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# Motor skills, depressive symptoms and cognitive functions in post-stroke patients

*Habilidade motora, sintomas depressivos e função cognitiva em pacientes pós-AVC*

*Habilidad motora, síntomas depresivos y función cognitiva en pacientes pos-ACV*

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**ABSTRACT |** The aim of this study was (1) to characterize post-stroke patients according to motor skills (MS), depressive symptoms (DS) and cognitive function (CF), (2) compare these aspects according to sex, age, level of physical activity and (3) correlate them to time after stroke. We evaluated 135 subjects with mean age of 60 (± 15) years and 17 months post-stroke time. The following instruments were used: sociodemographic questionnaire, Fugl-Meyer Motor Scale (MA), Beck Depression Inventory (DS) and Mini Mental State Examination (CF). The Mann-Whitney test was used to compare sexes, ages and physical activity practice. The Spearman coefficient was used to verify the correlation between post-stroke time and the variables analyzed (MA, DS and CF). The group obtained an average of 118.19 (± 30.45) to MA, 9.93 (± 7.14) for DS and 21.7 (± 5.43) to CF. The results showed that women presented higher levels of depressive symptoms than men, patients older than 50 years presented lower scores for CF. There were no significant differences between sedentary and non-sedentary patients with regard to motor skills, depressive symptoms and cognitive function. No significant correlations were found between time and the variables analyzed. Our results will contribute to action and planning which seeks to improve the patient's quality of life.

Keywords | Stroke; Motor Skill; Depression; Cognition; Exercise.

**RESUMO |** Os objetivos deste estudo foram (1) caracterizar pacientes pós-AVC em relação à habilidade motora (HM), sintomas depressivos (SD) e função cognitiva (FC); (2) realizar comparações desses aspectos entre sexo, idade, nível de atividade física; e (3) correlacioná-los com o tempo pós-AVC. Avaliamos 135 sujeitos com idade média de 60 (±15) anos e tempo médio pós-AVC de 17 meses. Foram usados os seguintes instrumentos: questionário sociodemográfico, Protocolo de Habilidade Motora de Fugl-Meyer (HM), Inventário de Depressão de Beck (SD) e Mini Exame do Estado Mental (FC). O teste Mann-Whitney foi utilizado para comparação entre sexo, idade e prática de atividade física. O coeficiente de Spearman para verificar a correlação entre o tempo pós-AVC e as variáveis analisadas (HM, SD e FC). O grupo obteve uma média de 118,19 (±30,45) para HM, 9,93 (±7,14) para SD e de 21,7 (±5,43) para FC. Além disso, nossos resultados mostram que as mulheres apresentam maiores níveis de sintomas depressivos do que os homens, pacientes maiores de 50 anos apresentaram pior escore para FC. Não houve diferenças significativas entre pacientes praticantes e não praticantes de atividade física em relação à habilidade motora, sintomas depressivos e função cognitiva. Não foram encontradas correlações significativas entre o tempo pós-AVC e as variáveis analisadas. Nossos resultados contribuem para o planejamento e ações que busquem a melhora da qualidade de vida dos pacientes.

Descritores | Acidente Vascular Cerebral; Destreza Motora; Depressão; Cognição; Exercício.

**RESUMEN |** Los objetivos de este estudio fueran (1) caracterizar a los pacientes después del accidente cerebrovascular en relación con las habilidades motoras (HM), síntomas

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depresivos (DS) y la función cognitiva (CF), (2) hacer comparaciones de estos aspectos en cuanto al sexo, edad, nivel de actividad física y (3) correlacionar con el tiempo post-AVC. Se evaluaron 135 sujetos con edad media de 60 (± 15) años y tiempo medio post-AVC de 17 meses. Se utilizaron los siguientes instrumentos: cuestionario sociodemográfico, Protocolo de Habilidad Motora de *Fugl-Meyer* (HM), Inventario de Depresión de Beck (SD) y Mini Examen del Estado Mental (FC). La prueba *Mann-Whitney* fue utilizada para la comparación entre sexo, edad y práctica de actividad física. El coeficiente de *Spearman* fue utilizado para verificar la correlación entre el tiempo post-AVC y las variables analizadas (HM, SD y FC). El grupo obtuvo una media de 118,19 (± 30,45) para HM, 9,93 (± 7,14) para SD y de 21,7 (± 5,43) para FC. Además, nuestros resultados muestran que las mujeres presentan mayores niveles de síntomas depresivos que los hombres; los pacientes mayores de 50 años presentaron peor escore para FC. No hubo diferencias significativas entre pacientes practicantes y no practicantes de actividad física en relación con la habilidad motora, síntomas depresivos y función cognitiva. No se encontraron correlaciones significativas entre el tiempo post-AVC y las variables analizadas. Los resultados contribuyen a la planificación y acciones que busquen la mejora de la calidad de vida de los pacientes.

