

# Dual motor disability in an outpatient rehabilitation center: hemiparesis after stroke and lower limb amputation patients - Who are they?

## Dupla deficiência motora em um centro de reabilitação: hemiparesia após acidente vascular cerebral e amputação de membro inferior - Quem são eles?

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### ABSTRACT

**Objectives:** To estimate the prevalence of dual motor disability and to identify social, demographic, clinical and rehabilitation-related characteristics. **Methods:** Retrospective descriptive study in an outpatient rehabilitation center with individuals with dual motor disability from major lower limb amputation associated to post-stroke hemiparesis. Social demographic, clinical and rehabilitation characteristics data were collected from medical record. **Results:** The prevalence of dual motor disability was 5.4%. Seventy-six subjects were evaluated, 69.7% were male, with a mean age of  $65.6 \pm 9.3$  years. Hypertension was present in 96.1% of subjects, and 25% were smokers. Over 73% of patients had had the stroke prior to amputation. Time elapsed between lesions had a median of 23 months, and sequelae were ipsilateral in 51.3% of patients. Of these, 54 patients (71%) were referred to physical therapy. The time interval between dual disability and the beginning of therapy was 28 months, with total rehabilitation time of 14.3 months. At rehabilitation completion, 36% achieved their goals but 30% were discharges consequent to lack of compliance. **Conclusion:** The prevalence of dual motor disability due to hemiparesis secondary to stroke and lower limb amputation in a rehabilitation center was 5.4%. Our population showed singular characteristics related to the rehabilitation process, such as a long time between the occurrence of dual disability and the beginning of rehabilitation, and long rehabilitation period.

**Keywords:** Stroke, Paresis, Amputation, Rehabilitation, Epidemiology

### RESUMO

**Objetivo:** Estimar a prevalência da dupla deficiência motora e identificar as características social, demográficas, clínicas e relacionadas à reabilitação desses indivíduos. **Métodos:** Estudo descritivo retrospectivo realizado em um centro de reabilitação com indivíduos com dupla deficiência motora decorrente de amputação de membro inferior associada à hemiparesia após acidente vascular cerebral (AVC). Características sociodemográfica, clínica e relacionada a reabilitação foram coletadas através de consulta a prontuários. **Resultados:** A prevalência da dupla deficiência motora foi de 5,4%. Dos 76 indivíduos avaliados, 69,7% eram do sexo masculino, com média de idade de 65,6 ( $\pm 9,3$ ). A hipertensão arterial sistema estava presente em 96,1% dos indivíduos e 25% eram tabagistas. Mais que 73% dos pacientes tiveram o AVC prévio à amputação. O tempo entre as lesões foi, em mediana, de 23 meses, as sequelas foram ipsilaterais em 51,3% dos pacientes. Desses, 54 pacientes (71%) foram encaminhados para as terapias físicas. O tempo entre a dupla deficiência e o início da terapia foi de 28 meses, com tempo de reabilitação total de 14,3 meses. Ao fim do processo de reabilitação 36% alcançaram suas metas, mas 30% teve alta devido a falta de adesão ao tratamento. **Conclusão:** A prevalência da dupla deficiência motora devido a hemiparesia após AVC e amputação de membro inferior foi 5,4%, e a população estudada apresentou características singulares relacionada ao processo de reabilitação, como um longo tempo entre a ocorrência da dupla deficiência e o início da reabilitação, e um longo tempo na reabilitação.

**Palavras-chave:** Acidente Vascular Cerebral, Paresia, Amputação, Reabilitação, Epidemiologia

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Submitted: May 11, 2020

Accepted: Jul 27, 2020

#### How to cite

Makhoul MP, Santana KJ, Lopes UBL, Rodrigues NBB, Dell'Aglio CF, Oliveira CB, et al. Dual motor disability in an outpatient rehabilitation center: hemiparesis after stroke and lower limb amputation patients - Who are they? Acta Fisiatr. 2020;27(1):45-50.

