

The Importance of Measuring Functional Independence for Rehabilitation Therapy in Older Trauma Patients

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Abstract— Traumatic injuries can have an impact on the functional capacity and quality of life of older adults. Given that, we sought to measure the functionality of older trauma patients and its implication for rehabilitation therapy. This is cross-sectional study of 257 trauma patients aged 60 years and older admitted to a public hospital in Brazil. A sociodemographic questionnaire and the Brazilian version of the Functional Independence Measure (FIM) were used. Mean FIM total score was 42.5 ± 19.9 , mean FIM motor score was 30.2 ± 21.5 , and mean FIM cognitive score was 74.5 ± 28.0 . The most affected FIM domains were self-care (mean of 25.6 ± 26.6), mobility (mean of 14.6 ± 28.7) and locomotion (mean of 9.7 ± 21.9). Men (mean total FIM score of 48.1 ± 23.1) were more independent than women (mean total FIM score of 39.0 ± 16.8), with statistically significant differences in mean FIM total score ($p < 0.001$) and in the motor ($p = 0.002$) and cognitive ($p = 0.029$) subscales. Self-care ($p < 0.001$), mobility ($p < 0.001$), locomotion ($p = 0.002$) and social cognition ($p = 0.024$) scores were significantly different between genders, with women exhibiting the worst scores. Lower body injuries significantly impaired motor ($p < 0.001$) and cognitive ($p = 0.002$) functionality. There was an impairment in functional independence, mainly among women, with a greater impact on the motor domain.

Keywords—Epidemiology; Trauma; Functional independence; Older adults.

Contribution of the paper:

- The present study assesses the three domains (FIM total, FIM motor and FIM cognitive) of the Functional Independence Measure.
- After the occurrence of a traumatic injury, older people present with their functional capacity at different levels of consequences.
- The FIM instrument can be used in clinical practice as an assessment tool intended to monitor individuals during the rehabilitation process.

I. INTRODUCTION

Aging is defined as a sequential, individual, cumulative, irreversible, universal, non-pathological process of deterioration of a mature organism that is common to all members of a species and that with time makes it less able

to cope with environmental stress, thus increasing the probability of death [1].

Brazil has a population of over 200 million inhabitants, 14.3% of whom are people aged 60 years and over [2]. The country has a high older population growth rate, with estimates for 2025 of about 30 million people aged 60 and older [3]. Maintenance of functional capacity in aging can be affected by demographic, social, economic, epidemiological and behavioral factors [4].

The demographic and epidemiological transition is a global problem in developed and developing countries [5]. This conjuncture gave rise to the concern of the World Health Organization regarding the conditions for "active" aging based on the process of optimizing opportunities for health, participation and safety to improve the quality of life of aging people [6].

Two concepts define aging: the senescence, the period when there is a gradual physical and mental deterioration but that is a natural process in the life cycle, and the senility, the stage in which there is a physical decline accompanied by mental disorganization that may suggest a pathological process [7].

Therefore, aging is a physiological process characterized by a gradual reduction of organic functional reserves which determine the progressive loss of ability to adapt to the environment, causing greater vulnerability to and higher incidence of pathological processes [8].

In the context of aging, disability for daily life activities and instrumental daily life activities present characteristics that suggest a complex casual network. Therefore, preventive actions are needed to improve older adults' quality of life [9].

Aging is accompanied by a significant increase of comorbidities and chronic and degenerative diseases which are closely related to a cognitive decline and dependence in functional activities [10]. Therefore, it is important to pay attention to the cognitive and functional performance of older adults with the aim of preventing their decline, which is quite frequent in public health services [11].

People aged 75 years and over have increased odds of becoming dependent and needing assistance to perform activities of daily living. Falls are the main leading cause of fractures, trauma admissions and loss of independence [12]. Furthermore, falls cause pain, isolation, disability, loss of confidence, and have a significant impact on quality of life and health-related costs [13].