**Palabras clave** | Accidente Cerebrovascular; Destreza Motora; Depresión; Cognición; Ejercicio.

## INTRODUCTION

The stroke is a disease that affects approximately 16.9 million people worldwide[1], considered a highly disabling disease[2]. In the Brazilian scenario, strokes are still the country's leading cause of death[3].

The definition of stroke by the World Health Organization (WHO) is "a clinical syndrome consisting of rapidly developing clinical signs of focal (or global in case of coma) disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin"[4]. We can classify stroke as hemorrhagic and ischemic, with the latter representing 80% of cases[5].

Post-stroke complications vary according to lesion location as well as how critical it is[6]. Among the most common complications is impairment in motor skills, which may include deficits in the upper limbs, lower limbs and trunk[7].

The study by Carod-Artal et al.[8] shows that depression must be recognized as a post-stroke impairment. The authors conducted a survey of 260 patients and showed that depression, as well as motor impairment, is a determining factor for the worsening in quality of life for post-stroke patients. Limitations in cognitive function are also important because they influence the patient's overall impairment, since the higher the cognitive function impairment, the worse the patient's general condition with regard to clinical variables[9].

Although we know the relationship of these post-stroke variables, we do not know how they behave in individuals of different sexes, ages, be they practitioners or non-practitioners of physical activity.

Information on post-stroke complications is important for planning physical activity programs and/or physical exercises that promote quality of life for patients. The practice of physical exercises has benefits in improving the risk factors for stroke, such as hypertension[10] and arterial function[11]. However, being physically active is challenging for these patients, as they still face barriers such as lack of information and family support[11].

Billinger et al.[12] emphasize the importance of multidimensional assessments that contribute to the exercise planning. Thus, characteristics regarding the differences between sex, age, physical activity and time after stroke can influence the preparation of these programs.

The aim of this study was to characterize post-stroke patients with regard to motor skills, depressive symptoms and cognitive function, in addition to comparing these three aspects between male and female, older and younger than 50 years, and patients physically active and sedentary, as well as to verify the correlation between post-stroke time and the three components analyzed.

## METHODOLOGY

### Participants

A total of 135 patients with mean age of 60 (± 15) years, 80 males, with mean post-stroke time of 17 months were evaluated. Patients treated by the neurovascular program of the Hospital Central da Unicamp were included in this study. All patients were aware of the research and signed the Free and Informed Consent Term (TCLE) approved

by the Comitê de Ética em Pesquisa (approval number: 377/2011 – CAAE: 0321.0.146.000-11).

Inclusion criteria were: patients with single ischemic stroke and age between 18 and 85 years. Patients with severe aphasia and who had subsequent ischemic stroke were excluded from this study.

### Instruments

1) Identification card: designed for patient characterization, with data regarding gender, age, physical activity and time after stroke. Due to the lack of instruments to characterize the level of physical activity of this population, we considered physically active patients those who practiced regular physical activity at least twice a week, with a minimum duration of 15 minutes with or without the supervision of a professional; and sedentary patients the ones who stated they did not perform physical activities.
2) Fugl-Meyer Physical Performance Protocol[13,14]: It was used to evaluate the patients' impairment, considering three aspects: motor control, motor impairment in the upper and lower extremities, and balance. These aspects are organized in an ordinal scale of three, where 0 (zero) corresponds to no performance and 2 (two) indicates full performance. Thus, the higher the score in this protocol, the lower the patient's motor impairment. In this study, we considered the aspects motor skills for upper and lower limbs, sensitivity and balance, with a total score of 138, and where the higher the score, the better the motor skills.
3) Beck Depression Inventory (BDI)[15]: with 21 questions about different situations related to depression. The responses range from 0 to 3, where 0 (zero) indicates mild symptoms and 3 (three) very intense symptoms. A score of 0-10 represents no or few depressive symptoms; 10 to 18, minimal to moderate depressive symptoms; between 19 and 29, moderate or severe depressive symptoms; from 30 to 63, severe depressive symptoms.
4) Mini Mental State Examination (MMSE)[16]: instrument that evaluates the general cognitive functioning of the patient, with scores ranging from 0 (zero) to 30 (thirty). The higher the score on this scale, the better the patient's cognitive status.

### Data analysis

An exploratory data analysis was used to characterize the patients. Age, post-stroke, motor skills, depressive symptoms and cognitive function data are presented as mean, standard deviation, minimum, median, maximum, and interquartile range of 25% and 75%. The Shapiro-Wilk test was used to verify data normality. The comparison between male and female, between ages of 50 and older, and between physically active and sedentary men were performed using the Mann-Whitney test. The relationship between motor skill variables, depressive symptoms and cognitive function, and post-stroke time was analyzed using the Spearman correlation coefficient. A 5% level of significance was adopted for the analyses.

