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Physical Activity Level of Ambulatory Stroke Patients: Is it Related to Neuropsychological Factors?

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ABSTRACT

Introduction: Physical inactivity is an important risk factor for stroke and stroke recurrence. There is insufficient knowledge about the physical activity (PA) level in stroke patients who are ambulatory in the subacute phase. Our aim was to compare the PA level between ambulatory stroke patients and a population of the same age and to investigate neuropsychological factors that could affect the PA level in the same stroke group.

Methods: Eighty-five subacute stroke patients and 58 healthy subjects were included. Patients' demographic features, disease-related features, and comorbidities were recorded. The PA level was assessed by the International Physical Activity Questionnaire-Short Version and a pedometer (OMRON Walking style II). The Apathy Rating Scale was applied to determine the apathy level. Depression level was investigated by the Geriatric Depression Scale. The standardized Mini-mental State Examination was performed to assess the cognitive status.

Results: The PA level was significantly higher in the healthy group than in the stroke group (p<0.001). Step count and walking distance were significantly higher in healthy group (p=0.001 and p=0.04, respectively). The PA level of men was significantly higher than that of women (p=0.03). Participants who were classified as level 4 had a lower PA level than those who were classified as level 5 according to the Functional Ambulation Category. There was no relationship between the PA level and the apathy, cognitive, and depression levels in the stroke patients (p>0.05).

Conclusion: Subacute stroke patients have a lower PA level than healthy subjects. This is not related to neuropsychological factors. The reasons for minor deficits related to ambulation should be researched further while developing strategies for increasing the PA level of subacute stroke patients.

Keywords: Stroke, apathy, depression, cognition, physical activity

INTRODUCTION

Physical activity (PA) is defined as movement produced by the action of skeletal muscles that substantially increases energy expenditure (1). After stroke, mobility problems in particular can lead to a decrease in the PA level of patients (2). Balance disorders, sensation loss, pain, and psychological and cognitive failures could be also reasons for a low PA level after stroke (3). Interestingly, the PA level is also low among high-functioning stroke patients (4).

As PA was observed to reduce the risk of recurrent stroke and stroke severity, there are some scientific recommendations indicating the PA as a method for the secondary prevention of stroke (4,5). It is known that regular PA can decrease the adverse effects of sedentary lifestyles such as cardiovascular diseases, falls, and depression after stroke (6,7). Because of all these reasons, clinicians who are related with stroke should be aware of importance of PA to guide stroke patients. In this regard, to not be aware of the exercise benefits, to not be oriented in a PA program, and lack of resources to attain these programs can be listed as environmental factors that cause low PA level among stroke patients, particularly for independent ambulatory patients in the community.

The PA level of stroke patients may be affected by psychological and cognitive factors as well as environmental factors. In some studies it was investigated that cognitive status and mood are more impaired than those in the same age, healthy group in the early stages of stroke (8,9). Apathy, which is a common disturbance in stroke, is defined as a lack of motivation or interest in goal-directed activities. It is known to impair the functional level after stroke (10).

To our knowledge, although the presence and frequency of these symptoms after stroke have been researched in the literature, there are few studies investigating their effects on PA level in subacute, community-dwelling stroke patients (2,11,12). Furthermore, it has been suggested to study why the PA level of independent ambulatory patients is less than that of a population of the same age. As a decrease in PA

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level cannot be explained only by loss of motor function, psychological and cognitive factors have been proposed to analyze (13,14). In light of these findings, we aimed to compare the PA level between ambulatory stroke patients and a population of the same age and to investigate the demographic features and disease-related and neuropsychological factors that could affect the PA level in the same stroke group. We hypothesized that the PA level of ambulatory subacute stroke patients would be less than that of healthy subjects. We further hypothesized that the PA level would be affected by neuropsychological factors in the same population.