DOI: 10.11606/issn.2317-0190.v27i1a169617



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## INTRODUCTION

The presence of arterial vascular disease in one territory represents an increased risk of occurrence of a second event in other territories.<sup>1</sup> The combination of cerebrovascular diseases and peripheral vascular diseases can result in an unfavorable physical condition with the concomitant presence of hemiparesis post-stroke and amputation often referred to as dual disability,<sup>2</sup> in this paper it was adopted the term dual motor disability to highlight exclusively motor impairments. The prevalence of dual motor disability varies according to the region: in the United States the prevalence is estimated at 18%<sup>2</sup> but in other countries such as Italy, the United Kingdom and Taiwan, it can be as high as 42%.<sup>1,3-5</sup> To the best of our knowledge, there is no information on the prevalence of dual motor disability in South America.

Dual motor disability has a direct impact on an individual's life, entails higher healthcare costs, and reduces the success rate of self-care and ambulation, in addition to making rehabilitation more difficult.<sup>1</sup> In the 1960s, prosthetic rehabilitation for individuals with both, amputation and hemiparesis, was contraindicated.<sup>6</sup> Even with an increased number of referrals in the beginning of the 1990s, this population was less frequently referred to prosthetic rehabilitation when compared with subjects who did not have dual motor disability.<sup>5,7</sup> Studies report that with advances in medicine and rehabilitation, there has been a significant change in this scenario, and patients who have had a stroke and an amputation started to be admitted to rehabilitation centers more frequently,<sup>1,4</sup> and have had satisfactory results with prosthetic rehabilitation.<sup>4</sup>

Many factors may influence the progress of rehabilitation in this population, including clinical severity and the unique characteristics of dual disability,<sup>3</sup> and this poses a great challenge to a multidisciplinary care team.<sup>3</sup> <sup>5</sup> Despite rising clinical and scientific interest about the rehabilitation of this population, dual motor disability remains under addressed.

## OBJECTIVE

In this context, the objective of this study was to estimate the prevalence of dual motor disability and to identify social, demographic, clinical and rehabilitation related characteristics of these individuals in an outpatient rehabilitation clinic.

## METHODS

This is a retrospective descriptive study, conforms to STROBE guidelines of information, conducted by a review of patients' charts in an outpatient rehabilitation center. Written informed consent was not obtained as this was a retrospective study and this study has been approved by the Ethics Committee of our Institution. All procedures performed involving human participants were in accordance to the ethical standards of the institutional and/or national research committee and with the 2000 Helsinki declaration and its later amendments or comparable ethical standards.

It was included individuals with medical diagnosis of major lower limb amputation associated with post-stroke hemiparesis, admitted to an outpatient rehabilitation center in the period between 2010 and 2015. The following levels were established for lower limb amputation: transtibial, knee disarticulation and transfemoral, either unilateral or bilateral, regardless of etiology. Subjects with incomplete charts, other associated neurologic pathologies, double hemiparesis, or absence of motor sequelae were excluded.

The following social and demographic characteristics were collected in this study: gender, age (in complete years) and level of education, which was categorized into: less than one year of schooling, from one to five years, from six to nine years and more than ten years of schooling.

Clinical data regarding stroke and amputation were based on the medical diagnosis and the following information was collected: date of occurrence of lesions, amputation side, level and etiology, side of hemiparesis and number of strokes.

Associated comorbidities listed were hypertension, diabetes mellitus (DM), dyslipidemia (DLP), chronic kidney disease (CKD), chronic obstructive pulmonary disease (COPD), heart disease, visual impairment, peripheral vascular disease, seizures and/or epilepsy. Lifestyle habits considered were drinking and smoking.

About rehabilitation process characteristics was considering the following time intervals were evaluated: time elapsed between dual motor disability and the beginning of rehabilitation, total rehabilitation time, as well as pre-prosthetic and prosthetic fitting time intervals. The type of therapy proposal was defined as following: pre-prosthetic therapy (i.e. preparing to prosthesis fitting); pre-prosthetic therapy

followed by prosthetic therapy (i.e. preparing and prosthesis fitting) and rehabilitation without prosthesis (i.e. rehabilitation without prosthetic goals). In addition, reasons for nonreferral of patients to physical rehabilitation were categorized as: clinical instability, patient forgoing rehabilitation and others.

The initial and final functional goals of rehabilitation for every patient were collected based the body function, activity and participation components of the International Classification of Functioning, Disability and Health (ICF), which belongs to the Family of International Classifications of the World Health Organization (WHO)<sup>8</sup> (Chart 1). The reason for patient's discharge or dropout from the rehabilitation process was categorized into: rehabilitation goals achieved, lack of compliance to treatment, clinical events/surgical procedures, cognitive or behavioural aspects and death.