Thus, the maintenance of the functional capacity of older adults can be affected by several factors that generally propagate chronic health problems, which are important components for assessing the health of older people, especially those with disabling diseases such as the ones resulting from trauma [14]. Functional capacity is understood as the product of the interaction between physical and mental health, the independence in activities of daily living and the integration into the social environment supported by family and economic independence [15].

Population aging is found to be associated with the increased occurrence of certain diseases, including those with external causes – accidents and violence [16] These events are significant in the older population because with advancing age older people often get frail and dependent and are hence more vulnerable to various types of trauma [17].

The concept of older adults' health is related to functional capacity, but the relationship between trauma and dependence/independence is still little discussed. Thus,

the application of the Functional Independence Measure (FIM) in older people allows to assess whether trauma can lead to a decreased functional capacity in both basic activities of daily living (ADL) and instrumental activities of daily living (IADL), loss of independence and autonomy, and decreased quality of life [18].

Given the growth of the older population and the occurrence of traumatic injuries that impact on their functional capacity and quality of life, the present study aimed to measure the functionality of older trauma patients and its implication for rehabilitation therapy. This study is deemed important due to the increasing number of older people in society and the preservation of functional capacity as a key aspect of the concept of health of the older people.

II. METHODS

This is a quantitative, descriptive and analytical cross-sectional study conducted in a reference university hospital for polytrauma care in the city of Fortaleza, Ceará, Northeastern Brazil. The hospital has 425 beds and performs an average of 15,500 consultations per month 24 hours a day. It is also equipped with a Center for Studies and Research suitable for the development of a continuing education program.

The study population consisted of older victims of trauma due to external causes admitted and hospitalized for clinical or surgical treatment in the hospital. Older adults aged 60 and older were selected and identified based on a census of patients organized by unit and bed of the five trauma centers. The census contained information on patient admission obtained from the hospital information system of Brazil's Ministry of Health – DATASUS.

Data were collected from April to August 2014 using a socioeconomic and demographic questionnaire (age, gender, education, income, marital status, household, and self-defined ethnicity) and the Brazilian version of the Functional Independence Measure (FIM). The FIM contains 18 items divided into two subscales: the motor subscale (13 items) and the cognitive subscale (5 items). The motor subscale collects information on self-care, sphincter control, transfer, and locomotion. The cognitive subscale collects information on communication and social cognition. All items are scored using a seven-point ordinal scale based on the number of assistance required for the patient to perform each activity. Higher FIM scores indicate higher levels of independence. The total FIM score ranges from 18 to 126 [19].

Since each FIM domain assesses a different number of items, the scores were standardized into a single scale to facilitate understanding of the results. Standardization of the scores followed the procedures described by Brazil's

Ministry of Health [20]. A scale of 0 to 100 was built using the following formula:

$$100 \times \frac{[\text{score obtained} - \text{minimum value}]}{\text{maximum value} - \text{minimum value}}$$

The study included people aged 60 years and older admitted to the university hospital with trauma. Eligible participants should present with physical and mental capacity to answer the questionnaire or be accompanied by family members, caregivers or nurses who could deliver the information requested. Patients with previous functional sequelae of trauma or any pathological associations such as Stroke, Alzheimer's disease, Parkinson's disease or any other physical diseases, amputation or mental disorder that limited the application of the questionnaires were excluded from the study.

Data were analyzed using the Statistical Package for the Social Sciences – SPSS version 20 (SPSS Inc., Chicago, IL, USA). Dependence in FIM domains and the degree of dependence according to location of injury and gender were assessed using analysis of variance (ANOVA), Tukey test and Chi-squared test. Inferential procedures were carried out considering a significance level of 5%.

This research is in accordance with all ethical standards of Resolution 466/12 of the National Health Council, which regulates research involving human subjects. Participants were explained about the research objectives and anonymity was ensured. Written informed consent was obtained from all the participants. Data collection took place after the project was approved by the Research Ethics Committee of the University of Fortaleza (UNIFOR) under Protocol No.564.088/2014.

