

Follow-up analysis of the motor function of post-stroke individuals

Estudo de seguimento da função motora de indivíduos pós-acidente vascular encefálico

Estudio de seguimiento de la función motora de individuos post accidente cerebro vascular

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ABSTRACT | The aim of this study was to characterize and analyze changes in the variables related to the motor function of chronic hemiparetic patients after a period of seven years. The demographic and clinical data of the participants, who were initially assessed in 2003, were collected by telephone. All individuals were invited to participate in the reassessments, which included data related to respiratory strength, functional performance, physical ability, and physical activity levels. Descriptive statistics, Wilcoxon or paired *t*-tests were used for analyses. Out of the 101 hemiparetic participants, who were initially assessed in 2003, 65 subjects or their relatives were contacted by telephone; 35 (64.5±10.6 years) answered the questions by telephone, 8 passed away, and 22 (56.8±13.3 years) were physically assessed. After a mean follow up of seven years, none of the physically assessed variables showed significant differences between the two assessments (0.08<p<0.96), except for inspiratory strength (p<0.05), which increased. Although the decreasing motor and functional performances were expected due to the aging process, their maintenance or even improvements were observed. These results highlighted the importance of physical activity for this population.

Keywords | stroke; follow-up studies; clinical evolution; motor activity.

RESUMO | Objetivou-se caracterizar e analisar mudanças nas variáveis relacionadas à função motora de hemiparéticos crônicos após um período médio de sete anos. Coletaram-se via telefone dados demográficos e clínicos de hemiparéticos avaliados em 2003. Todos foram convidados a participar da reavaliação, em que se coletaram medidas de força da musculatura respiratória, desempenho funcional, capacidade física e nível de atividade física. Estatísticas descritivas, testes *t* pareado ou Wilcoxon foram utilizados para análise dos dados. Dos 101 hemiparéticos avaliados presencialmente em 2003, contataram-se por telefone 65 deles ou seus familiares, sendo que 35 (64,6±10,6 anos) responderam às questões por

telefone, 22 (56,8±13,3 anos) foram avaliados presencialmente e 8 faleceram. Após uma média de sete anos de seguimento, em relação às medidas realizadas presencialmente, nenhuma variável apresentou diferença significativa entre as avaliações (0,08<p<0,96), exceto a força da musculatura inspiratória (p<0,05), que aumentou. Apesar de serem esperadas reduções nos valores das variáveis devido ao envelhecimento, evidenciou-se a sua manutenção ou aumento, ressaltando-se assim, a importância desta população manter-se ativa.

Descritores | acidente vascular cerebral; seguimentos; evolução clínica; atividade motora.

RESUMEN | Se buscó caracterizar y analizar cambios en las variables relacionadas a la función motora de hemiparéticos crónicos después de un período medio de siete años. Se colectaron por teléfono datos demográficos y clínicos de hemiparéticos evaluados en 2003. Todos fueron invitados a participar de reevaluación, donde se colectaron medidas de fuerza de la musculatura respiratoria, desempeño funcional, capacidad física y nivel de actividad física. Estadísticas descriptivas, tests *t* pareados o Wilcoxon fueron utilizados para análisis de los datos. De los 101 hemiparéticos evaluados presencialmente en 2003, se contactaron por teléfono 65 de ellos o sus familiares, siendo que 35 (64,6±10,6 años) respondieron las preguntas por teléfono, 22 (56,8±13,3 años) fueron evaluados presencialmente y 8 fallecieron. Después de una media de siete años de seguimiento, en relación a las medidas realizadas presencialmente, ninguna variable presentó diferencia significativa entre las evaluaciones (0,08<p<0,96), excepto la fuerza de la musculatura inspiratoria (p<0,05), que aumentó. A pesar de ser esperadas reducciones en los valores de las variables debido al envejecimiento, se evidenció su manutención o aumento, resaltándose así, la importancia de que esa población se mantenga activa.