METHODS

Sample

This cross-sectional study included ambulatory stroke patients and healthy subjects with the same age range. Stroke survivors were recruited from outpatient stroke clinics in a research and training hospital between June 2014 and July 2015. The study was approved by the Bakırköy Prof. Dr. Mazhar Osman Psychiatric Training and Research Hospital Ethic Committee of the same institution (No: 41340010/18954-290) and was conducted in accordance with the Helsinki Declaration. Subjects who fulfilled the following criteria were included: 1) <3 months after stroke, 2) ≥50 years old, 3) >3 according to the Functional Ambulation Category (FAC) (15), and 4) adequate communication and hearing skills to understand the outcome measures that require an interview. Exclusion criteria were 1) pain in the lower extremity related to musculoskeletal dysfunctions, limiting the level of ambulation; 2) additional systemic diseases (COPD, hearth failure etc.) causing dyspnea at level of ≥3 according to the Medical Research Council Dyspnea Scale (MRC); and 3) having a hospital exit report recommending physical activity restriction for a certain period of time.

G*Power was used to calculate the sample size (16). In a previous study the response for the International Physical Activity Questionnaire (IPAQ)-Short Version within experimental and control groups was normally distributed with standard deviation of 1200 (17). If the true difference in the experimental and control group means is 500, the program calculates to include 132 participants (88 experimental and 44 control subjects) to be able to reject the null hypothesis that the population means of the experimental and control groups are equal with a probability (power) of 0.8. This was inflated by 10% for any missing responses to give a total of 145 participants.

Procedure

Outpatient stroke patients and healthy subjects who met inclusion criteria and who volunteered participated. Age, gender, height, weight, body mass index, background related to other illness, and smoking habits were recorded for each participant. Stroke related variables, including the time from stroke, stroke type, and stroke lateralization were recorded for the stroke patients. The global disability level was defined in the Modified Rankin Scale (mRS). mRS determines functional independence with reference to the pre-stroke state on six grades from "0-No symptom" to "5-Severe disability; bedridden, incontinent, and requiring constant nursing care and attention" (18). Scores on FAC and MRC were also registered. FAC categorizes patients at six levels between levels 0 (non-functional ambulation) and 5 (ambulatory independent) according to basic motor skills necessary for functional ambulation. According to FAC, while level 4 (ambulatory-independent level surfaces only) indicates patients who can walk independently on level ground but who require help on stairs, slopes, or uneven surfaces. Level 5 indicates patients who can walk independently anywhere (15). Dyspnea grade was deter-

Table 1. Demographic and clinical features of the stroke and healthy groups

Demographic	Stroke group (n=85)	Healthy group (n=58)	p
Age (years, mean±SD)	64.7±10.2	64.4±11.7	0.608
Sex (F/M, n)	35/50	38/20	0.006*
BMI (kg/m^2, mean±SD)	27.8±4.6	28±3.6	0.493
Education (years, mean±SD)	5.9±3.7	7.7±4.2	0.01*
Smoking, n (%)			0.04*
Never smoked	10 (11.8)	15 (26.3)	
Quit or still smoking	75 (88.2)	43 (73.7)	
FAC, n (%)			
Level 4	24 (28.2)	NA	
Level 5	61 (71.8)	NA	
Walking aid, n (%)	12 (14.1)	NA	
MRC Dyspnea, n (%)			0.003*
Level 1	58 (68.2)	25 (43.1)	
Level 2	27 (31.8)	33 (56.9)	
Time since stroke (days, mean±SD)	56.63±31.17		
First ever stroke, n (%)	67 (78.8)		
Lesion type, n (%)			
Ischemic	75 (11.8)		
Hemorrhagic	10 (88.2)		
Lesion side, n (%)			
Right hemisphere	33 (38.8)		
Left hemisphere	30 (35.3)		
Brain stem	12 (14.1)		
Cerebellum	10 (11.8)		
Comorbidities, n (%)			
Hypertension	53 (62.4)		
Diabetes Mellitus	20 (23.5)		
Cardiac Disease	23 (16.1)		
Respiratory Disease	9 (10.6)		
Other Comorbidities	23 (27.1)		
Number of comorbidities, n (%)			
None	16 (18.8)		
1	20 (23.5)		
2	30 (35.3)		
3	14 (16.5)		
4	4 (4.7)		
5	1 (1.2)		
Neuropsychological factors, n (%)			
Apathy Evaluation Scale,			
Scored <36	31 (36.5)		
Scored ≥37	54 (63.5)		
Mini-mental State Examination,			
Scored <24	10 (11.7)		
Scored ≥24	75 (88.3)		
Geriatric Depression Scale,			
Scored <14	22 (25.9)		
Scored ≥14	63 (74.1)		