III. RESULTS

Of the 280 older people enrolled, 23 were excluded from the study due to previous functional sequelae of trauma. The study included 257 older people hospitalized due to different types of trauma. The age of the participants ranged from 60 to 99 years, with a mean age of 75.8 (± 9.74). There were 158 (61.5%) women and 99 (38.5%) men. There was a predominance of individuals with incomplete primary education and uneducated individuals. Most of the participants received one minimum wage, were married and lived with family members. There was a predominance of pardos (mixed-race Brazilians) and white individuals.

The mean time of bed rest taken at the hospital by older people in the present study was 7.83 days ($SD \pm 15.55$): men spent 14.11 days ($SD \pm 21.99$) and women spent 4.39 days ($SD \pm 8.87$). The mean scores in the subscales and their domains are described in Table 1. The mean FIM

total score was 42.5 ± 19.9 , the mean FIM motor score was 30.2 ± 21.5 , and the mean FIM cognitive score was 74.5 ± 28.0 . The most affected FIM domains were self-care (mean of 25.6 ± 26.6), transfer (mean of 14.6 ± 28.7) and locomotion (mean of 9.7 ± 21.9) (Table 1).

Table 2 shows that men (mean total FIM score of 48.1 ± 23.1) were more independent than women (mean total FIM score of 39.0 ± 16.8), with statistically significant differences in the mean FIM total score ($p < 0.001$) and in the motor ($p = 0.002$) and cognitive ($p = 0.029$) subscales. Self-care ($p < 0.001$), transfer ($p < 0.001$), locomotion ($p = 0.002$) and social cognition ($p = 0.024$) scores were significantly different between genders, with women exhibiting the worst scores (Table 2).

Table 3 depicts the mean FIM total scores and its subscales and domains in relation to location of injury. Lower body injuries were the ones that mostly impaired functional independence, both in the motor ($p < 0.001$) and cognitive ($p = 0.002$) subscales. Lower body injuries significantly ($p < 0.001$) impaired self-care, transfer, locomotion, and social cognition (Table 3).

Table 4 shows that most patients had lower body injuries (214; 83.3%) and a high prevalence of lower body fractures – fracture of femur (86; 33.5%) (Table 4). The clinical diagnosis of injuries was based on the codes of the International Classification of Diseases – ICD-10 described in the medical charts.

IV. DISCUSSION

The present study stands out for assessing the three domains (FIM total, FIM motor and FIM cognitive) of the Functional Independence Measure in 257 older hospitalized patients to assess functional capacity after a traumatic injury. In our study, the mean age of the participants was 75.8 ± 9.74 . Research conducted with geriatric trauma patients found a similar mean age (78 ± 8.2) [21]. Evidence on the association between age and functional dependence is well reported and the risk for dependence increases per year of age [22, 23, 24].

The predominance of individuals with incomplete primary education and uneducated individuals is in line with evidence on the association between low literacy and functional dependence [25]. Education is an important component of health as it transforms general intelligence into higher-order cognitive skills that promote risk assessment and decision making abilities related to health [26]. In the case of patients with low literacy skills and poor functional independence, health education could be provided by health care professionals, particularly nurses, as they are in contact with the patients more often than any other member of the healthcare team.

The mean time of bed rest taken at the hospital by older people in the present study was 7.83 days (SD±15.55): men spent 14.11 days (SD±21.99) and women spent 4.39 days (SD±8.87). Shorter hospital length of stay is associated with better functional outcomes and lower mortality [27]. It should be noted, however, that determining whether hospital length of stay is short or long is difficult because it depends on several variables, such as the type of trauma and the patient's recovery time. In our study, the variation obtained in the scores of the FIM domains corresponds to the possible range of variation. A similar study that aimed to identify changes in functional independence of older patients admitted to medical centers at the time of hospital admission, hospital discharge and one month after returning home, found – at admission – FIM total scores of 109.2, FIM motor scores of 76.8, and cognitive FIM scores of 32.4 [28]. These values are proportionally similar to the values found in our study.

