

Functional Capacity and Risk Factors in Elderly Trauma Victims

ORIGINAL

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Abstract

Objective: To determine changes in the functional capacity of elderly victims of external-cause trauma using the Modified Barthel Index and to evaluate related independent risk factors during hospitalization and ninety days after discharge.

Method: This prospective study of 247 elderly trauma victims in northeastern Brazil aged ≥ 60 years. Data were analyzed using the software BioEstat 5.0. The Wilcoxon test was used with a significance level of 5%. The independent predictors of incapacity that showed interactions ($p < 0.2$) with the outcome were evaluated using logistic regression with a stepwise selection model and adjusted odds ratios with a confidence interval of 95%. This study was approved by the Research Ethics Committee.

Results: The mean age was 70.8 years, and the mean duration of hospitalization was 10.5 days. The logistic regression analysis showed that a history of cardiovascular disease, traumatic brain injury and femoral neck fracture were independent factors associated with moderate/severe functional incapacity in elderly trauma patients during hospitalization. Ninety days after discharge, associated factors were female gender, age greater than or equal to 80 years and femoral neck fracture.

Conclusion: The Modified Barthel Index showed improvement in functional capacity in almost all categories, except for elderly who remained in wheelchairs during hospitalization and 90 days after hospital discharge, with evidence of independent factors associated with incapacity, particularly femoral neck fracture. Studies involving the elderly can scientifically support the formulation of public policies.

Keywords

Elderly; Activities of Daily Living; Risk Factors; Wounds and Injuries; Hospitalization.

Introduction

Population aging and urbanization represent a huge challenge for the 21st century as increased life expectancy results from fundamental gains in public health and living standards of the population. The elderly are considered productive and in many cases are a resource for their families and economies. They have therefore also become more exposed to risks during daily living and work activities [1, 2]. Risks to which the elderly are exposed can contribute to a decrease in the loss of functional capacity and quality of life. Functional capacity has become a new health paradigm and should reflect the functionality with which the individual performs daily living activities. When an elderly individual starts to depend on other people to perform these activities, it may be considered detrimental to their functional independence, social relationships and activities at more advanced ages [3, 4].

External causes such as physical violence, trauma, falls and traffic accidents have a great social and economic impact, involving long-term hospitalization and rehabilitation of the victim, which can vary according to the severity of the injury suffered and have lifelong physical and psychological consequences [5].

The occurrence of falls among the elderly is associated with several factors such as comorbidities and physiological changes due to aging, which may contribute to clinical complications after trauma [6]. In Brazil, it is clear that for the elderly to age in a healthy manner, special attention should be given to this population in public health policies regarding the maintenance of capacity and muscle strength through the encouragement of a healthier lifestyle [7].

The Modified Barthel Index (MBI) is one of the various instruments used to determine functional capacity. It was originally developed to monitor the performance of patients hospitalized for an extended time, with paralysis conditions before and after treatment, and to indicate the medical care neces-

sary for such patients [8]. Due to its ease and speed of application, the MBI is now used as an evaluation instrument for neurological and musculoskeletal disorders and to predict hospitalization time, prognosis and consequences of discharge [9].

The MBI may be used on adults, not necessarily the elderly, with neuromuscular disorders such as stroke, spinal cord injuries and multiple sclerosis as well as for various musculoskeletal problems such as burns, heart disease, rheumatoid arthritis and amputations [10, 11].

The MBI evaluates daily living activities and functional independence through 10 activities/categories such as personal hygiene, bathing, feeding, toilet habits, climbing stairs, dressing, bladder control, bowel control, walking and/or use of a wheelchair and getting in and out of the chair/bed. Each category is scored according to the performance of the patient in performing the tasks independently, with some help or in a dependent manner and results in a total score that can range from 0 to 100 or can be scored in intervals that reflect the degree of dependency of the patients for daily living activities [9, 11, 12]. Cultural adaptation of the MBI was performed and validated for Brazil in 2004, and the instrument may help to prevent or delay the onset of disability [13, 14].

The objectives of this study were to determine changes in the functional capacity of elderly victims of external-cause trauma using the Modified Barthel Index and to evaluate independent risk factors for trauma in the elderly in terms of functional capacity.

Method

Study Design

This work was a prospective study of elderly victims of external-cause trauma who were admitted to a public hospital, a reference center for trauma victims, in the state of Sergipe, northeastern Brazil.