BMI: Body Mass Index; FAC: Functional Ambulation Category, *p<0.05

mined by MRC. MRC is a five-level rating unidimensional scale based on the patient's perception of dyspnea in daily activities: grade 1: "I only get breathless with strenuous exercise," grade 2: "I get short of breath when hurrying on a level or up a slight hill," grade 3: "I walk slower than people of the same age on a level because of breathlessness or have to stop for breaths when walking at my own pace on a level," grade 4: "I stop for breaths after walking 100 yards or after a few minutes on a level," and grade 5: " I am too breathless to leave the house" (19).

Outcome Measurements

Whole outcome measurements were applied by a face-to-face interview.

Physical activity level was assessed by the Turkish version of IPAQ-Short Version, which was administered in an interview (20). The IPAQ-Short Version comprises eight questions. The following activities with four different intensity levels are recorded: 1. Vigorous-intensity activity, 2. moderate-intensity activity, 3. walking, and 4. sitting. For all activities, the number of days per week and minutes per day the patient continually performed the activity for ≥10 min for the last seven days was recorded. Total daily PA was calculated by adding the product of reported time within each item by a Metabolic equivalent (MET) value specific to each category of PA (21).

The PA level was also measured with a pedometer. OMRON step Counter type Walking Style II was used with this aim (22). OMRON step Counter type Walking Style II is a uniaxial spring-levered pedometer, which releases data on the total number of daily steps and total distance walked. The participants were asked to place the pedometers on a belt at the hip with its holder. The pedometer tripped for 72 h to determine the average number of steps and walking distance. The average of three days' performance was used for each patient in this study (23).

Apathy was measured by the Apathy Evaluation Scale, clinician version (24). It has 18 items that address initiative, effort, productivity, emotional responsivity, novelty seeking or curiosity, perseverance, and social engagement. Each item is scored on a four-point ordinal scale. Reliability and validity of the Apathy Evaluation Scale has been demonstrated. It has been used to determine apathy in patients with stroke and traumatic brain injury. Total scores range from 18 to 72; the cutoff point that indicates apathy is ≥37 (24).

The mini-mental State Examination (MMSE) was used to assess the cognitive state of the participants (25). The test has 11 tasks that examine orientation, memory, attention, language skills, and constructional abilities. While the scale ranges from 0 to 30 points, the generally accepted cutoff point to present cognitive impairment is <24. The Turkish version of MMSE was used in our study (26).

Depression was measured by the Geriatric Depression Scale (GDS). GDS was developed by Yesavege et al. and its Turkish version validity and reliability has been established (27,28). It contains 30 items of self-reported questions requiring a yes or no response. While 30 is the total possible score, a score of 14 and above indicates clear depression.

Statistical Analysis

Statistical Package for Social Science (IBM SPSS Statistics New York, USA) 21.0 was used to analyze the data. Kolmogorov-Smirnov test was used to test for normal distribution of data before statistical analysis. As the assumption of normal distribution was not always possible, nonparametric tests were used to analyze differences between the stroke and healthy groups. While the Mann-Whitney U test was performed to detect differences in continuous variables, the chi-square test was used to determine differences in the distribution of categorical variables between the groups. To compare two or more independent samples, the Kruskal-Wallis test was performed. The relation between PA level and continuous variables was determined by Spearman correlation analysis. A *P*-value of <0.05 was considered statistically significant for all analyses.