The most affected FIM domains in our study were self-care, transfer and locomotion. Care dependence in old age has major implications for older adults as many of them will be vulnerable to suboptimal care and care failures [29]. Therefore, assessing older adults' functional dependence is important to identify potential care vulnerabilities to which they may be exposed to and thus develop and implement interventions to provide dependent older adults with quality care. In our study, men presented higher mean scores in nearly all the domains.

This finding demonstrates that women had a more compromised functional independence. Other studies have shown similar results [19,30], thus confirming that the female gender is an independent risk factor for functional dependence. Estimates of the prevalence of functional disability resulting from trauma reveal that many people, mostly women, have greater difficulties or disabilities in daily activities, and these difficulties increase with age [23, 24].

Another study that compared men and women in all age groups found that functional limitation is more common among women and older adults [31].

Functional capacity differences in relation to gender are well known. Poorer functional independence in women may be associated with the fact that women live longer than men on average, but with a poorer health status, which results in a survival with limitations. Therefore, the female gender stands out as an independent risk factor for decreased functionality because women have an increased life expectancy and are at higher risk of developing chronic diseases which can result in functional limitations and disabilities [32, 33].

In our study, the analysis of the association between functional Independence measure and location of injury revealed that lower body injuries were the ones that mostly impaired functional independence, both in the motor ($p<0.001$) and cognitive ($p=0.002$) subscales. Lower body injuries significantly ($p<0.001$) impaired self-care, transfer, locomotion, and social cognition. These findings are consistent with the findings of research which showed that 73.0% of the interviewees had injuries in the lower limbs compared with 13.5% in the upper limbs [34]. Lower body functional limitation is a well-known risk factor for functional dependence as it can directly affect locomotion and transfer and hence lead to decreased self-care, cognitive function and social cognition [25].

Researchers, supported by clinical and neural data, argue that motor and cognitive processes are functionally related and probably share a similar evolutionary history. In addition, the authors argue that cognitive processes coincide with complex motor output and support the reverse notion that motor processes can contribute to cognitive function, i.e., motor and cognitive processes possess dynamic bidirectional influences on each other [35].

It should be noted that all the participants included in our study presented with injuries from external causes. In this regard, Itami et al.[34] emphasize that trauma caused by accidents and violence cause tremendous economic costs due to the potential years of life lost, hospitalization, treatment and rehabilitation, which in turn lead to social and psychological/emotional damages.

The FIM is a multidimensional instrument that is mainly aimed at assessing the patient's progress in rehabilitation therapy on a hospital basis, particularly in victims of traumatic injuries. In this regard, researchers have found that there was a considerable increase in the mean FIM scores (FIM motor and total FIM) at discharge, suggesting functional independence gain in relation to the moment following the traumatic injury [36,37].

The FIM Instrument was intended to monitor individuals during the rehabilitation process and aims to analyze the individuals' efficiency in performing activities of daily living independently. Studies on trauma reveal that clinicians and researchers require reliable and valid measures of long-term outcome. They report that the FIM instrument should be used in clinical practice as an assessment tool intended to monitor individuals during the rehabilitation process, and the early onset of rehabilitation will enable patients to perform more comfortable daily life activities and to achieve more functional gain [34, 38]. In addition, the use of the FIM instrument enables the members of the interdisciplinary

rehabilitation team to be continually aware of the progress being achieved by each team member and by the team as a whole [39, 40].

One of the limitations of the present study was the lack of information about the FIM before the traumatic injury, which could be compared to the findings after the traumatic injury; thus, such information was limited to the patients' or caregivers' self-reports. Another limitation is the fact that some older patients or caregivers had no prior knowledge of the presence of systematic diseases; additionally, as they are patients admitted on an emergency basis, the records did not always contain the results of complementary tests. However, it should be noted that the FIM instrument should be used for decision making in clinical practice during the rehabilitation process.

