

# Depression as a major factor affecting physical activity in geriatric inpatients

## Depresja jako ważny czynnik wpływający na aktywność fizyczną u pacjentów oddziału geriatrycznego

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### Abstract

**Introduction.** Physical activity is a predictor for two-year survival in geriatric inpatients. The aim of the study was to assess factors that affect the level of physical activity in geriatric inpatients. **Material and methods.** The study group comprised of 80 patients aged  $78.6 \pm 7.0$  years ( $\bar{x} \pm SD$ ), 68.8% women, admitted to the Department of Geriatrics. Comprehensive geriatric assessment complemented with tests for physical frailty phenotype according to Fried et al. criteria were performed for all patients. Physical activity was assessed according to the short version of the Minnesota Leisure Time Activity Questionnaire (MLTAQ). **Results.** Two independent factors were associated with the positive Fried frailty criterion of low physical activity in a multivariate logistic regression model: depression (OR = 7.825; 95% CI = 1.419-43.139;  $P = 0.018$ ) and interleukin 6 (IL-6) concentration (OR = 1.319; 95% CI = 1.108-1.570;  $P = 0.002$ ). The same two independent factors were associated with a physical activity lower than 600 kcal per week (the best discriminating level of the physical activity score for two-year survival prediction): depression (OR = 8.322; 95% CI = 1.703-40.673;  $P = 0.009$ ) and IL-6 concentration (OR = 1.316; 95% CI = 1.126-1.573;  $P = 0.001$ ). **Conclusion.** Depression is a major factor affecting physical activity in patients referred to the geriatric ward. (Gerontol Pol 2017; 25: 229-234)

**Keywords:** geriatric inpatients, frailty, physical activity, depression, interleukin 6, endothelin 1.

### Streszczenie

**Wstęp.** Aktywność fizyczna jest czynnikiem predykcyjnym dwuletniego przeżycia u pacjentów oddziału geriatrycznego. **Celem pracy** była analiza czynników wpływających na aktywność fizyczną w tej grupie pacjentów. **Material i metody.** Grupa badana składała się z 80 pacjentów w wieku  $78,6 \pm 7,0$  lat ( $\bar{x} \pm SD$ ) przyjętych do Oddziału Geriatrii (68,8% kobiet). Całościowa ocena geriatryczna została uzupełniona u wszystkich pacjentów testami fizycznego fenotypu zespołu słabości według Fried i wsp. Aktywność fizyczną oceniano przy pomocy krótkiej wersji Minnesota Leisure Time Activity Questionnaire (MLTAQ). **Wyniki.** Wieloczynnikowy model regresji logistycznej ujawnił dwa niezależne czynniki związane z małą aktywnością fizyczną (dodatkowo kryterium zespołu słabości): depresję (OR = 7,825, 95% CI = 1,419-43,39,  $P = 0,018$ ) i stężenie interleukiny 6 (IL-6) (OR = 1,319; 95% CI = 1,108-1,570,  $P = 0,002$ ). Te same dwa niezależne czynniki związane były z aktywnością fizyczną mniejszą niż 600 kcal na tydzień (najlepsza wartość dyskryminacyjna poziomu aktywności fizycznej dla dwuletniej prognozy przeżycia): depresja (OR = 8,222, 95% CI = 1,703-40,673,  $P = 0,009$ ) i stężenie IL-6 (OR = 1,316, 95% CI = 1,126-1,573,  $P = 0,001$ ). **Wniosek.** Depresja jest głównym czynnikiem wpływającym na aktywność fizyczną u chorych kierowanych do oddziału geriatrycznego. (Gerontol Pol 2017; 25: 229-234)

**Słowa kluczowe:** oddział geriatryczny, zespół słabości, aktywność fizyczna, depresja, interleukina 6, endotelina 1.

### Introduction

Physical activity is essential for well health maintenance throughout life including old age. It mitigates detrimental effects of ageing and enables so-called suc-

cessful ageing. Beneficial effects of regular physical activity in prevention and treatment of a wide range of diseases has been established [1,2]. In older persons a favorable influence on muscle strength, coordination and balance, frailty prevention [3,4], fall risk reduction [5]

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and disability prevention is of a particular importance. Physical activity is one of the diagnostic components for Fried frailty phenotype [6]. In our recent study we found that this component is an independent predictive factor for two-year survival in geriatric inpatients [7]. Therefore, an extended analysis of the conditions associated with physical activity in this group of patients was reasonable.

## Aim

The aim of this study was to assess factors associated with the level of physical activity in geriatric inpatients during two weeks preceding admission to the hospital.