RESULTS

Two-hundred sixty possible stroke candidates were evaluated between June 2014 and July 2015 at the outpatient stroke clinic of a research and training hospital. Eighty-five stroke patients who met the inclusion criteria were enrolled.

Table 2. Comparison of outcome measures' results between the stroke and healthy groups

Outcome measures	**Stroke group (n=85)**	**Healthy group (n=58)**	**p**
IPAQ- SV			
Mean (SD); Median (Min-Max)	425.9±541.9; 198 (0-2772)	3153.3±5832.3; 1024 (0-27090)	<0.001*
Apathy Evaluation Scale			
Mean (SD); Median (Min-Max)	31.49±11.94; 31 (18-61)	29.3±11.9; 26.5 (18-63)	0.320
Mini-mental State Examination			
Mean (SD); Median (Min-Max)	27.2±4.7; 29 (8-30)	25.72±5.4; 28 (8-30)	0.09
Geriatric Depression Scale			
Mean (SD); Median (Min-Max)	6.8±5.7; 5 (0-26)	7.9±6.1; 6 (0-23)	0.384
Outcome measures	Stroke group (n=30)	Healthy group (n=30)	p
Pedometer			
Step count			
Mean (SD); Median (Min-Max)	2646.5±1235.6; 2199 (299-7013)	6136.2±5220.8; 4203(580-21862)	0.001*
Walking distance			
Mean (SD); Median (Min-Max)	1.8±1.0; 1.5 (0.2-6.4)	3.3±2.9; 2.5 (0.3-14.1)	0.04*

IPAQ-SV: International Physical Activity Questionnaire-Short Version. *p<0.05

Table 3. The relationship among demographic, clinical, and disease characteristics of stroke patients with physical activity level

	IPAQ-SV (n=85) r; p	PM, step count (n=30) r; p	PM, walking distance (n=30) r; p
Continuous Variables			
Age	−0.07; 0.494	−0.09; 0.6	−0.08; 0.65
BMI	0.01; 0.927	0.22; 0.23	0.22; 0.12
Education	0.05; 0.6	0.159; 0.4	0.169; 0.37
Time since stroke	0.1; 0.313	−0.199; 0.29	−0.289; 0.12
Apathy Evaluation Scale	−0.11; 0.29	−0.15; 0.42	0.01; 0.92
Mini-mental State Examination	0.09; 0.38	0.03; 0.87	−0.07; 0.9
Geriatric Depression Scale	−0.16; 0.13	0.1; 0.29	0.2; 0.12
	IPAQ-SV (n=85) Mean (SD); Median	**PM, step count (n=30) Mean (SD); Median**	**PM, walking distance (n=30) Mean (SD); Median**
Continuous Variables			
Sex			
Female	3134.92 (887.07); 810.75	5925.6 (5712.87); 3574.5	3.2 (3.4); 1.9
Male	3188.45 (5878.5); 1386	6519.36 (4417.31); 5	3.65 (2); 3.55
Z; p	−2.137; 0.03	−0.686; 0.493	−0.155; 0.877
FAC			
Level 4	233.06 (347.34); 99	2041.20 (1184.56); 2153	1.46 (0.88); 1.5
Level 5	501.77 (586.75); 231	2767.56 (1232.71); 2232	1.94 (1.11); 1.5
Z; p	−2.651; 0.008	−1.175; 0.24	−0.588; 0.556
Walking Aid			
Yes	218.66 (264.87); 99	2060.50 (1366.91); 2153	1.47 (1.02); 1.5
No	459.97 (568.91); 231	2736.65 (1218.04); 2232	1.92 (1.09); 1.5
Z; p	−1.479; 0.39	−0.767; 0.443	−0.246; 0.806
MRC			
Level 1	478.79 (568.5); 231	2655.87 (1334); 2160	1.88 (1.18); 1.5
Level 2	312.29 (469.96); 99	2609.00 (817.32); 2740	1.78 (0.58); 1.85
Z; p	−1.927; 0.054	−0.313; 0.754	−0.470; 0.638
First ever stroke			
Yes	410.54 (532.36); 198	2574.66 (1012.69); 2232	1.75 (0.72); 1.5
No	483.08 (588.90); 214.5	2933.83 (2003.69); 2153	2.3 (2.0); 1.5
Z; p	−0.454; 0.650	−0.365; 0.715	−0.157; 0.876
Lesion type			
Ischemic	389.40 (329.55); 462	1535 (1070.4); 2153	1.06 (0.75); 1.5
Hemorrhagic	430.77 (565.72); 198	2770.00 (1206.89); 2232	1.95 (1.08); 1.5
Z; p	−0.226; 0.821	−1.49; 0.135	−1.07; 0.281