The patients were monitored from admission to 90 days after hospital discharge. Data were collected from March to November 2013 in the hospital and at the victim's home. This study was entirely submitted and formally approved by the Research Ethics Committee at Federal University of Sergipe under protocol number 12629713.1.0000.5546. The identity and the rights of participants were preserved, as required by the National Board of Health of the Ministry of Health of Brazil, stated at Resolution number 466, edited in December 12, 2012. All elderly trauma victims voluntarily agreed to participate in this study by signing a writing consent. For those elderly trauma victims that could not sign a writing consent because of cognitive, hearing/talking or visual disturbances or disorders, the writing consent was obtained by a legally authorised representative. This consent procedure was approved by the Research Ethics Committee at Federal University of Sergipe.

Eligibility criteria

The convenience sample was non-probabilistic, chosen according to the spontaneous demand of elderly trauma victims who met the following inclusion criteria: both genders, ≥ 60 years, victim of external-cause trauma such as motor vehicle accidents, accidental injury, self-harm and physical violence; having been admitted to the emergency department within 48 hours after trauma; accompanied by family member or caregiver so that possible cognitive, auditory, visual or speech disorders did not hamper application of the evaluation instrument; agreed to participate in the study voluntarily or through the permission of caregivers or family members in the case of cognitive and/or hearing impairment. The following were considered to be exclusion criteria for elderly victims of external-cause traumas: events of undetermined intent, medical and surgical care complications, unclassified external causes and refusal to participate in the study.

Sample Size Calculation

For calculation of the sample size, the total number of elderly victims of external-cause trauma hospitalized between January and December 2011 was used, according to data from the Hospital Information System of the Unified Health System (Sistema Único de Saúde), with an error of tolerance of 5%. A goal was set for the selection of at least 279 elderly victims of external-cause trauma.

Glasgow Coma Scale (GCS)

The level of consciousness was measured by the GCS for all elderly trauma victims upon admission [15-17]. The patients were categorized into three groups according to the following scale: 3-8 major trauma, 9-12 moderate trauma and 13-15 mild trauma [18]. Variables related to gender, age, mechanism of injury, preexisting conditions and type of injury were also collected.

Modified Barthel Index (MBI)

The MBI was used to evaluate functional capacity as reported by the patient, caregiver or family member as well as through direct observation by the researchers, based on descriptions of daily living activities relating to self-care, mobility, locomotion and evacuations. When the elderly victim was not able to read the questionnaire, the caregiver or the researchers read it so that he or she could respond. When the person was unconscious, physical examination determined the ability to perform the activities studied.

The sum of the values obtained in each activity produced a total score of 0-100. The elderly were categorized into two groups to determine the impairment of functional capacity: moderate to severe impairment (0-75 points) and light impairment to complete independence (76-100 points). The relationship between these groups and the clinical variables studied was then tested. Ninety days after hospital discharge, functional capacity was reevaluated at the victim's home. To facilitate pairing of the sample of the elderly during hospitalization and

90 days after discharge, all deaths were excluded. Thus, 247 reevaluations were performed.

Statistical Analysis

The data were stored and analyzed using the software BioEstat 5.0. The dependent variable was functional capacity measured by MBI and was expressed as the median (interquartile range). The values obtained during hospitalization and 90 days after discharge were compared using the Wilcoxon test at a significance level of 5%. Independent predictors of moderate to severe dependence during hospitalization and 90 days after discharge were initially evaluated using univariate logistic regression to reduce the number of potential confounders.

Subsequently, a multivariate logistic regression model was developed that incorporated the variables that had shown modest interactions ($p < 0.2$) with the outcome of interest. These variables were entered into the model using stepwise selection and an adjusted odds ratio with 95% confidence interval and were used to determine the risk factors associated with moderate to severe dependence at both evaluation time points.

Results

A total of 282 elderly victims of external-cause trauma were hospitalized during the study period. Of these patients, 30 died during hospital monitoring, and 5 died at home after being discharged. The final sample thus consisted of 247 elderly victims.

The mean age of patients completing the study was 70.8 ± 9.5 years, with a mean hospital stay of 10.5 ± 15.6 days. The MBI evaluation during hospitalization and 90 days after hospital discharge showed change with improved functional capacity in almost all surveyed categories, except for elderly victims who remained in a wheelchair 90 days after the trauma, for whom an increase in the level of dependency was observed (**Table 1**), as demonstrated by the inability to move the chair over small distances

Table 1. Modified Barthel Index categories during hospitalization and 90 days after hospital discharge.