## Statistical Analysis

A descriptive analysis was conducted for the clinical, social, demographic and rehabilitation-related variables aiming to identify the characteristics of the population studied. Normality analysis of the data was conducted using the Kolmogorov-Smirnov test, with numeric variables being presented as average and standard deviation ( $X \pm SD$ ) when normal, or median and range when not normal. Category variables will be presented in absolute terms and/or relative frequency. The established level of significance was 5% ( $p < .05$ ). The Statistical Package for the Social Sciences software (SPSS version 21, Inc., Chicago, IL, USA) was used for all analysis.

## RESULTS

Figure 1 demonstrates the flowchart for the processes of selection, inclusion and exclusion of patients with dual motor disability. Prevalence was estimated at 5.4%

As for social and demographic data of the patients analyzed, it was observed that 53 (69.7%) were male, and the mean age (SD) was 65.6 ( $\pm 9.3$  years). As for level of education, 11 (14.5%) had less than one year of schooling, 27 (35.5%) had one to five years, 36 (47.3%) has six to nine years, and 2 (2.6%) had more than ten years of schooling.

The clinical characteristics of dual motor disability patients are presented in Table 1 patients had a median of 1 stroke, ranging from

**Chart 1.** International Classification of Functioning (ICF) categories, and initial and final functional goals of subjects with dual motor disability in a rehabilitation center

ICF Categories	Initial and final functional goals
d410	Changing and maintaining body position (kneeling, sitting, standing, bending)
d465	Moving around using equipment (crutches and walkers)
b730	Muscle power functions
d420	Transferring oneself
b798	Neuromusculoskeletal and movement-related functions (stump massage, neuroma, compressive dressings)
d540	Dressing
b710	Mobility of joint functions
d415	Maintaining basic body position (remain standing)
d455	Moving around (stairs)
d198	Learning and applying knowledge

1 to 2. Time between lesions had a median of 23 months (average  $56.9 \pm 87.5$  months) varying from 0 to 562 months (approximately 47 years). Of the 76 patients analyzed, 22 were not eligible to begin physical rehabilitation, the most frequent reason being uncontrolled medical conditions ( $n=20$ , 91%). Of the 54 (71%) who were referred to a rehabilitation program, 34 (63%) of them were referred to a complete program (pre-prosthetic and prosthetic therapy), and 20 (37%) were referred to rehabilitation without prosthesis.

Of the 34 that initiated the complete program, 13 (38.2%) did not make it to the prosthetic fitting. Nine (20%) of patients are currently in rehabilitation. 36 patients completed the rehabilitation process.

Reasons for discharge or dropout of therapies were: goals achieved in 13 (36.1%) of subjects, lack of compliance to treatment in 11 (30.4%), clinical events during the therapy process in six (16.6%), death in four (11%), and cognitive/behavioural deficit, making the continuation of therapy not feasible, in two (5.5%).

Length of stay in the pre-prosthetic rehabilitation phase was, on average,  $11.7 \pm 7.3$  months for the 30 patients who completed this phase. Only 13 patients completed the training phase with the prosthesis, with an average period of  $5.8 \pm 3.8$  months. Thus, total rehabilitation time was  $14.3 \pm 10.8$  months. The time interval between dual motor disability (considered since the onset of the last impairment) and the beginning of therapy was  $28.6 \pm 21.1$  months. Subjects who began physical rehabilitation had their initial functional goals and their achieved goals categorized according to ICF codes that are presented in Figure 2.

## DISCUSSION

This study showed the unique characteristics of patients with dual motor disability secondary to lower limb amputation and post-stroke hemiparesis who were referred to an outpatient rehabilitation center. The characteristics of this particular population are diverse and not yet broadly established.<sup>1,9</sup> In a systematic review, Hebert et al<sup>9</sup> identified a prevalence variation ranging between 8 and 18%. Brunelli et al.<sup>3</sup> in 2006, reported a prevalence of 14%, of patients affected by above-knee amputation and hemiparesis. In Taiwan, the prevalence found was 8.7%.<sup>4</sup>