IPAQ-SV: International Physical Activity Questionnaire-Short Version; PM: Pedometer; mRS: Modified Rankin Scale; r: Spearman Rho

Demographic and clinical features of the participants are summarized in Table 1. Eighty-five stroke patients with a mean age of 64.71±10.25 years and 58 healthy subjects with a mean age of 64.41±11.70 years were included. The number of years for receiving education in the healthy group was higher than that in the stroke group (p=0.01). Additionally, there were statistically differences between the groups as a manner of distribution about sex, smoking habits, and MRC dyspnea level (p=0.04, p=0.02, and p=0.003; respectively). The mean time from stroke onset was 56.63±31.17 days at the time of enrollment. The number and frequency of stroke patients according to mRS levels 0, 1, 2, and 3 were 6 (7.1%), 47 (55.3%), 19 (22.4%), and 13 (15.3%), respectively.

The PA level was significantly higher in the healthy group than in the stroke group (p<0.01). Further, the step count and walking distance were significantly higher in the healthy group (p=0.001 and p=0.04, respectively). There were no difference between the two groups in the apathy (p=0.320), cognitive (p=0.09), and depression (p=0.384) levels (Table 2).

The relationship between the demographic and disease characteristics of the stroke group and PA level is presented in Table 3. Only men and participants who were classified as level 5 according to FAC had a statistically higher PA level. There was no difference in the PA level between patients according to having any of recorded comorbidity (p>0.05) or according to the total number of comorbidities (p=0.517). The relationship between the PA level and neuropsychological factors are also demonstrated in Table 3. There were no relationship between the PA level and apathy, cognitive, and depression levels in the stroke patients.

DISCUSSION

The results of this study have shown that ambulatory subacute stroke patients have a significantly lower PA level than that of a population of the same age subjects. After stroke, men and those who are able to walk independently have a higher PA level. On the other hand, neuropsychological factors, such as apathy, cognitive, and depression levels, are not related to the PA level of stroke patients.

It is well known that a sustained decline in PA is common among stroke patients in the chronic term (29). It is also known that the PA levels of stroke patients are low in acute stroke wards (12,30). We found similar results for ambulatory stroke survivors in the early phase, although we included patients with an FAC level of >4 to except patients with moderate to severe motor deficits. This result is interesting in terms of the inequivalent distribution of dyspnea level of the participants in this study. Although the stroke group had statistically more participants at level I according to MRC (*"I only get breathless with strenuous exercise"*), it seems that this result does not positively affect the PA level in the stroke group when compared to the healthy group. There are some studies using accelometers that proved a low PA level of stroke patients (12,31). As pedometers were also found feasible to evaluate the PA level of stroke patients (22,32), we preferred to use a pedometer and found that the step count and walking distance in the stroke group were significantly less than those in the healthy group. This means these ambulatory stroke patients should not be overlooked as they have a high motor function to be able to walk in the community. It should be taken into consideration that they may have a low PA level. As physical inactivity is an important risk factor for stroke recurrence, its reasons should be investigated from the beginning of the disease to overcome this risk factor.