Category	Hospitalization P50 (P25-P75)	90 days after discharge P50 (P25-P75)	p-value
Personal hygiene	1.0 (1.0-3.0)	4.0 (4.0-5.0)	< 0.0001
Bathing	1.0 (1.0-3.0)	4.0 (4.0-5.0)	< 0.0001
Feeding	5.0 (2.0-8.0)	8.0 (8.0-10.0)	< 0.0001
Toilet habits	2.0 (0.0-5.0)	8.0 (8.0-10.0)	< 0.0001
Climbing stairs	0.0 (0.0-5.0)	8.0 (5.0-10.0)	< 0.0001
Dressing	0.0 (0.0-5.0)	8.0 (5.0-10.0)	< 0.0001
Bladder control	10.0 (8.0-10.0)	10.0 (10.0-10.0)	< 0.0001
Bowel control	10.0 (8.0-10.0)	10.0 (10.0-10.0)	< 0.0001
Walking	0.0 (0.0-8.0)	12.0 (8.0-12.0)	< 0.0001
Wheelchair	5.0 (0.0-5.0)	0.0 (0.0-0.0)	0.0002
Getting in and out of chair/bed	3.0 (0.0-8.0)	12.0 (8.0-12.0)	< 0.0001
Total	38.0 (23.5-64.5)	82.0 (65.5-94.0)	< 0.0001

and confirmed by the median value, which decreased by 5 points.

Table 2 shows the association between the clinical variables studied and the level of dependency measured by the MBI during hospitalization. The frequency of moderate/severe functional dependence was significantly higher among elderly women

Table 2. Factors associated with moderate and severe dependency in elderly trauma victims during hospitalization.

Variables	n	Barthel Index ≤ 75 (%)	OR (95% CI)	p-value
Gender				
Male	132	102 (77.2)	2.5 (1.2-5.2)	0.017
Female	115	103 (89.5)		
Age (years)				
60-69	136	105 (77.2)	1.4 (0.6-3.1)	0.499
70-79	58	48 (82.7)		
≥ 80	53	52 (98.1)		

Variables	n	Barthel Index ≤75 (%)	OR (95% CI)	p-value
Fall				
Yes	161	143 (88.8)	3.1 (1.6-6.1)	0.002
No	86	62 (72.1)		
Traffic accident				
Yes	54	46 (85.1)	1.2 (0.5-2.8)	0.799
No	193	159 (82.4)		
Physical violence				
Yes	17	9 (52.9)	0.2 (0.07-0.5)	0.002
No	230	196 (85.2)		
History of endocrine disease				
Yes	54	48 (88.8)	1.8 (0.7-4.6)	0.272
No	193	157 (81.3)		
History of cardiovascular disease				
Yes	191	169 (88.4)	4.2 (2.1-8.6)	< 0.001
No	56	36 (64.2)		
History of respiratory disease				
Yes	4	4 (100.0)	1.9 (0.1-35.9)	0.669
No	243	201 (82.7)		
History of musculoskeletal disease				
Yes	134	118 (88.0)	2.2 (1.1-4.3)	0.032
No	113	87 (76.9)		
History of neurological disease				
Yes	17	17 (100.0)	7.9 (0.5-133.8)	0.152
No	230	188 (81.7)		
History of psychiatric disease				
Yes	7	6 (85.7)	1.2 (0.1-10.5)	0.752
No	240	199 (82.9)		
History of neoplastic disease				
Yes	3	3 (100.0)	1.5 (0.07-29.0)	0.800
No	244	202 (82.7)		
Traumatic brain injury				
Yes	62	55 (88.7)	1.9 (0.8-4.5)	0.151
No	185	150 (81.1)		
Femoral neck injury				
Yes	87	86 (98.8)	29.6 (4.0-219.6)	< 0.001
No	160	119 (74.4)		
Fracture of tibia and/or fibula				
Yes	14	12 (85.7)	1.2 (0.3-5.8)	0.930
No	233	193 (82.8)		
Thoracic trauma				
Yes	13	9 (69.2)	0.4 (0.1-1.5)	0.328
No	234	196 (83.8)		

Variables	n	Barthel Index ≤75 (%)	OR (95% CI)	p-value
Rachimedular Trauma				
Yes	9	6 (66.6)	0.4 (0.1-1.6)	0.380
No	238	199 (83.6)		
Upper limb fracture				
Yes	25	20 (80.0)	0.8 (0.3-2.3)	0.888
No	222	185 (83.3)		
Glasgow Coma Score				
3-8	5	5 (100.0)	2.6 (0.1-48.3)	0.518
9-12	27	26 (96.2)	6.1 (0.8-46.5)	0.080
13-15	215	174 (80.9)		

aged 80 years or over, victims of falls or physical violence, patients with a history of cardiovascular, musculoskeletal or neurological disease, patients who suffered traumatic brain injury (TBI) or femoral neck fracture and patients whose GCS score was between 9 and 12 points.

