent Cornelissen meta-analysis from 11 randomised controlled trials shows a net reduction of 2.2 mmHg for systolic blood pressure and 3.3 mmHg for diastolic blood pressure [4]. The World Health Organisation has developed a recommendation of physical activity for patients with hypertension [5]. Patients with hypertension should optimise their physical behaviour regardless to blood pressure values [6].

24-hour accelerometers are currently used to objectively evaluate physical activity. They record physical activity and evaluate its level and duration. We can determine a patient's physical lifestyle based on the accelerometer data [7]. The altigraph is a non-invasive acceleration device used to monitor physical behaviour [8]. We expressed physical activity in this study, as the period of time in minutes spent at each level of physical activity – period of time spent sitting during the day, moderate, and vigorous PA levels.

Subjective perception based on cognitive assessment and emotions is important for the evaluation of Quality of Life (QL) and may not be directly proportional to real health. The WHO defines quality of health as: "Quality of life is determined by how a person perceives his or her position in life in the context of the culture and value systems in which he or she lives and in relation to his or her personal goals, expectations, lifestyle and interests" [9]. Quality of life is therefore not only a state of absence of disease, but also a subjective experience of living with a disease. The presence of a disease is a significant objective factor affecting QL. It

affects directly the person affected by the disease and to those around him or her – family, friends, colleagues [10]. Hypertension is a lifelong disease that affects the physical behaviour of patients. In relation to quality of life, various studies have also looked at its relationship with hypertension [11]. According to a meta-analysis of 20 observational studies, hypertensive individuals have worse QL levels than non-hypertensive individuals [12].

The implication of the environmental effects with physical activity have so far been investigated in a relatively limited set of studies. The importance of the location has been associated in the context of district density, green density, climate incentives or seasonal microclimates [13, 14]. The level of physical activity in urban locations is linked to its availability within the civic amenities of public spaces, while in rural areas it is associated with the development of tourism and in connection with the maintenance of residences and gardens. Some studies confirm the connection of environmental factors (air, noise, temperature) to cardiovascular disease, especially hypertension [15]. We focused on monitoring the level of physical activity of patients with essential hypertension, using the Actigraph accelerator, in our study. We connected data on the level of physical activity with the perceived quality of life.

Methods

We monitored the activity levels of 60 patients (21 men/ 39 women) with grade I and II essential hypertension (age 58.35 ± 6.05). The inclusion standard was the absence of a serious musculoskeletal disease that would prevent the patients from performing normal activities of a daily, working or sporting nature. The patients were divided into two groups according to their permanent residence: 1st group "city" (n: 30), 2nd group "countryside" (n: 30). Blood pressure data were provided by the patients – morning blood pressure values recorded according to a standard prescription (three measurements on the right hand, before administration of antihypertensive drugs).

The average blood pressure values of the two groups varied only by a small difference: the "city" group systolic blood pressure (SBP) 146.2 mm Hg (± 8.24), diastolic blood pressure (DBP) 91.8 mm Hg (± 5.03); the "country" group systolic blood pressure (SBP) 149.3 mm Hg (± 8.07), diastolic blood pressure (DBP) 92.37 mm Hg (± 5.19) (Table 1).

Table 1. Demographic data

	n	age	BMI	Smoke yes/no	SBP (mmHg)		DBP (mmHg)			
					min	max	min	max		
urban	30 (50%)	57.47 $\pm$ 6.75	27.70 $\pm$ 4.09	9:21	146.2 $\pm$ 8.24	130	159	91.8 $\pm$ 5.03	80	100
rural	30 (50%)	59.23 $\pm$ 5.22	27.64 $\pm$ 4.10	8:22	149.3 $\pm$ 8.07	137	164	92.37 $\pm$ 5.19	84	102
men	21 (35%)	60.24 $\pm$ 6.02	29.88 $\pm$ 4.05	5:16	155.24 $\pm$ 5.40	143	164	96.24 $\pm$ 3.48	90	102
women	39 (65%)	57.33 $\pm$ 5.89	26.49 $\pm$ 3.58	12:27	143.71 $\pm$ 6.50	130	157	89.85 $\pm$ 4.36	80	100
total	60 (100%)	58.35 $\pm$ 6.05	27.68 $\pm$ 4.06	17:43	147 $\pm$ 8.24	130	164	92.08 $\pm$ 8.08	80	102

BMI-body mass index; SBP-systolic blood pressure; DBP diastolic blood pressure

Results

We used the evaluation in the form of the standardized questionnaire SF 36 short version, to understand the subjective

perception of a respondent's health and quality of life. The questionnaire evaluates the psychological and physical health with regards to the respondent's mobility and social situation.