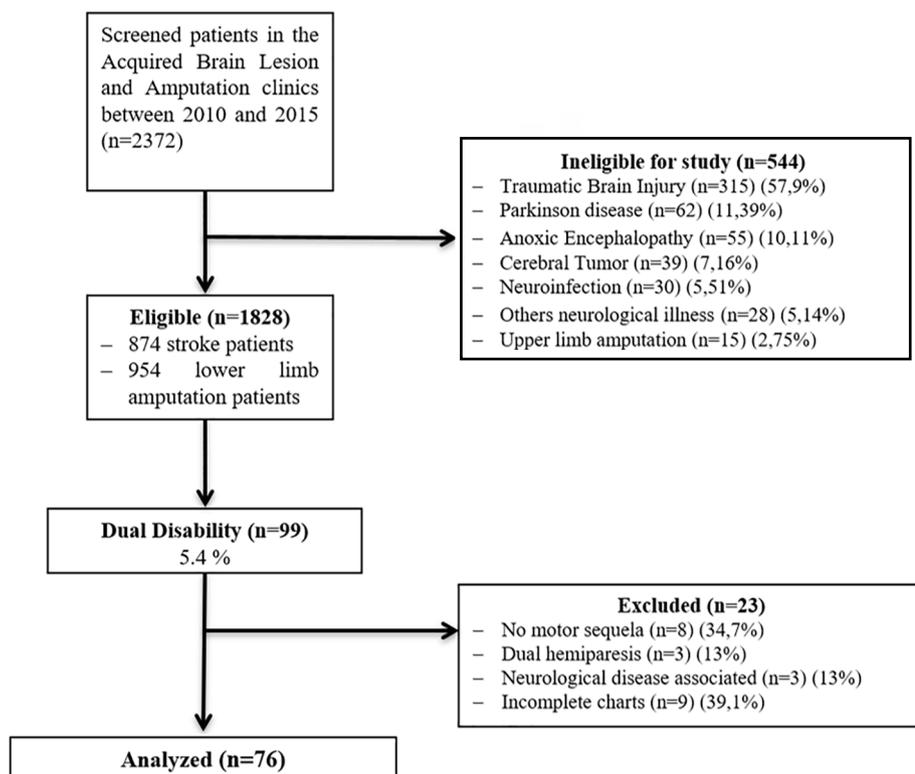
The prevalence for dual motor disability found in our study (5.4%) was lower than the reported in previous literature. This could be explained by several reasons: i) this population has a high incidence of mortality and the patients might have not reached the rehabilitation center. The presence of cerebrovascular disease increases mortality rate after an amputation in 2.3 times in the first 30 days and in 2.5 times in the first year<sup>10</sup>; ii) Prvu-Bettger et al.<sup>2</sup> have shown that amputees with concomitant neurological disorders have a higher number of comorbidities than patients with only an amputation; this could also decrease the presence of these subjects in a rehabilitation center; iii) this study was performed in a third world country in which patients have less access to Health Care and less information about Rehabilitation and this could lead to less referrals to the Rehabilitation Center; iv) in addition, Neumann et al.<sup>5</sup> reported that stroke associated with amputation is classified as a reason for nonreferral for rehabilitation, as well as cardio-respiratory problems, cognitive

dysfunction, patient's unwillingness, arthritis, or the association of any of these conditions,<sup>5</sup> in addition to the high morbidity/mortality rate of these individuals, that prevents them from getting to the rehabilitation phase<sup>1,2,5</sup>; v) our population presented with a low level of education and it has been shown that people with higher years of schooling, have a higher ability to manage chronic health conditions.<sup>11</sup>

Average age found in the present study ( $65.6 \pm 9.3$  years) corroborates previous ones, in which a variation of 62 to 69 years has been reported.<sup>1-4,12</sup> Age increased leads to greater exposure to risk factors which are common to both pathologies, such as hypertension, diabetes, dyslipidemias,<sup>13</sup> in addition to vascular alterations linked to aging itself, resulting in a higher risk of this condition occurring in the elderly.<sup>14</sup> As for gender distribution, there were more men than women in this study, as well as in several previous studies.<sup>1-5,12,15</sup>