Palabras clave | accidente cerebro vascular; seguimientos; evolución clínica; actividad motora.

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INTRODUCTION

The increasing life expectancy observed throughout the world in the past few years led to the higher number of individuals who survived chronic diseases, among them, stroke¹. Saposnik and Del Brutto reported data on the incidence and prevalence of stroke in South America, where prevalence rates ranged from 1.74 to 6.51 per 1,000 inhabitants; incidence rates annually ranged from 0.35 to 1.83 per 1,000 inhabitants. With this increasing population, there are new demands related to public health services, especially focusing on the improvement of quality of life. Studies report that expenses related to hospitalization, rehabilitation and other aspects of long term care with this population generate considerable costs for society^{3,4}. It is estimated that approximately 3 to 4% of the total expenses with health in western countries are addressed to the treatment of stroke⁵.

After the stroke, individuals usually present with contralateral hemiparesis to the lesion, besides other motor deficits. Hemiparetic patients generate major social and economic impact not only for health systems, but also for their families and caretakers in terms of long term comorbidities and impairment⁶. Besides, one third of the chronic hemiparetic patients present remnant motor deficit^{7,8}, thus making their community reinsertion more difficult.

Studies demonstrate that both non-modifiable (hypercholesterolemia and presence of heart disease)⁹ and modifiable factors (such as muscle weakness and reduced cardiorespiratory conditioning) directly impact the morbidity and mortality of this population¹⁰. However, literature fails to mention how the variables related to modifiable factors, that is, those that can be manipulated with preventive strategies, impact or behave, with time, on hemiparetic patients.

Facing the expectation of the increasing incidence and recurrence of stroke in Brazil¹¹, there should be efforts to understand the observed deficits and the modifiable variables related to morbidity and mortality in order to provide its proper handling and prevention. Therefore, the objective of this study was to characterize and analyze variables related to the motor function in a population of chronic hemiparetic Brazilian patients after a mean follow-up period of seven years. The hypothesis was that worsened motor function could be observed with time.

METHODOLOGY

A longitudinal study was conducted in the Laboratory of Evaluation and Research of Cardiorespiratory Performance at *Universidade Federal de Minas Gerais* (UFMG). Hemiparetic patients from clinics, hospitals and rehabilitation centers from the city of Belo Horizonte, Minas Gerais, who were initially assessed from 2003 on, were recruited by telephone to compose the sample.

Inclusion criteria of the study for the physical assessment were: understanding and executing the commands identified by the Mini-Mental State Examination with cutoff points for the Brazilian population^{12,13}; being able to ambulate and having no other neurological or orthopedic disabilities. Those who could not understand/execute the procedures were excluded. The study was approved by the Ethics Committee of UFMG and all of the participants signed the informed consent form.

All of the 101 participants who participated in the first evaluation from 2003 on were contacted by telephone and, after this contact, demographic and clinical data, as well as information concerning time between evaluations, frequency of physical activity and hospitalization, were collected in order to characterize the sample. All of the participants who could be reached were invited to participate in a physical reassessment.

According to the same procedures and standardizations adopted at the time of the first evaluation, all measures were retaken. Data concerning the level of physical activity (Human Activity Profile – HAP¹⁴), functional performance (habitual and maximum gait speed¹⁵), respiratory muscle strength (manuvacuometer: maximal inspiratory pressure – MIP and maximal expiratory pressure – MEP^{16,17}) and physical ability (six minute walk test – 6MWT^{18,19}).

The level of physical activity was obtained by the self-reported performance questionnaire HAP¹⁴, being classified by the adjusted activity score (AAS), as follows: inactive (AAS<53), moderately active (53<AAS<74) and active (AAS>74)¹⁴. The maximal activity score (MAS) was also calculated.