## Patients and methods

### Patients

The study group comprised of 80 consecutive patients aged  $78.6 \pm 7.0$  years ( $\bar{x} \pm SD$ ; in the range from 60 to 92 years), 68.8% women, admitted to the Department of Geriatrics at University Hospital No 7 SUM, Upper-silesian Medical Center, in Katowice, Poland, between October 2014 and December 2014, who provided informed consent for a participation in the study. Exclusion criteria included patients unable to provide informed consent because of cognitive impairment.

### Measurements

Comprehensive geriatric assessment (CGA) complemented with tests for frailty were performed for all patients. Functional assessment included Barthel Index of Activities of Daily Living (Barthel Index), Instrumental Activities of Daily Living Scale (IADL), Mini-Mental State Examination (MMSE), Geriatric Depression Scale (GDS). A detailed description of these methods was presented in our previous paper [7]. Frailty was diagnosed according to Fried et al. criteria [6], with physical activity measured as a weighted score of kilocalories expended per week calculated at baseline according to the short version of the Minnesota Leisure Time Activity Questionnaire (MLTAQ) [8,9] (with fulfilled frailty criterion if physical activity lower than 383 kcal per week for men or lower than 270 kcal per week for women). Physical activity was also assessed using a modified Physical Activity Questionnaire for the Elderly (PAQE) [10], as proposed by Saum KU et al. [11], that measures activities of daily living, sport activities, leisure-time activities, and a comprehensive score for total physical activity in older persons.

Fasting blood samples were collected into EDTA-containing tubes and immediately centrifuged at  $500 \times g$  for 10 minutes. Plasma were collected and stored in new cryo-vials at  $-80^{\circ}\text{C}$  till the assay. IL-6 level in plasma was assessed using IL-6 Quantikine high-sensitivity ELISA kit (RnD Systems). ET-1 levels were assayed using Human ET-1 QuantiGlo ELISA kit with chemiluminescent detection. Resulting absorbance (IL-6) or luminescence (ET-1) were measured using Tecan M200Pro microplate reader. Obtained data were analyzed with Magellan Data Analysis Software. Assay performance was monitored using appropriate quantitative controls for the determination of cytokine and endothelin-1 concentrations in biological fluids provided by RnD Systems.

## Statistical Analysis

Data was analyzed using STATISTICA version 12 (Stat Soft, Inc., Tulsa, OK, USA; Stat Soft Polska). Chi-square test, V-square test and Fisher's exact test were used for categorical variables and the nonparametric Mann-Whitney U test for quantitative variables to compare distinguished groups of patients. The Kaplan-Meier method was used to estimate probability of two-year survival in subgroups of patients in respect to physical activity level, while differences between these subgroups were assessed with the Wilcoxon-Gehan statistic. Variables were tested to define the value corresponding with the lowest P level. Multivariate logistic regression was used to determine factors associated with physical activity. Analysis with backward elimination included variables that yielded P values of 0.1 or lower in the initial univariate analysis. P values  $< 0.05$  were considered statistically significant.

## Ethics

The study protocol was approved by the Bioethical Committee of the Medical University of Silesia in Katowice, Poland (Letter KNW/0022/KB1/1/14).

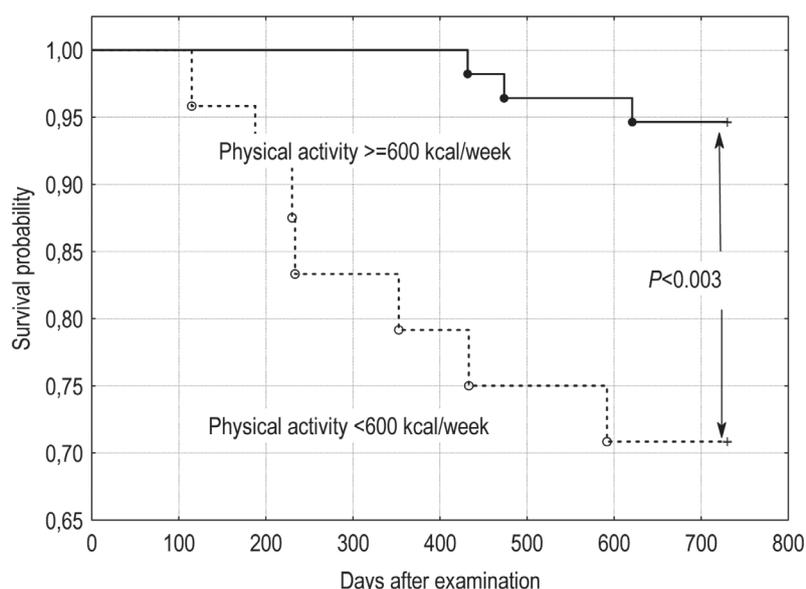
## Results

As compared with patients who survived, a group of 10 patients (12.5%) who died within the two-year follow-up period had higher age and higher rate of depression, managed lower physical activity before admission to the hospital, had lower lymphocytes count, lower triglycerides, sodium and insulin concentration, and higher IL-6 concentration (Table I). The fifth Fried frailty criterion of low physical activity was fulfilled in 11 patients (13.8%). Two independent factors were as-