When the pathologies are evaluated separately, a higher prevalence of males is also noticed<sup>16</sup>, thus increasing the occurrence in dual disability. With regards to level of education, no investigation was found addressing the level of schooling of subjects with dual motor disability. However, it is known that there is a positive correlation between subjects' level of education and their health conditions, even when other social and economic factors, such as income and race, are isolated, in such a manner that an additional one year of education reduces death rate by at least 3.6 percentage points for the next 10-year.<sup>11</sup> Also, education provides the individual with critical thinking that is vital to improve health.<sup>11</sup>

Regarding the order in which lesions occur in dual disability, our findings corroborate those of a number of studies,<sup>2,4,7,15</sup> which found a higher frequency of stroke occurring first, being followed by amputation. The presence of vascular injury in one territory is a risk factor for a second vascular event.<sup>1</sup> Stroke, as a first lesion, generates an important impact on subjects' mobility<sup>5</sup>, which, added to old age and hemiparesis, can lead to a greater predisposition to deep venous thrombosis, which in turn can trigger a process that leads to limb amputation.<sup>17</sup> Patients who have had a stroke prior to amputation are known to have a poorer prognosis as it relates to ambulation and rehabilitation success.<sup>18</sup> As for time between lesions, in this investigation we found a median of 23 months between lesions, similar to findings of previous studies conducted (23 to 32 months).<sup>3,15,19</sup>



**Figure 1.** Flowchart of selection of subjects with dual motor disability in an outpatient rehabilitation center

Findings by Chiu et al.<sup>4</sup> differ from the literature in that they show an average time between lesions of 4.9 years. It is known that functional status and the ability to walk after the first lesion are factors related to a better prognosis during rehabilitation.<sup>7</sup>

Among the comorbidities analyzed, hypertension, peripheral vascular disease and diabetes mellitus were the top three comorbidities seen in individuals with dual disability. Prvu-Bettge et al.<sup>2</sup> identified hypertension as the most frequent comorbidity, followed by congestive heart failure and anemia. Lifestyle habits as they relate to the occurrence of dual disability remain poorly studied, with the case report by Handa et al.<sup>15</sup> to be highlighted, pointing to alcohol abuse and smoking as the main habits. In this study, we could verify that 25% of subjects were smokers, reinforcing the impact of risk factors considered to be modifiable on the occurrence of dual disability.

Given the multifactorial etiology of both lesions, we can expect a clinical profile that adds risk factors.<sup>16,20</sup> These findings have a direct correlation with the vascular etiology, the most frequent cause of amputation found both in the present study and in previous ones.<sup>1,3,4</sup>

Laterality is one of the main prognostic factors leading to prosthesis abandonment.<sup>1</sup> The present investigation identified ipsilateral sequelae as the most frequent, in agreement with the literature.<sup>1,3,4,7,19,21</sup> Ipsilateral amputation and hemiparesis are recognized as one of the factors associated with a successful prosthetic rehabilitation of patients with dual disability.<sup>1,3,4,7</sup> The condition of the remaining limb as well as the condition of the limb contralateral to the affected leg are also predictors that may influence the success of prosthetic fitting.<sup>22</sup> Hemiparesis in the non-affected limb may interfere negatively in patients' ability to walk.<sup>1,3,7</sup>

One of the unique characteristics of our investigation has to do with time elapsed between the patient having dual disability and beginning rehabilitation, which is, on average, 28.6 months. No previous studies reported this type of data, but the importance of an early intervention in the rehabilitation process is well known, both for postamputation rehabilitation,<sup>1,4</sup> and for post-stroke rehabilitation, in which early intervention is a prognostic predictor of gait and independence in activities of daily living.<sup>23</sup>

In addition, in this investigation approximately 30% of the subjects were not referred to therapy and the main reason for this was an uncontrolled medical condition. It is broadly accepted that clinical conditions are an important factor influencing referral and the rehabilitation process; previous studies report that subjects amputated at the transtibial and transfemoral levels have a mortality rate over 52% within a year of amputation.<sup>24,25</sup>

In the same framework, previous studies has reported cerebral diseases as one of the factors associated with increased mortality within 30 days, and patients with cerebrovascular disease stand a 2.3-fold higher chance of dying than those without it.<sup>10</sup> Considering the period within one year of amputation, the chance of a patient dying increases to 2.5-fold.<sup>10</sup> These findings point to the importance of clinical stability as a patient safety factor for the start of the rehabilitation process.