In order to determine the level of functional performance, habitual and maximum gait speeds were assessed (the latter, only in reassessment). Individuals were asked to ambulate, in both speeds, through a 28 meter distance, using support ambulation orthosis if necessary. The time spent to walk through the 24 central meters was registered with a chronometer, using the mean of three measures for analysis¹⁵.

Manuvacuometry was used to indirectly assess the respiratory muscle strength by means of MIP and MEP. The used manovacuometer, which had been previously calibrated, presented operational interval of ± 300 cmH₂O (GeRar®, São Paulo, Brazil). The collection procedures were performed according to Neder et al.¹⁶ and Teixeira-Salmela et al.¹⁷.

Physical ability was assessed by the 6MWT. The procedures were performed according to the protocol described by Steele¹⁸, and standardizations were conducted in Brazilian Portuguese¹⁹. The individual was asked to walk as fast as possible, without running, on a flat corridor 34 meters long for six minutes. The distance run during the test was registered and used for analysis.

Data Analysis

Descriptive statistics was used to characterize the sample, with measures of central tendency and dispersion for quantitative variables and frequency measures for

categorical variables. In order to assess if there were significant differences in the level of physical activity, gait speed, inspiratory and expiratory muscle strength and distance run in the 6MWT between the assessments, the paired *t* test or the Wilcoxon test were used. The statistical software Statistical Package for the Social Sciences (SPSS), version 17.0, was used, and the considered significance level was 5%.

RESULTS

Out of the 101 assessed hemiparetic patients, it was possible to get in touch with 66 of them, and one refused to participate in the study. Therefore, it was possible to contact 65 participants or their relatives. Out of the 57 remaining individuals, 35 only answered the questions by phone and 22 were physically assessed. The recruiting process and reasons for not attending the re-assessment can be observed in Figure 1.

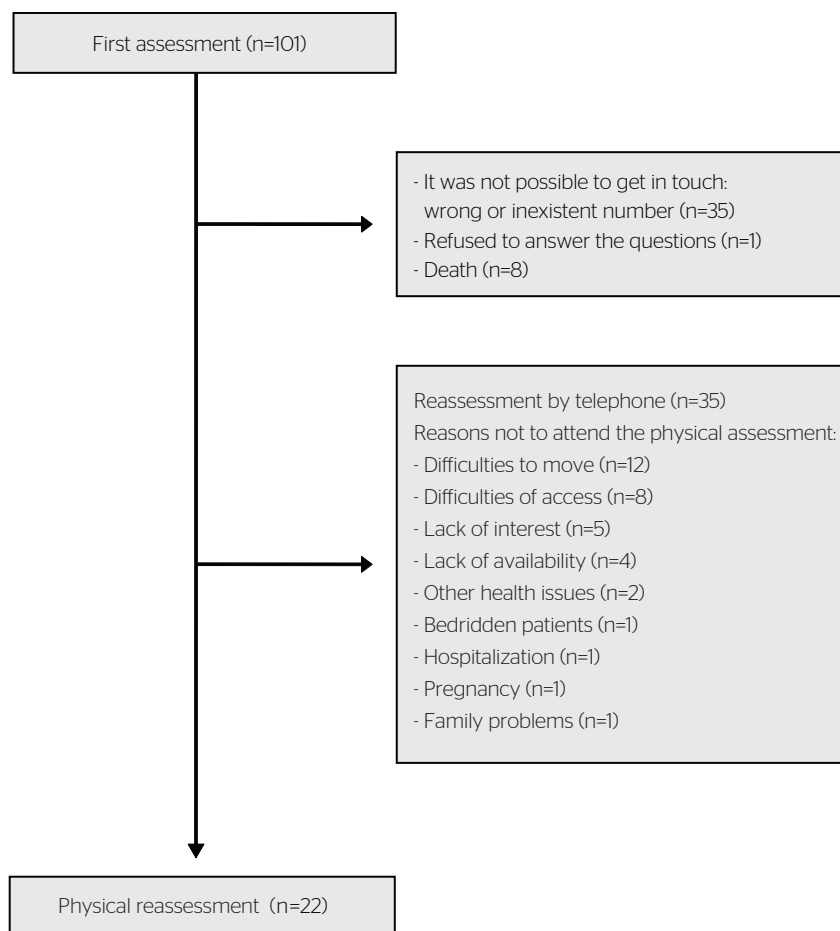


Figure 1. Recruiting process

Table 1 reports data related to the 22 individuals who were physically reassessed and to the 35 participants whose data were collected by telephone.