**Table I. Clinical and functional characteristics of geriatric inpatients who did not survive (NS) two-year follow-up as compared to inpatients who survived (SV)**

Variable	Whole group n = 80 Mean $\pm$ SD <sup>1</sup>	NS n = 10 Mean $\pm$ SD <sup>1</sup>	SV n = 70 Mean $\pm$ SD <sup>1</sup>	NS vs. SV P - value
Age, years	78.6 $\pm$ 7.0	83.1 $\pm$ 4.4	78.0 $\pm$ 7.0	0.023
Sex, percentage of females	68.8	80.0	67.1	0.649
Body mass, kg	71.4 $\pm$ 14.0	63.2 $\pm$ 12.2	72.5 $\pm$ 13.9	0.037
Body mass index, kg/m <sup>2</sup>	27.9 $\pm$ 4.9	25.7 $\pm$ 5.0	28.2 $\pm$ 4.8	0.193
Systolic blood pressure, mmHg	132.6 $\pm$ 18.5	137.5 $\pm$ 19.9	131.9 $\pm$ 18.3	0.348
Diastolic blood pressure, mmHg	76.5 $\pm$ 10.2	76.0 $\pm$ 8.1	76.6 $\pm$ 10.5	0.856
Mini-Mental State Examination score	25.5 $\pm$ 4.1	23.8 $\pm$ 4.1	25.7 $\pm$ 4.0	0.132
Geriatric Depression Scale	5.6 $\pm$ 2.5	6.9 $\pm$ 2.4	5.4 $\pm$ 2.5	0.062
Barthel Index	79.9 $\pm$ 19.0	70.5 $\pm$ 26.9	81.3 $\pm$ 17.5	0.260
Instrumental Activities of Daily Living Scale	19.7 $\pm$ 5.9	18.1 $\pm$ 6.1	19.9 $\pm$ 5.9	0.323
Modified Timed Up and Go Test, points	5.6 $\pm$ 2.3	4.6 $\pm$ 2.2	5.7 $\pm$ 2.3	0.146
Visual Analogue Scale, points	3.8 $\pm$ 3.2	3.6 $\pm$ 3.0	3.8 $\pm$ 3.2	0.919
Physical activity mMLTAQ <sup>2</sup> , kcal/week	1156.9 $\pm$ 997.3	469.2 $\pm$ 449.1	1255.1 $\pm$ 1016.9	0.004
Physical activity PAQE <sup>3</sup> , score	13.2 $\pm$ 7.6	7.7 $\pm$ 6.2	14.0 $\pm$ 7.5	0.014
Red blood cells, T/L	4.3 $\pm$ 0.6	4.3 $\pm$ 0.4	4.3 $\pm$ 0.7	0.503
Hemoglobin, g/dL	13.0 $\pm$ 1.8	12.6 $\pm$ 1.4	13.1 $\pm$ 1.9	0.302
Hematocrit, %	38.3 $\pm$ 4.9	37.2 $\pm$ 3.5	38.4 $\pm$ 5.1	0.230
Lymphocytes, G/L	1.7 $\pm$ 0.7	1.4 $\pm$ 0.6	1.7 $\pm$ 0.7	0.016
C-reactive protein, mg/L	6.9 $\pm$ 7.3	6.0 $\pm$ 2.1	7.0 $\pm$ 7.8	0.788
Albumin, g/L	39.1 $\pm$ 4.8	35.9 $\pm$ 5.7	39.5 $\pm$ 4.6	0.054
Vitamin B12, pmol/L	378.1 $\pm$ 261.3	480.1 $\pm$ 347.6	363.3 $\pm$ 246.1	0.465
25(OH) vitamin D total, ng/mL	14.9 $\pm$ 8.7	12.6 $\pm$ 8.3	15.3 $\pm$ 8.7	0.249
Total cholesterol, mg/dL	183.6 $\pm$ 47.7	186.9 $\pm$ 47.7	183.1 $\pm$ 48.0	0.822
HDL-cholesterol, mg/dL	58.1 $\pm$ 18.7	58.9 $\pm$ 22.8	57.9 $\pm$ 18.2	0.819
LDL-cholesterol, mg/dL	104.0 $\pm$ 42.6	112.0 $\pm$ 39.5	102.8 $\pm$ 43.2	0.411
Triglycerides, mg/dL	100.8 $\pm$ 35.6	80.2 $\pm$ 21.5	103.8 $\pm$ 36.4	0.048
Sodium, mmol/L	140.7 $\pm$ 3.5	138.6 $\pm$ 3.2	141.0 $\pm$ 3.4	0.011
Insulin, $\mu$ U/mL	12.4 $\pm$ 12.3	8.9 $\pm$ 7.6	12.9 $\pm$ 12.8	0.046
Interleukin 6, pg/mL	4.3 $\pm$ 3.9	7.9 $\pm$ 5.7	3.8 $\pm$ 3.4	0.016