Table 2. SF 36 descriptive statistics

	Urban (n:30)	Rural (n:30)	Total (n:60)
General health perceptions	61.00	53.17	57.03
Limitations in physical activities	86.17	84.76	85.55
Limitations in usual role activities	78.96	74.58	76.77
Bodily pain	78.5	72.58	75.54
Vitality	72.08	69.79	70.94
Limitations in social activities	79.58	76.25	77.92
Limitations from emotional problems	89.44	83.89	86.67
General mental health	82.83	80.17	81.5
Physical health	76.16	71.27	73.74
Mental health	80.99	77.52	79.26
Index SF 36	78.57	74.40	76.50

Based on the results of the individual items of the SF 36 questionnaire, we evaluated the resulting values for physical health, mental health, and the resulting quality of life index. The worst-rated item in both groups was the General health perceptions (urban: 61.00; rural: 53.17). It is interesting for our research to find out that the limitations in physical activities were evaluated very favourably (urban: 86.17; rural: 84.76). The summary of both the physical ($\bar{x}$ 71.27) and mental components ($\bar{x}$ 77.52) of the questionnaire points to a worse quality of life for hypertensive patients living in the countryside.

The level of physical activity was recorded using the Actigraph acceleration monitoring device and evaluated using the licensed ActiLife program. The monitoring device was worn by patients during the day for one week, attached to the waist. The device recorded physical activity in three basic positions: lying down, sitting up and standing up. Patients were instructed to strap the device on as soon as they woke up and fold it before a night's sleep (the device is also usable in an aquatic environment – it can withstand a dive of up to 5 m).

Table 3. Actigraf – monitoring group (min/week)

	n	Mean (SD)	Median	Modus	min	max
Setting during the day (min/week)	60	1479.70 ± 247.20	1486.50	1548.00	565.00	2054.00
Light PA (min/week)	60	2190.13 ± 400.19	2266.00	-	755.00	3223.00
Moderate PA (min/week)	60	123.62 ± 63.57	123.00	-	14.00	304.00
Vigorous PA (min/week)	60	0.68 ± 2.10	0.00	0.00	0.00	14.00
Steps (count/week)	60	43017.13 ± 8410.19	42165.50	-	25465.00	66424.00

SD – standard deviation

The activity level recorded by Actigraph is categorised as "light, medium and high" according to the conversion to METs (light PA ≤ 3 METs; medium PA 3–6 METs; vigorous 6–9 METs; very vigorous ≥ 9 METs). PA is expressed in units of minutes per

week in the tables. The very vigorous activity level was not recorded in none of the respondents in our measurement. For this reason, it is not included in the table.

Table 4. PA level in the monitored groups (Actigraph min/week)

	n	Mean (SD)	Median	Modus	min	max
Urban sitting	30	1601.73 ± 190.773	1553.50	-	1336.00	2054.00
Urban light PA	30	2307.30 ± 249.836	2282.00	-	1956.00	3223.00
Urban moderate PA	30	98.03 ± 54.190	84.50	-	14.00	179.00
Urban vigorous PA	30	0.80 ± 2.592	0.00	0.000000	0.00	14.00
Urban steps	30	40142.27 ± 6342.242	37937.50	-	31430.00	56627.00
Rural sitting	30	1357.67 ± 238.987	1386.00	-	565.00	1751.00
Rural light PA	30	2072.97 ± 484.770	2251.00	2266.000	755.00	2821.00
Rural moderate PA	30	149.20 ± 62.694	140.00	-	68.00	304.00
Rural vigorous PA	30	0.57 ± 1.478	0.00	0.000000	0.00	6.00
Rural steps	30	45892.00 ± 9304.738	46619.00	-	25465.00	66424.00

SD – standard deviation

Based on ActiLife data evaluation, the time spent in activity sitting for respondents in the "city" group averaged 1,601 minutes per week, representing 3 hours and 49 minutes when converted into days. In the "country" group, the time spent in activity sitting, when converted into days averaged 3 hours and 14 minutes. The moderate PA averaged 2,307.30 min/week

in the city group and 2,072.97 min/week in the rural group. Median physical activity was more frequently performed in the rural hypertensive group (ø149.20 min/week) compared to the urban hypertensive group (ø98.03 min/week). The time spent performing vigorous-level PA was negligible in both study groups.

Table 5. t-test urban–rural

	n	Mean	SD	t value	P-value
Urban sitting	30	1601.73	± 190.773	4.371614	0.000052
Rural sitting	30	1357.67	± 238.987		
Urban light PA	30	2307.30	± 249.836	2.353476	0.022009
Rural light PA	30	2072.97	± 484.770		
Urban moderate PA	30	98.03	± 54.190	-3.38190	0.001294
Rural moderate PA	30	149.20	± 62.694		
Urban vigorous PA	30	0.80	± 2.592	0.428338	0.669992
Rural vigorous PA	30	0.57	± 1.478		
Urban steps	30	40142.27	± 6342.242	-2.79669	0.006993
Rural steps	30	45892.00	± 9304.738		

SD – standard deviation

Higher values of moderate physical activity were observed in hypertensive patients from an urban setting. Hypertensive patients from a rural setting are more likely to perform moderate-level physical activity and they perform more steps than hypertensive patients from an urban setting. The results of the Actigraph accelerator measurements were evaluated using the

statistical analysis of the student's t-test, for 2 independent variables at the $\alpha \leq 0.005$ level of significance. Significant differences were confirmed for sitting time ($p = 0.000052$) and PA levels: mild ($p = 0.022009$), moderate ($p = 0.001294$). The number of steps per week was significantly different ($p = 0.006993$).