Table 2 presents the comparison between scores obtained in the reassessment in comparison to the first evaluation of the 22 analyzed individuals. In the first evaluation, six participants were classified as inactive by the HAP, 12 as moderately active and 4 as active. In the second evaluation, 5 were classified as active, 12

as moderately active and 5 as inactive. No statistically significant differences were observed for the HAP variables (AAS) ($p=0.77$) and HAP (MAS) ($p=0.18$), demonstrating that levels of physical activity were not different between evaluations. None of the other variables presented statistically significant differences between assessments ($0.08 < p < 0.96$), except for MIP ($p < 0.05$) (Table 2). Individuals presented maximum gait of 1.40 ± 0.6 m/s in the reassessment.

Table 1. Characteristics of the participants assessed physically and by telephone

Variable	Physical (n=22) mean±SD	By telephone (n=35) mean±SD
Age (years) (minimum-maximum)	56.8±13.3 (31-86)	64.6±10.6 (41-84)
Male gender (%)	11 (50.0)	16 (47.1)
Side of Hemiplegia, right (%)	17 (77.3)	12 (35.3)
Post-stroke time (years) (minimum-maximum)	10.8±3.3 (4.9-16.0)	12.4±5.6 (5.9-28.0)
New stroke (%)	1 (4.5)	6 (17.6)
Number of medications (number), mean±SD and variation (minimum-maximum)	4.7±2.9 (0-9)	4.0±1.8 (0-7)
Number of associated diseases (minimum-maximum)	3.1±2.1 (0-6)	3.4±2.0 (0-9)
Physical activity, yes (%)	5 (22.7)	5 (14.3)
Rehabilitation, yes (%)	7 (31.8)	5 (14.3)
Time of rehabilitation between assessments (years) (minimum-maximum)	NA	1.7±2.2 (0-9)
BMI (kg/m ²) (minimum-maximum)	26.5±5.4 (17.8-38.0)	NA

SD: standard deviation; NA: not assessed; BMI: body mass index

Table 2. Comparison of variables investigated between the two assessments (n=22)

Variable	Assessment	Follow-up	p-value
HAP (AAS) mean±SD (minimum-maximum)	60.23±17.69 (20-86)	64.00±16.80 (15-94)	0.45
HAP (MAS) mean±SD (minimum-maximum)	76.41±12.47 (43-94)	74.59±12.22 (33-94)	0.64
Gait speed (m/s) mean±SD (minimum-maximum)	0.97±0.45 (0.13-1.95)	0.87±0.34 (0.08-1.32)	0.23
MIP (cmH ₂ O) mean±SD (minimum-maximum)	78.55±36.62 (20-150)	99.55±37.60 (40-180)	0.03
MEP (cmH ₂ O) mean±SD (minimum-maximum)	93.76±49.19 (20-200)	88.13±38.94 (40-170)	0.52
6MWT (m) mean±SD (minimum-maximum)	360.48±139.93 (40-570)	317.1±135.25 (27-510)	0.08

HAP: human activity profile; AAS: adjusted activity score; MAS: maximal activity score; MIP: maximal inspiratory pressure; MEP: maximal expiratory pressure; 6MWT: distance run in the six minute walk test; SD: standard deviation

DISCUSSION

This is the first Brazilian study that analyzed the behavior of variables related to the motor function of chronic hemiparetic patients after a long follow-up period. Interestingly, even though the stroke is considered as the worst problem in Brazilian public health, little attention has been addressed to the control of risk factors for new events and follow-up of post-lesion survivors²⁰.