More importantly, as the present study was limited to patients of a single reference traumatology hospital, its findings cannot be extrapolated to the rest of the older population who suffered a traumatic injury. However, because it is a large hospital of excellence in Northeastern Brazil, similar results are expected in other populations with the same characteristics.

Furthermore, it is believed that health promotion and prevention and self-care should be emphasized in reference to the senescence process, both for undergraduate students and for continuing education professionals in the health field.

Further research is recommended to deepen knowledge in the area and support the development of strategies aimed to minimize the impact of trauma on the functional capacity of older adults and hence contribute to a healthy aging.

V. CONCLUSION

The results revealed an impairment in functional independence, particularly among women. Such impairment has greater impact on the motor domain, with a loss of the ability to perform self-care, transfer and locomotion activities, which show that after the occurrence of a traumatic injury, older people present with their functional capacity at different levels of consequences.

Therefore, the Functional Independence Measure – a sensitive and reliable instrument – can be a great ally of health professionals, particularly in traumatology, to assess the performance and progress of patients with functional disability resulting from trauma who receive recovery and rehabilitation therapy.

ETHICAL APPROVAL

This study was approved by the Research Ethics Committee of the University of Fortaleza (UNIFOR) under Protocol No. 564.088/2014.

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Table 1. Descriptive analysis of original and standardized FIM scores.

FIM	Scale	Mean ± Standard Minimum	
		deviation	Maximum
Total	Original	63.9 ± 21.5	19 – 126
	Standardized	42.5 ± 19.9	0.9 – 100
Motor	Original	36.6 ± 16.8	13 – 91
	Standardized	30.2 ± 21.5	0 – 100
Cognitive	Original	27.4 ± 8.4	5 – 35
	Standardized	74.5 ± 28.0	0 – 100
Self-care	Original	15.2 ± 9.6	6 - 42
	Standardized	25.6 ± 26.6	0 - 100
Sphincter control	Original	12.6 ± 3.3	2 - 14
	Standardized	88.2 ± 27.7	0 - 100
Transfer	Original	5.6 ± 5.2	3 - 21
	Standardized	14.6 ± 28.7	0 - 100
Locomotion	Original	3.2 ± 2.6	2 - 14
	Standardized	9.7 ± 21.9	0 - 100
Communication	Original	11.8 ± 3.5	2 - 14
	Standardized	81.9 ± 28.8	0 - 100
Social cognition	Original	15.5 ± 5.4	3 - 21
	Standardized	69.5 ± 29.9	0 - 100

Table 2. Association of FIM total score and domains with participants' gender.

FIM	Scale	Men	Women	P
		Mean ± Standard Deviation		
Total	Original	70.0 ± 24.9	60.1 ± 18.1	<0.001
	Standardized	48.1 ± 23.1	39.0 ± 16.8	
Motor	Original	41.8 ± 20.1	33.3 ± 13.4	0.002
	Standardized	37.0 ± 25.8	26.0 ± 17.2	
Cognitive	Original	28.1 ± 8.7	26.9 ± 8.2	0.029
	Standardized	77.1 ± 29.1	72.9 ± 27.2	
Self-care	Original	18.3 ± 11.1	13.3 ± 8.0	0.001
	Standardized	34.0 ± 30.8	20.3 ± 22.2	
Sphincter control	Original	12.5 ± 3.2	12.6 ± 3.4	0.434
	Standardized	87.8 ± 27.0	88.4 ± 28.2	
Transfer	Original	7.2 ± 6.2	4.6 ± 4.1	<0.001
	Standardized	23.3 ± 34.5	9.1 ± 22.8	
Locomotion	Original	3.9 ± 3.2	2.7 ± 2.1	<0.001
	Standardized	15.5 ± 26.6	6.0 ± 17.4	
Communication	Original	11.9 ± 3.5	11.8 ± 3.4	0.581
	Standardized	82.4 ± 29.4	81.6 ± 28.5	
Social cognition	Original	16.3 ± 5.4	15.1 ± 5.3	0.024
	Standardized	73.6 ± 30.1	67.0 ± 29.6	

Mann-Whitney U test.