Discussion

Based on the evaluation of the SF 36 quality of life questionnaire, we declare that patients with essential hypertension living in cities, rate their physical health (score $\bar{x}$ 76.16), psychological health (score $\bar{x}$ 80.99) as well as general sense of health (score $\bar{x}$ 78.57) better, than those with hypertension from a rural environment (physical health score $\bar{x}$ 71.27; psychological health score $\bar{x}$ 77.52; general sense of health score $\bar{x}$ 74.40). The individual values of the SF 36 items were not significantly different. The blood pressure (SBP and DBP) values in each group: city/country were at comparable values. A similar study looking at the quality of life of hypertensive patients depending on their environment was carried out by Vietnamese scientists. Their results stated that hypertensive patients living in a rural environment have higher quality of life values than those from an urban environment, with the exception of the mental health domain, which was significantly lower ($\bar{x}$ 49.4) [16].

Actigraph works as a motion detector and thus records movement at a very low level, which we characterize as sitting. The current flow of the instrumental modernization and economization of movement tasks, does not favour a healthy lifestyle. The places which we regularly attend – workplaces, schools, households, but also public spaces are arranged and adapted in a way that minimizes regular movement and muscle activity, thereby maximizing the time spent sitting. In our study, the average time spent sitting was 1479.7 minutes per week ($\pm$ 247.20), which is 3.5 hours on daily basis. This indication is not a high number considering that an adult is awake for an average of 16 hours per day. We sit while eating, travelling in a vehicle, working behind a computer, while reading, watching TV, during a leisure activity. The slight differences between hypertensive patients from urban and rural settings are therefore not significant – a difference of 35 minutes per day in favour of the countryside. Studies from America and Australia on the physical behaviour of hypertensive patients using accelerometers indicate a high percentage of time spent sitting: on average 55% to 70% of their waking time (or $>$ 8–10 hours/day) by sedentary behaviour [17, 18]. However, mild PA in relation to hypertension is a question. Studies suggest that lower sitting time and higher time spent doing light physical activity helps to lower blood pressure values [19]. Nevertheless, mild PA levels are associated with sedentary lifestyles. In our study, respondents from urban environments performed mild PA on average 5.5 hours per day and respondents from rural environments performed mild PA on average 5 hours per day ($p = 0.022009$). Based on fact that easy activity is associated

with sedentary behaviour, we note that respondents to our set spend 8-9 hours per day in this lifestyle mode (sitting + easy PA: city $\bar{x}$ 9 hours/day; countryside $\bar{x}$ 8 hours/day).

Interventions to change the exercise habits of patients with cardiovascular disease have a small but consistent benefit in health outcomes, including a positive effect on blood pressure [20]. Cardio exercise is associated with moderate exercise activity as well as walking. In our study, rural residents ($\bar{x}$ 149.20 min/week) showed significantly better results in mean PA ($p = 0.001294$) than urban residents ($\bar{x}$ 98.00 min/week). Similarly, steps were evaluated: urban $\bar{x}$ 5.734 steps/day; rural $\bar{x}$ 6.556 steps/day ($p = 0.006993$). The prevailing view among laymen is that 10,000 steps per day is ideal to maintain good condition. However, cross-sectional analyses show that healthier older people achieve a nominal rate of 8000 steps/day, exercising $>$ 20 minutes per day at an intensity $>$ 3 METs [21].

Few studies have attempted to link the prevalence of hypertension to the living environment of the patients. The influence of negative city characteristics such as dust, noise, traffic on the occurrence of hypertension has been investigated. However, there are no major rural studies in which the association of greenery and hypertension is clearly linked to blood pressure values [22]. At the same time, the current rapid rural urbanisation is blurring the differences in environmental impact on cardiovascular disease [23, 24]. Yet a study by Cameroon researchers linked higher prevalence of hypertension to lower levels of physical activity in urban dwellers compared to rural dwellers.

Conclusion

Physical behaviour modifies a lifestyle that has a significant impact on the prevalence of hypertension. While the results of our work point to improved physical behaviour of hypertensive people living in rural areas, it is not possible to generalise these findings. The rapid urban growth of cities and their facilities with sports centres blurs the differences in physical behaviour of hypertensive people living in cities and rural areas. Larger population studies are needed to confirm the influence of the environment on physical activity and quality of life.

Adres do korespondencji / Corresponding author

Gabriela Škrečková

e-mail: gabriela.skreckova@unipo.sk

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