In addition to this, energy expenditure during ambulation of transtibial amputees increases by 9 to 42%, while for above-knee amputees, energy expenditure increases by 82 to 125%,<sup>26</sup> but no one knows the impact of dual disability on energy expenditure in patients ambulating with prosthesis. Still, we can suppose that energy expenditure would be even greater leading to a higher risk of a cardiovascular event.

Subjects with dual motor disability have been improved independence in activities of daily living after rehabilitation. Moreover, it is known that these patients may benefit as specific training than in prosthetic therapy,<sup>1-5,7,9,12,15</sup> reaffirming the importance of including this population in a rehabilitation process. In this context, the literature suggests that regaining gait, with the aid of a prosthetic device, becomes the primary goal of the rehabilitation team when working with patients with dual disability.<sup>1,3-5,12,15,18,21</sup>

In the present investigation, most referrals, were to therapies aiming at prosthetic fitting, corroborating the literature. In a previous study,<sup>9</sup> approximately 58% of subjects with dual disability were referred to rehabilitation with a prosthetic device, with 70-80% of them maintaining gait one year after rehabilitation.<sup>9</sup> Factors correlated with success in prosthetic rehabilitation and gait of patients with dual disability are: amputation and ipsilateral hemiparesis, transtibial amputation and the absence of cognitive sequelae.<sup>1,3,5,7</sup>

The success of prosthetic rehabilitation is closely related to the phase prior to acquisition of the prosthetic device, with the need to

**Table 1.** Clinical characteristics of subjects with dual motor disability in an outpatient rehabilitation center

		N (%)
<b>Amputation side</b>	Right	32 (42.1)
	Left	33 (43.4)
	Bilateral	11 (14.5)
	Transstibial	16 (21.1)
	Transfemoral	49 (64.5)
<b>Amputation level</b>	Transstibial R and transstibial L	2 (2.6)
	Transstibial R and transfemoral L	3 (3.9)
	Transfemoral R and transfemoral L	4 (5.3)
	Transfemoral R and transstibial L	2 (2.6)
	Vascular	72 (94.7)
<b>Amputation etiology</b>	Infectious	2 (2.6)
	Traumatic	2 (2.6)
	Right	41 (53.9)
<b>Hemiparesis side</b>	Left	35 (46.1)
	Stroke-Amputation	56 (73.7)
<b>Order of occurrence</b>	Amputation-Stroke	17 (22.4)
	Simultaneous	3 (3.9)
	Ipsilateral	39 (51.3)
<b>Laterality of sequelae</b>	Contralateral	26 (34.2)
	Bilateral	11 (14.5)
	Hypertension	73 (96.1)
	Peripheral vascular disease	62 (81.6)
	Diabetes Mellitus	46 (60.5)
<b>Comorbidities</b>	Dyslipidemia	34 (44.7)
	Heart disease	32 (42.1)
	Chronic renal failure	6 (7.9)
	COPD	3 (3.9)
	Visual impairment	3 (3.9)
	Seizures/Epilepsy	2 (2.6)
	Alcohol consumption	9 (11.8)
<b>Lifestyle habits</b>	Smoking	19 (25.0)

prepare and explore the subject's maximum capacity in the pre-prosthetic phase.<sup>27</sup> General conditioning, cardiovascular endurance, adequate muscle strength and range of motion, management of the non-affected limb, and standing balance are all factors which contribute positively to a fitting of a prosthetic device.<sup>27,28</sup>

Patients with chronic diseases are frequently physically unfit due to reduced mobility and several comorbidities present. Consequently, they present functional dependence and dependence in activities of daily living, muscle weakness, balance deficit, and stroke-related deformities. In this context, the most frequent initial goals, based on ICF, are geared to primary aspects, such as stump massage, desensitization of a painful neuroma, functions related to muscle power and patient and family education.

To the best of our knowledge, no studies have used ICF to set the goals for rehabilitations in this dual disability population. It was opted for the use of ICF as the World Health

Organization report on disability considers the ICF as a universal landmark, and recommends its use both for research purposes and as a clinical and functional approach in disabilities.<sup>29</sup>

Other frequent goals were related to transferring oneself from one surface to another and changing basic body positions, such as kneeling, sitting, standing up and bending. The high frequency of goals considered to be basic in the prosthetic rehabilitation phase may be justified due to clinical and cognitive factors present in these individuals.