Table 3. Independent risk factors for moderate and severe dependency in elderly trauma victims during hospitalization with logistic regression analysis.

Variable	Regression coefficient	OR (95% CI)	p-value
History of cardiovascular disease	1.415	4.1 (1.9-9.1)	0.0005
Traumatic brain injury	1.614	5.0 (2.0-12.8)	0.0007
Femoral neck fracture	3.830	46.0 (6.1-349.1)	0.0002

The results of the logistic regression analysis (**Table 3**) showed that a history of cardiovascular disease, TBI and femoral neck fracture were independent factors associated with moderate/severe functional incapacity in elderly trauma patients during hospitalization.

The frequency of moderate/severe functional dependency 90 days after hospital discharge (**Table 4**) was significantly higher among elderly females aged 70 years or older, victims of falls, traffic accidents or

Table 4. Factors associated with moderate and severe dependency in elderly trauma victims 90 days after hospital discharge.

Variables	n	Barthel Index≤75 (%)	OR (95% CI)	p-value
Gender				
Male	132	29 (22.0)	5.5 (3.2-9.6)	< 0.001
Female	115	70 (60.9)		
Age (years)				
60-69	136	26 (19.1)	4.0 (2.0-7.7)	< 0.001
70-79	58	28 (48.3)		
≥80	53	45 (84.9)		
Fall				
Yes	161	143 (88.8)	6.4 (3.3-12.5)	<0.001
No	86	62 (72.1)		
Traffic accident				
Yes	54	46 (85.1)	0.4 (0.2-0.7)	0.004
No	193	159 (82.4)		
Physical violence				
Yes	17	9 (52.9)	0.1 (0.01-0.7)	0.006
No	230	196 (85.2)		
History of endocrine disease				
Yes	54	48 (88.8)	2.0 (1.1-3.8)	0.032
No	193	157 (81.3)		
History of cardiovascular disease				
Yes	191	169 (88.4)	1.9 (1.0-3.7)	0.065
No	56	36 (64.2)		
History of respiratory disease				
Yes	4	4 (100.0)	4.6 (0.5-44.8)	0.356
No	243	201 (82.7)		
History of musculoskeletal disease				
Yes	134	118 (88.0)	1.8 (1.1-3.0)	0.042
No	113	87 (76.9)		
History of neurological disease				
Yes	17	17 (100.0)	2.3 (0.8-6.2)	0.169
No	230	188 (81.7)		
History of psychiatric disease				
Yes	7	6 (85.7)	1.1 (0.2-5.1)	0.811
No	240	199 (82.9)		
History of neoplastic disease				
Yes	3	3 (100.0)	3.0 (0.3-33.9)	0.725
No	244	202 (82.7)		

Variables	n	Barthel Index≤75 (%)	OR (95% CI)	p-value
Traumatic brain injury				
Yes	62	55 (88.7)	0.6 (0.4-1.2)	0.193
No	185	150 (81.1)		
Femoral neck fracture				
Yes	87	86 (98.8)	13.4 (7.1-25.2)	< 0.001
No	160	119 (74.4)		
Fracture of tibia and/or fibula				
Yes	14	12 (85.7)	0.4 (0.1-1.4)	0.236
No	233	193 (82.8)		
Thoracic trauma				
Yes	13	9 (69.2)	0.1 (0.01-0.9)	0.029
No	233	196 (83.8)		
Rachimedular Trauma				
Yes	9	6 (66.6)	0.4 (0.08-2.0)	0.443
No	238	199 (83.6)		
Upper limb fracture				
Yes	25	20 (80.0)	0.3 (0.1-0.9)	0.052
No	222	185 (83.3)		

physical violence, patients with a history of endocrine, cardiovascular, musculoskeletal or neurological diseases and patients who had suffered TBI, femoral neck fracture, chest trauma or fracture of the upper limbs.

The results of the logistic regression analysis (**Table 5**) showed that female gender, age greater than or equal to 80 years and femoral neck fracture are independent factors associated with moderate/severe functional incapacity in elderly victims of external-cause trauma 90 days after discharge.

Table 5. Independent risk factors for moderate to severe dependency in elderly trauma victims 90 days after hospital discharge with logistic regression analysis.