As the results of recent studies, we indicated that some neuropsychological factors, such as depression or cognition status, might be the reasons for the decrease in the PA level (11,14,33). Cognitive impairment appears in approximately two-thirds of stroke patients in an acute setting (34). It can cause disability with major impacts on independence in stroke patients. It is known that identifying stroke patients with impaired cognitive function is very important as they are at risk for developing inactivity one year after stroke (35). van der Zee et al. (36) found out that cognitive independence influences participation in community-dwelling stroke patients. In our study, we found no relation between PA and cognitive level. This may be related to the feature of the stroke patients we included. As the participants in this study may be classified as having minor stroke, cognitive impairment was not found to be sufficiently predominant among the participants.

Apathy secondary to stroke is another neuropsychiatric disturbance that impairs the ability of stroke patients to reason about goal-directed activity (37). van Almenkerk et al. (38) found apathy to be independently related to being in bed for >12 h a day in chronic stroke patients. Yao et al. (39) found that apathy has significant negative effects on leisure-time PA in community-dwelling elderly subjects. To our knowledge, there is no study that aimed to define the effect of apathy on the PA level in the subacute stage of stroke. We found no relation between the apathy and PA levels in our study. On the other hand, similar to the literature, we found that nearly 40% of the patients were apathetic during this phase (40).

Depressive symptoms have been estimated to occur in approximately 30% of stroke patients during the first weeks after stroke (41). Our finding is similar with this after approximately two months from stroke. It is known that depression leads to a decrease in the mobility level one to three years following stroke (42). In our study, as the participants can walk independently in the community, we thought that depression did not rebound to the PA level of those patients.

In our study, men in the stroke group were to be found more active than women. Surprisingly, there were more men in the stroke group in this study; the PA level of the healthy group was higher than that of the stroke group. This means the statistically inequivalent distribution of men between the groups did not cause bias in favor of the healthy group in this study. On the other hand, women may be thought to be have more risks for sedentary lifestyles after stroke. We understand the importance of eligible PA for women from a study that proved 17% stroke risk reduction for the most active women in comparison to the least active women (43). The strategies for raising the PA level of women needs to be studied further.

The FAC level is the other factor related to the PA level in our study. The major reason that causes a difference in terms of the PA level between two ambulation classifications might be muscle strength. The marked loss of strength in most of the major muscle groups of both lower limbs, even among ambulatory stroke patients, has been proved in a recent study (44). This finding shows that if subacute stroke patients have mild impairments related to ambulation level, this parameter should be checked carefully and treated before referral to regular PA.

This study has some limitations. Firstly, we did not perform item analysis of outcome measurements. Items that measure similar features in each outcome measurement could be analyzed to detail the effects of those factors on PA. Secondly, comorbidities of the healthy group were not collected as the participants had no regular reports about their health condition. There were some statistically differences between the stroke and healthy groups in this study. Differences in sex distribution and dyspnea level were discussed before. Distribution in smoking was not surprising because as smoking is a risk factor for stroke, we thought that it was normal to find more participants who quit or still smoke in the stroke group. As education level may affect the PA level, this significant difference between the groups could be regarded as another limitation of this study. This study also has some strengths. To our knowledge, this is the first cross-sectional study that analyzes the PA level and its non-motor contributions in subacute ambulatory stroke patients. Further, the study provides local information about PA habits of older people in Turkey. Another strength is that this study was able to highlight the low PA level among minor stroke patients. In light of the results, further studies could be performed in the same group collecting data on the detailed physical reasons of a low PA level. Balance, perception of balance, muscle strength impairments, or fear of falling might be the other reasons that affect the ambulatory and PA levels directly and/or indirectly in the stroke group.

In summary we conclude that ambulatory subacute stroke patients have a significantly lower PA level than that of a population of the same age. While neuropsychological factors are not related to the PA level of stroke patients, minor deviations from normal conditions about ambulation level cause to lower PA level. Women are under more risk for physical inactivity. To prevent stroke recurrence, referral of patients to PA is important and factors that limit PA level should be checked carefully in a physical manner.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Bakırköy Prof. Dr. Mazhar Osman Psychiatric Training and Research Hospital.

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