Even though André et al.¹ pointed out the reduced post-stroke mortality throughout the years in Brazil, which was justified, among other reasons, by the improved health conditions of the population, it was observed that after the average of seven years, 12% of the participants passed away. This value was higher than the one found in literature, which reports a mortality rate of approximately 5% for individuals aged between 55 and 64 years old²¹. Since it was not possible to obtain data concerning the severity of the lesion in individuals who passed away in this study, it is not possible to state that this discrepancy could be justified by the severity of the observed lesion.

Also, a 14% recurrence rate was observed for stroke, which was inferior to that reported in literature, which points out that the individuals in a period of approximately five years after the lesion have a 25 to 40% chance of suffering a new episode^{22,23}. However, this rate can be underestimated, since it is not possible to know if new episodes have occurred among the people who could not be reached.

Recently, Malmann et al.²⁴ observed in a population of hemiparetic patients that physical inactivity was determinant for new stroke events. The results of this study corroborate this finding, because in the first assessment, only 26.5% of the participants were classified as inactive, which contributes with the low found recurrence. Besides, the 22 individuals who were physically

reassessed maintained the activity levels and only one individual reported a new episode of stroke.

In relation to the functional level, no significant differences were observed between the assessments. Even though a tendency of reduced speed gait values was observed, participants kept appropriate values for community ambulation (>0.8 m/s)²⁵. Once gait speed measures are recognized as indicators of functional performance, independence and social participation²⁶, this fact points to the maintenance of the integration of the individuals in the community. Besides, in reassessment it was observed that individuals were able to improve their speed in 62% (analyzed by the maximum gait speed), and this finding is relevant, since this ability is related to community activities that demand acceleration, such as crossing streets safely²⁷.

In this study, an increased MIP was observed in reassessment. In this sense, it is very important to maintain the proper functioning of the post-stroke inspiratory muscles, once such weakness can lead to compromised respiratory function²⁸, thus leading to recurrent hospitalizations. Teixeira-Salmela et al.¹⁷ observed the decreased strength of respiratory muscles in hemiparetic patients when compared to healthy individuals. The increased MIP observed in this study could be partially explained by the high functional level observed, which could probably be associated with the increased motor demands throughout the years (muscle strength, for instance), which were not assessed in this study. This hypothesis is strengthened by studies that demonstrated the correlation between MIP and MEP and the peripheral muscles in individuals aged 20 to 80 years old¹⁶, and exclusively among the elderly²⁹.

Even though differences have been found between the values of MIP between the evaluations, no differences were observed between the distance run in the 6MWT, which is different from the result observed by Kelly et al.³⁰, who reported a relation between the performance in the 6MWT of acute hemiparetic patients with cardiorespiratory performance. This counterpoint can be explained by the differences between the samples in the studies, such as post-lesion time and functional levels.

In reassessment, only 20% stated to practice physical activities. However, data related to physical activity were not initially collected, so it was not possible to verify changes in this behavior. Studies show that all the variables investigated in this study present the tendency to decrease with time^{14,31-34}. However, such tendency was not confirmed.

Some limitations can be observed in this study. Data were reported by the individuals themselves, which may have led to memory bias. Factors that may have influenced the studied variables were not controlled between assessments, once the individuals were analyzed only twice. Besides, the episodes that occurred with people who could not be reached are not known. The data presented can only be generalized in populations with similar characteristics to the one analyzed here: chronic hemiparetic patients with high functional levels, since only these individuals had physical conditions to return to the reassessment location.

Therefore, even though reductions were expected in the values of the variables analyzed with aging, this study showed their maintenance or increase in the cases of MIP. Such fact can be associated with the maintenance of physical activity levels of post-stroke individuals.

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