Table 3. Association of FIM total score and domains with location of injury.

FIM	Scale	Location of injury			p
		Upper body	Lower body	Skull and face	
		Mean ± Standard deviation			
Total	Original	80.8 ± 19.5	60.0 ± 17.5	87.6 ± 37.9	<0.001
	Standardized	58.1 ± 18.0	38.9 ± 16.2	64.5 ± 35.1	
Motor	Original	50.1 ± 16.5	33.2 ± 12.8	58.8 ± 30.6	<0.001
	Standardized	47.6 ± 21.2	25.9 ± 16.4	58.8 ± 39.2	
Cognitive	Original	30.7 ± 6.2	26.8 ± 8.4	28.8 ± 9.9	0.002
	Standardized	85.5 ± 20.8	72.8 ± 28.1	79.4 ± 33.0	
Self-care	Original	21.3 ± 9.0	13.6 ± 8.1	25.9 ± 16.1	<0.001
	Standardized	42.5 ± 24.9	21.2 ± 22.5	55.2 ± 44.6	
Sphincter control	Original	13.0 ± 2.8	12.6 ± 3.4	11.9 ± 3.7	0.603
	Standardized	91.7 ± 23.1	88.2 ± 28.0	82.8 ± 30.7	
Transfer	Original	10.8 ± 5.7	4.4 ± 3.7	13.1 ± 8.6	<0.001
	Standardized	43.2 ± 31.7	7.8 ± 20.4	56.2 ± 47.7	
Locomotion	Original	5.0 ± 2.4	2.6 ± 1.8	7.9 ± 5.1	<0.001
	Standardized	25.3 ± 19.8	4.6 ± 14.6	49.0 ± 42.6	
Communication	Original	12.9 ± 2.3	11.7 ± 3.5	12.2 ± 3.6	0.118
	Standardized	91.0 ± 19.6	80.6 ± 29.5	84.8 ± 30.2	
Social cognition	Original	17.7 ± 4.6	15.2 ± 5.3	16.6 ± 6.6	<0.001
	Standardized	81.8 ± 25.6	67.5 ± 29.6	75.8 ± 36.8	

Kruskal-Wallis test

Table 4. Distribution, location and identification of traumatic injuries.

	Location	N	%
Injury	Upper body	26	10.10
	Lower body	214	83.30
	Skull and face	17	6.60
ICD according to location			
Lower body	s72 – Fracture of femur	92	43.0
	s72.2 – Subtrochanteric fracture of femur	40	18.7
	s72.0 – Fracture of head and neck of femur	33	15.4
	s82.2 – Fracture of shaft of tibia	29	13.6
	s72.3 – Fracture of shaft of femur	11	5.1
	S92 – Fracture of feet	6	2.8
	S82 – Fracture of lower leg, including ankle	3	1.4
	Upper body	s42.2 – Fracture of upper end of humerus	5
s42.3 – Fracture of shaft of humerus		10	38.5
s53.1 – Unspecified subluxation and dislocation of ulnohumeral joint		4	15.40
s42 – Fracture of shoulder and upper arm		2	7.7
s62 – Fracture at wrist and hand level		3	11.5
s42.0 – Fracture of clavicle		2	7.7
Skull and face	s02.4 – Fracture of malar, maxillary and zygoma bones	4	23.50
	s02.6 – Fracture of mandible	3	17.6
	s02.7 – Multiple fractures involving skull and facial bones	2	11.80
	s06.9 – Unspecified intracranial injury	5	29.4
	t07 – Unspecified multiple injuries	3	17.6

N= Number of individuals; %= frequency in percentages