**Abbreviations:** 1) SD, standard deviation; 2) mMLTAQ, modified Minnesota Leisure Time Activity Questionnaire; 3) mPAQE, modified Physical Activity Questionnaire for the Elderly

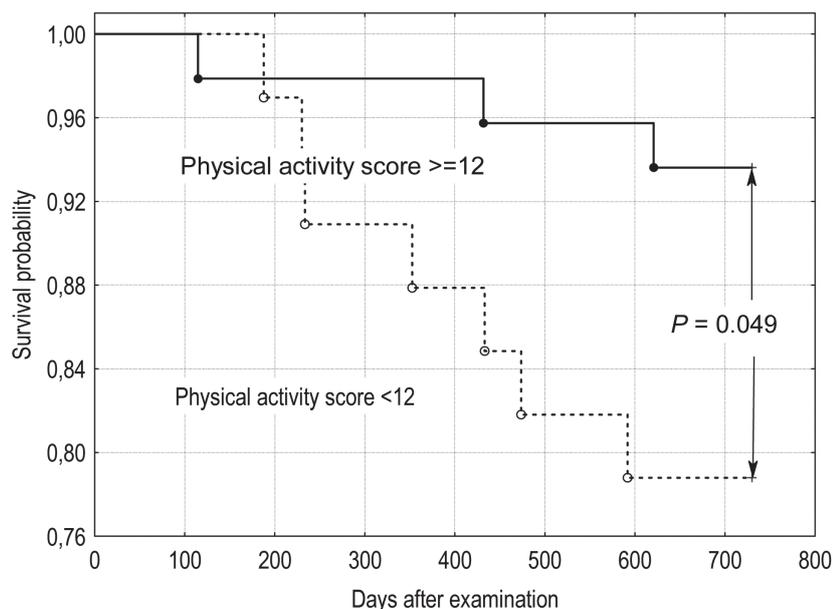
**Figure 1. Probability of survival in two years of follow-up depending on the outcome of physical activity according to the short version of the MLTAQ questionnaire**

sociated with this positive criterion in a multivariate logistic regression model: depression (OR = 7.825; 95% CI = 1.419-43.139; P = 0.018) and IL-6 concentration (OR = 1.319; 95% CI = 1.108-1.570; P = 0.002). However, the best discriminating level of the physical activity score according to the MLTAQ for two-year survival prediction was the value of 600 kcal per week (Figure 1). Similarly to the fifth Fried criterion, the same two independent factors were associated with a physical activity lower than 600 kcal per week in a multivariate logistic regression model: depression (OR = 8.322; 95% CI = 1.703-40.673; P = 0.009) and interleukin 6 concen-

tration (OR = 1.316; 95% CI = 1.126-1.573; P = 0.001). Patients who presented physical activity lower than 600 kcal per week were more frequently affected with dementia and depression, more often used calcium antagonists, had worse functional scale results, lower hemoglobin and bilirubin concentrations and higher endothelin 1 concentration (Table II). Patients who died within two-year follow-up period presented also lower physical activity assessed according to the PAQE, with the best discriminating value of the physical activity score of 12 points (Figure 2).