Variable	Regression coefficient	OR (95% CI)	p-value
Female gender	0.898	2.5 (1.2-4.9)	0.010
Age≥80 years	2.024	7.6 (3.5-16.2)	< 0.0001
Femoral neck fracture	2.050	7.8 (3.8-15.9)	< 0.0001

Discussion

The longer life expectancy of the population in recent decades and the increasing social participation of older people both make the elderly more vulnerable to trauma and accidental injury. This study evaluated the functional capacity of hospitalized elderly trauma victims using the MBI. Evidence of significant functional impairment during hospitalization, including bladder and bowel control, was found in all categories. Despite the maximum MBI score being in the 50th and 75th interquartile, 25% of the sample needed supervision and presented incontinence due to loss of control of the bladder and anal sphincters. This result may be related to difficulty in accessing the toilet as a function of the functional impairment in walking, which showed the lowest value in the 25th and 50th interquartile.

However, 90 days after hospital discharge, a change was observed with improved functional capacity in almost all categories studied, except for the wheelchair category, which showed severe functional dependence after hospitalization. However, studies on elderly hospitalized due to external-cause trauma that relate capacities to MBI categories are still scarce, which makes comparative analysis difficult.

A score ≤ 75 points on the MBI was considered to define moderate to severe dependency, as in previous studies [19-21]. Multivariate logistic regression revealed that at the time of hospitalization, the independent factors that showed a relationship with $MBI \leq 75$ points were a history of cardiovascular disease, TBI and femoral neck fracture. Ninety days after hospital discharge, the independent factors were female gender with age ≥ 80 years and femoral neck fracture, which showed a 46 times greater chance of loss of functionality. These results are similar to the results of studies that have shown a predominance of elderly women, 70 or older, fall victims [1, 2, 22-27], TBI [24, 28] and associated comorbidities [25, 29, 30].

To quantify the severity of TBI victims, many studies have used the GCS [15, 16, 31] during the first

72 hours after injury, which can assist in predicting outcome and in determining the care necessary for the victim [17]. In this study, the majority of TBI victims had a GCS score between 13-15 points, which is considered mild trauma.

There may be a decrease in functional capacity in the elderly who are suffering from chronic diseases and do not adhere to treatment, which contributes to arterial complications and cardiovascular problems [25, 32] as well as increased likelihood of mortality, disability and cognitive impairment in older adults with endocrine disease such as diabetes mellitus [33]. The presence of musculoskeletal disease such as osteoporosis and the occurrence of falls are distinct conditions and, when associated, promote fractures in the elderly population, with increased morbidity and mortality [34].

In this study, there was a twofold increase in the risk of functional incapacity among patients with a history of musculoskeletal disease, both during hospitalization and 90 days after hospital discharge. However, the logistic regression analysis did not indicate a history of musculoskeletal disease as an independent factor. This result can be explained by the fact that musculoskeletal disorders are risk factors for femoral neck fracture; however, alone they cannot contribute directly to moderate to severe functional dependency.

The main orthopedic injury observed in this study was femoral neck fracture, which remained an independent risk factor for loss of functional independence during hospitalization and also 90 days after hospital discharge. Functional impairment in walking is directly related to femoral neck fracture and is also related to the elderly person remaining in bed with real difficulty in moving during hospitalization and also in the home after hospital discharge. Functional impairment in walking may contribute to skin lesions due to prolonged recumbence in bed and to absence from the economic and social activities that were performed before the traumatic event.

The most common mechanisms of traumatic injury in the elderly are falls with a predisposition to femoral fracture [24, 35, 36]. Falls may be associated with the use of multiple drugs [37], the decline in functional activity, weakness and postural instability in walking [6,38] indicating the need for specialized care to maintain conditions that favor recovery and quality of life.

However, the psychomotor reaction speed of individuals who have some difficulty with postural balance may be considered an important predictor of falls, as it is directly related to the responsiveness of the elderly at the time of the trauma event [27]. In this context, the maintenance of appropriate social activity after the occurrence of femoral fracture as a result of a fall represents a challenge for health professionals.

While the main limitation of this study was the lack of investigation of home environmental factors that might contribute to accidents and injuries or even hinder functional recovery of the elderly, its strength lies in the investigation of the functional capacity of elderly trauma victims using the MBI, while hospitalized and at home, with no segment loss during analysis. The scarcity of published studies on this subject underlines its importance.

In summary, this study identified five risk factors associated with moderate to severe functional dependency in elderly victims of external-cause trauma, among which femoral neck fracture was particularly important because 90 days after hospital discharge, it remained a factor associated with functional impairment according to the MBI.

It is very important to address this subject in the elderly to scientifically support the development of public policies and decision-making aimed at this population group, which will allow the appropriate use of public resources for the promotion of disease prevention and improvement in the quality of life of the elderly.

Disclosure statement

The authors declare no conflict of interest.

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