It is known that transfemoral amputation, old age, cognitive function deterioration, clinical and psychosocial status, as well as diabetes, are factors that negatively influence rehabilitation, impacting patients' motor learning ability and the acquisition of new skills.<sup>1-5</sup> The vascular etiology is closely related to cognitive alterations, mainly executive functions.<sup>30</sup> And so, gait becomes no longer the primary goal, and moving around with

equipment and transferring become more important.<sup>27</sup>

In the present study, only 36.1% of patients were discharged from rehabilitation because they achieved the goals proposed by the multidisciplinary team. Unfortunately, another frequent reason for patients to discontinue rehabilitation was the lack of compliance to treatment (30.4%). Rehabilitation treatment maintenance is associated with social, economic and emotional factors, requiring a network of care around the patient.<sup>29</sup> Factors such as lack of transportation, absence of a companion, clinical instability and motivational factors can make the rehabilitation process unfeasible.<sup>29</sup>

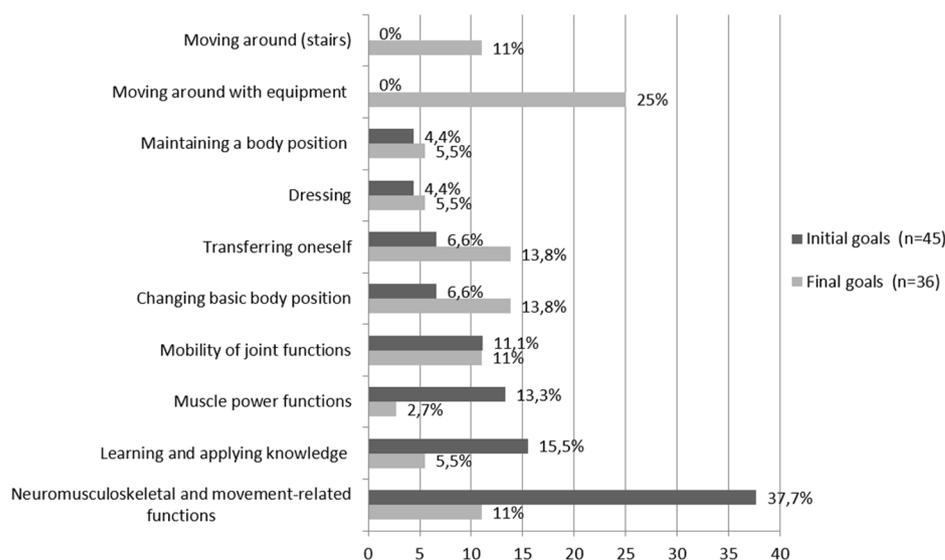
In this study, rehabilitation time was shown to be approximately six times longer than that reported by Brunelli et al.<sup>1,3</sup> and five times longer than that reported by Chiu et al.<sup>4</sup> A longer length of stay in specialized centers increases public spending and leads to changes in the family routine.<sup>29</sup>

The long length of stay of these subjects may be associated with the characteristics of dual disability presented in this study, such as amputation at the transfemoral level, longer time to begin rehabilitation (leading to increased osteo-articular and muscular complications, and cardiovascular unfitnes) and all consequences resulting from immobilization; all these factors could lead to a longer length of stay at our rehabilitation center.

The knowledge about subjects with dual motor disability is an important field which concern both scientific and clinical domains in order to provide an appropriate approach to this population which can benefit from rehabilitation. Our study was limited by its retrospective nature that implied all the known biases and limitations such as: missing data and variable assessment carried out by various examiners. The studied population is very specific, and this study presented a small sample size. Hence, we consider that a larger number of individuals could allow to perform a deeper analysis specially concerning the influence of sociodemographic and clinical characteristics on the rehabilitation process.

## CONCLUSION

The prevalence of dual motor disability due to hemiparesis secondary to stroke and amputation of lower limbs in a rehabilitation center is 5.4%. Our population showed singular characteristics related to rehabilitation process, such as long time between the occurrence of dual disability and the beginning of rehabilitation, and long stay in this process.



**Figure 2.** Initial and final goals of rehabilitation for subjects with dual motor disability in an outpatient rehabilitation center

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