## RESULTS

A total of 135 subjects, mean age 60 (±15) years, of which 80 (59.3%) were male, 127 (94.1%) were right-handed and 64 (47.4%) were affected by stroke in the right hemisphere.

Regarding the characterization of the components evaluated for motor skills, the patients presented an average of 118.19 (±30.45) points. For depressive symptoms, mean 9.93 (±7.14) and mean cognitive function of 21.7 (±5.43). Data from Table 1 show mean, standard deviation, minimum, median, maximum, and interquartile range values of 25% and 75% for age, time after stroke and the variables analyzed.

The comparison between male and female for the analyzed variables is shown in Table 2. Only depressive symptoms presented a statistically significant difference between sexes, in that women presented higher values than men.

For the analysis of age, participants were divided into two groups: older than 50 years and younger than or equal to 50 years. Table 3 shows that patients older than 50 years present greater impairments in cognitive function.

Table 4 presents the comparison between the group of physically active (GF) and sedentary patients (GS). No statistically significant differences were found between groups.

Table 5 shows the correlation values between post-stroke time and the variables analyzed, showing that no statistically significant correlations were found.

Table 1. General characterization

| Variable | Mean | SD | Minimum | IR1 | Median | IR3 | Maximum |
|---|---|---|---|---|---|---|---|
| T. post-stroke (month) | 17.21 | 30.66 | 1.00 | 3.87 | 5.70 | 12.23 | 173.70 |
| Age (years) | 60.86 | 15.28 | 18.00 | 54.00 | 63.00 | 72.00 | 90.00 |
| FM | 118.19 | 30.45 | 0.00 | 116.00 | 131.00 | 136.00 | 138.00 |
| BDI | 9.93 | 7.14 | 1.00 | 5.00 | 8.00 | 14.00 | 45.00 |
| MMSE | 21.70 | 5.43 | 6.00 | 18.00 | 23.00 | 26.00 | 30.00 |

SD: Standard deviation; IR1: interquartile range of 25%; IR3: interquartile range of 75%; T. post-stroke: Time after stroke; FM: Fugl- Meyer; BDI: Beck Depression Inventory; MMSE: Mini Mental State Examination.

Table 2. Comparison of motor skills, depressive symptoms and cognitive function between male and female sex

| Variable | Female (N=55) | Male (N=80) | p-value[1] |
|---|---|---|---|
| FM (Mean ± SD) | 117.8 ± 28.8 | 118.5 ± 31.7 | 0.41 |
| BDI (Mean ± SD) | 12.9 ± 8.9 | 7.9 ± 4.7 | <0.01* |
| MMSE (Mean ± SD) | 21.3 ± 5.2 | 22.0 ± 5.6 | 0.38 |

SD: Standard deviation; FM: Fugl-Meyer; BDI: Beck Depression Inventory; MMSE: Mini Mental State Examination; [1] = Mann-Whitney test (p<0.05); *: Statistically significant difference.

Table 3. Comparison of motor ability, depressive symptoms and cognitive function between ages

| | Mean (±SD) | | |
|---|---|---|---|
| | ≤ 50 years (n=29) | > 50 years (n=106) | p-value[1] |
| FM | 121.93 (27.72) | 117.16 (31.20) | 0.097 |
| BDI | 12.96 (11.06) | 9.09 (5.39) | 0.174 |
| MMSE | 23.41 (5.41) | 21.22 (5.36) | 0.021* |

FM: Fugl-Meyer; BDI: Beck Depression Inventory; MMSE: Mini Mental State Examination; *: Statistically significant difference, [1] = Mann Whitney test, p<0.05.

Table 4. Comparison of motor ability, depressive symptoms and cognitive function among practitioners and non-practitioners of physical activity

| Variable | SG (n=99) | PG (n=36) | p-value[1] |
|---|---|---|---|
| FM (Mean ± SD) | 116.6 ± 31.6 | 122.6 ± 27.1 | 0.15 |
| BDI (Mean ± SD) | 10.1 ± 6.9 | 9.4 ± 7.7 | 0.47 |
| MMSE (Mean ± SD) | 21.5 ± 5.5 | 22.1 ± 5.2 | 0.61 |

SG: Sedentary Group; PF: Physically Active Group; SD: Standard Deviation; FM: Fugl-Meyer; BDI: Beck Depression Inventory; MMSE: Mini Mental State Examination; [1]: Mann-Whitney test.