**Table II. Clinical and functional characteristics of geriatric inpatients who realized physical activity below the level of 600 kcal per week as compared to inpatients who realized physical activity at the level of 600 or more kcal per week (according to the short version of the Minnesota Leisure Time Activity Questionnaire)**

	Patients with physical activity < 600 kcal/week	Patients with physical activity ≥ 600 kcal/week	P
Age, years	81.0 ± 6.85	77.6 ± 6.94	0.117
Sex, percentage of females	66.1	75.0	0.599
Dementia, percentage of patients	54.2	21.4	0.004
Depression, percentage of patients	33.3	5.36	0.003
Calcium antagonist use, percentage of patients	33.3	10.7	0.034
Mini-Mental State Examination score	23.3 ± 4.3	26.4 ± 3.6	0.001
Geriatric Depression Scale, points	7.29 ± 2.71	4.82 ± 2.03	< 0.001
Barthel Index of Activities of Daily Living	66.9 ± 21.8	85.5 ± 14.7	< 0.001
Instrumental Activities of Daily Living Scale	16.5 ± 5.1	21.0 ± 5.7	0.002
Hemoglobin, g/dL	12.4 ± 1.8	13.3 ± 1.8	0.039
Bilirubin concentration, mg/dL	0.52 ± 0.37	0.62 ± 0.29	0.006
Endothelin 1, pg/mL	7.19 ± 4.96	3.13 ± 2.65	0.001



**Figure 2. Probability of survival in two years of follow-up depending on the outcome of physical activity according to the modified PAQE questionnaire**

## Discussion

The characteristic feature of geriatric patients is multi-morbidity, including somatic diseases, overlapping mental disorders and specific geriatric syndromes that effect disability development. This complex and divers clinical picture is further modified (not always favorably) by therapy, especially polypharmacy. Therefore, multiple factors may affect physical activity in older people.

In our previous study we demonstrated that physical activity was the only frailty phenotype component that was an independent prognostic factor for two-year survival in geriatric inpatients [7]. An extended analysis presented in this paper revealed two independent factors that effected physical activity in this group of patients: depression and IL-6 concentration. Depressive symptoms may prevent older adults from engaging in regular physical activity [12]. Galper et al. showed an inverse dose-response association between physical activity and depressive symptomatology, and a positive dose-response association between physical activity and emotional well-being [13]. Thus, a negative influence of depression on physical activity might be expected. However, a significance of depression as a major negative determinant of physical activity in geriatric inpatients was unexpected. Dementia was another important psychological condition, although not of an independent influence on physical activity. These observations confirm the opinion that psychological factors in human beings at older age are even more important than biological conditions for behavior decisive for health status and survival. Our previous study demonstrated also a negative impact of anti-depressants on muscle strength [7] that is connected with physical activity. Thus, not only the disease, but also its pharmacological treatment may impede physical activity. These observations indicate an importance of non-pharmacological treatment of depression, including regular aerobic exercises that seem to be frequently omitted in clinical practice. Another factor negatively associated with physical activity in our study group was interleukin 6. IL-6 is a multifunctional cytokine that was shown to increase with age, even in the absence of an overt disease [14], as a marker of the aging-associated chronic inflammation. Geffken et al. found negative association between self-reported physical activity and markers of inflammation [15]. Puzianowska-Kuźnicka et al. observed that higher IL-6 levels were associated with poorer cognitive and physical performance as well

as higher risk of mortality in both the general elderly population and successfully aging individuals [16]. Our observations indicate a level of 600 kcal of physical activity per week as a threshold value most precisely discriminating a group of geriatric inpatients with an increased health risk associated with low physical activity. Calcium antagonist use, lower hemoglobin and bilirubin concentrations and higher endothelin 1 concentration were other factors connected with lower physical activity (Table II). Endothelin-1 (ET-1), which is produced by vascular endothelial cells, has potent constrictor and proliferative activity in vascular smooth muscle cells and, therefore, has been implicated in regulation of vascular tonus and progression of atherosclerosis [17]. Maeda et al. showed that age-associated ET-1 plasma level increase is reduced by a regular exercise in the healthy older women [17]. We did not find any reports in the literature that could plausibly explain association between calcium antagonist use and diminished physical activity. Adverse effects of calcium antagonists include postural hypotension, edema, flushing, headache, dizziness, constipation (particularly with high-dose verapamil), nausea, rash, and drowsiness. They increase a risk for injurious falls [18]. We were not able to elucidate if the effect of calcium antagonists on physical activity displays in-class differences because of too few the study participants. This study limitation prevented also analysis of the association between current depression status and physical activity. However, this study confirmed the predominant impact of psychological status on the health behaviors of geriatric inpatients.

## Conclusion

Depression is a major factor affecting physical activity in patients referred to the geriatric ward.

## Conflict of interest

None

## Funding

This project was funded by Medical University of Silesia grants to statutory work (contracts KNW-1-029/K/4/0) and young scientist research agreement (KNW-2-013/N/4/N).

## Acknowledgments

Authors express their acknowledgments to Dr. Krzysztof Wilczyński for the language review of the paper.

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