Table 5. Correlation between motor skills, depressive symptoms and cognitive function, and time after stroke

| | | FM | BDI | MMSE |
|---|---|---|---|---|
| T. post-stroke | (r) | -0.02 | 0.04 | -0.07 |
| | (p) | 0.8 | 0.62 | 0.42 |

(r): Spearman correlation coefficient; (p): Significance; FM: Fugl-Meyer; BDI: Beck Depression Inventory; MMSE: Mini Mental State Examination.

## DISCUSSION

The aim of this study was to characterize post-stroke patients regarding motor aspects, depressive symptoms and cognitive function. In addition, we compared these variables between sex, age (older and younger than 50 years), and sedentary and physically active. We also performed a correlation between post-stroke time and MS, SD and CF. The results showed that women have more depressive symptoms than men; individuals older than 50 years present a greater impairment in cognitive function; practice of physical activity and time after stroke are not related to motor performance, depressive symptoms and cognitive function of individuals.

Regarding the aspect motor skills, the patients presented an average of 118.19 points (total of 138). Deficit in Motor skills in the case of post-stroke patients is very common[5]. Such impairments directly influence daily life activities[17], thus reducing the quality of life of these patients.

In addition, our study identified the presence of depressive symptoms in patients. The importance of checking for depressive signs and symptoms can avoid complications and death, as some authors show that patients with depression are 4 times more likely to die[18].

In this study, we compared motor skills, depressive symptoms and cognitive function amongst post-stroke patients, male and female. We found differences only in depressive symptoms, wherein women presented more intense levels, as observed in the study by Teng et al.[19]. For this finding, Grace et al.[20] explain that the reason may be due to genetic causes, psychosocial inequality, different social support and access to rehabilitation programs. In addition, brain organization and function may influence the difference found in this study, and depressive symptoms may be associated with the left cerebral hemisphere affected by stroke in women[21].

For the analysis of age, our study showed that patients older than 50 years have greater impairment in

cognitive function. Our finding corroborates the study by Kammersgaard et al.[22], in which older patients have more severe cognitive deficits. In addition, Naço et al.[23] also state that cognitive decline after a stroke exponentially increases after age 65.

We did not find significant differences in the motor ability of individuals older than 50 years. Despite this, we emphasize the importance of care in the planning of physical rehabilitation activities, respecting the individuality and the need of each patient.

Regarding the practice of physical activity, our results showed that there was no statistically significant difference for the variables analyzed between physically active and sedentary individuals. Similar findings were found in the study by Danielsson et al.[24], which showed that the motor function factor is not associated with the level of physical activity. In contrast, the systematic review study[25] involving 983 patients showed that higher levels of physical activity correlate with better levels of walking, balance and physical fitness. Possible gaps in the literature regarding tools that accurately assess information regarding the practice of physical activity in post-stroke patients may justify the differences presented in the review. We also emphasize that there is no empirical evidence on the incentive to practice regular exercise, as well as sources that promote exercise after the conventional rehabilitation process[26], and thus we recommend the development of tools and parameters to evaluate and classify the level of physical activity of post-stroke patients, as well as actions to promote the practice of systematized physical exercises and accompanied by appropriate professionals after the rehabilitation process.

Some studies have shown that physical activity is an important tool for improving physical fitness, reducing risks related to cardiovascular diseases[27], aside from its psychosocial benefits[12]. Billinger et al.[12] also stated that some precautions should be taken, such as patient follow-up through medical examinations. The authors also point out that there is insufficient information to determine how early the patient is ready to resume physical activity.

Our findings showed that post-stroke time does not correlate with the variables analyzed. Findings from Kwakkel et al.[28] indicate that motor skill and depressive symptoms improve over time. The study by Desmond et al.[29] also shows improvement in cognitive function as a function of time. However, in previous studies, the mean post-stroke time was four and three months, respectively. In our study, mean post-stroke time was 17 months, indicating that the variables analyzed improved in less time than our findings, and that there may be a plateau in motor skill improvement over time.

With regard to social support, Prout et al.[30] emphasize that the lack of family support and information are strong obstacles that prevent the post-stroke patient from having a physically active life. Thus, this study contributes with relevant information regarding different perspectives for a better understanding of the patient, thus enabling multi/interdisciplinary care, which favors the integral improvement of the patient.

## CONCLUSION

In this study, it was possible to conclude that female participants have more depressive symptoms than men. In addition, patients older than 50 years have a greater impairment in cognitive function than younger patients. We also observed that the mean time of 17 months post-stroke did not influence the aspects evaluated.

Regarding physical activity, the parameters considered in this study (15 minutes of exercise, twice a week) did not indicate differences between the sedentary group and the group practicing physical activity. However, we emphasize the importance of the practice of regular physical exercise that is guided by a professional of the area, contributing to the fight against risk factors for stroke.

The specificity of the presented characteristics regarding sex, age and physical activity practice contribute to the planning of actions that allow for the improvement in the quality of life of post-stroke patients.

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