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Evaluation of the trauma-specific frailty index in geriatric trauma patients according to the new World Health Organization age classification

Rumeysa Sut,[1] Adem Az,[1] Sumeyye Cakmak,[2] Ozgur Sogut[1]

[1]Department of Emergency Medicine, University of Health Sciences, Haseki Training and Research Hospital, Istanbul, Turkiye

[2]Department of Emergency Medicine, University of Health Sciences, Bakirkoy Dr. Sadi Konuk Training and Research Hospital, Istanbul, Turkiye

ABSTRACT

OBJECTIVE: We compared the 15-variable trauma-specific frailty index and traditional injury scoring systems to determine trauma severity and predict discharge disposition in geriatric trauma patients based on the old and new World Health Organization age classifications.

METHODS: This prospective, observational, single-center study included geriatric patients aged ≥65 years with blunt trauma. We categorized patients as elderly based on the old or new World Health Organization age classification into group I (aged 65–79 years) and group II (aged ≥80 years), respectively. At admission, we used traditional injury scoring systems (e.g., the Glasgow coma scale, injury severity score, and revised trauma score) to determine trauma severity. We compared the Trauma-Specific Frailty Index and traditional injury scoring systems between the patient groups and evaluated them for correlations.

RESULTS: We included 169 geriatric patients (80 and 89 in groups I and II, respectively). The mean Trauma-Specific Frailty Index score was significantly higher among females than males (p=0.025) and group II than group I (p=0.021). No significant correlations were observed in terms of the Trauma-Specific Frailty Index and traditional injury scoring systems in both groups. The mean Trauma-Specific Frailty Index score was significantly different between the hospitalized and discharged patients in group I (p=0.005), but not in group II (p=0.526).

CONCLUSION: The 15-variable Trauma-Specific Frailty Index score is superior to traditional injury scoring systems for managing and predicting discharge disposition in geriatric trauma patients aged 65–79 years.

Keywords: Frailty; geriatrics; injuries, traumatology; wounds.

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Over the past century, improvements in disease treatment and prevention have significantly increased life expectancy worldwide [1, 2]. Consequently, the definition of elderly has been revised; the World Health Organization (WHO) updated its age-specific categories in 2017. Currently, the WHO categorizes individuals aged 0–17, 18–65, 66–79, and ≥80 years as juvenile, young, middle-aged, and elderly, respectively [3].

Trauma is the fourth leading cause of death for all ages after heart disease, cancer, and stroke. In the geriatric population, 28% of all deaths are the result of trauma [4, 5]. Older individuals have a greater number of comorbidities and higher risks of severe disability and death compared to young individuals. In geriatric patients, injury may occur due to minor events; indeed, even low-energy trauma can result in severe injuries [6].

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Correspondence: Adem AZ, MD. Saglik Bilimleri Universitesi, Haseki Egitim ve Arastirma Hastanesi, Acil Tip Klinigi, Istanbul, Turkiye.
Tel: +90 212 312 84 56 - 24 06 e-mail: adem.aaz@gmail.com

Early prediction of geriatric trauma patients' dispositions (i.e., discharge or hospitalization) is essential for their management in the emergency department (ED). Therefore, clinical assessment tools are required to predict adverse outcomes in geriatric trauma patients [7].

Frailty is a common geriatric syndrome characterized by age-associated decline in physiological reserves, which may lead to weakness, slowed movement, reduced energy and activity, and in more severe cases, unintended weight loss [8, 9]. Frailty increases the risk of poor health outcomes, including disability, hospitalization, and mortality. The risk of frailty increases with age, with a prevalence of 10–25% and 30–45% among patients aged ≥65 years and ≥85 years, respectively. Frailty is receiving increased attention because frail older individuals have increased health expenditures and mortality and morbidity rates in response to stress [9]. The early identification of frailty in older individuals is essential to preventing undesirable outcomes, such as increased mortality and morbidity rates [8].

The trauma-specific frailty index (TSFI) scales consist of 50, 40, and 23 variables developed to measure frailty in the older population [10–12]. The TSFI is superior to age and injury severity scores for predicting adverse outcomes in geriatric trauma patients. The traditional 50-variable TSFI is comprehensive but time-consuming to administer, which makes it impractical for use in the ED. To facilitate the application of TSFI in cases of acute trauma, a modified 15-variable TFSI was developed based on the 50-variable TSFI [8]. Joseph et al. [8] reported that the 15-variable TSFI independently predicted unfavorable discharge disposition in geriatric trauma patients.

We aimed to compare the modified 15-variable TSFI with traditional injury scoring systems in determining trauma severity and predicting discharge disposition after acute trauma (within 24 h of trauma) in geriatric patients classified based on the old and new WHO classification. We hypothesized that TSFI is superior to traditional injury scoring systems in predicting the discharge disposition of geriatric trauma patients.

MATERIALS AND METHODS

Ethics Committee Approval and Patient Consent

This study was conducted in accordance with the 1989 Declaration of Helsinki and was approved by the Institutional Review Board (IRB) of Haseki Research and Training Hospital (03.06.2020, no. 2020-34). Patient consent to review their medical records was not required by the IRB, because there were no potentially identifying marks and no patient identifiers in the images or accompanying text.

Highlight key points

- Trauma patients admitted to the ED were more commonly females.
- The mean ISS, RTS, and GCS scores were not significantly different patients aged 65–79 and ≥80 years.
- The mean TSFI score was significantly higher among patients aged ≥80 years compared to those aged 65–79 years.
- In group I, the mean TSFI score was significantly higher for hospitalized patients than for discharged patients.
- In group II, we observed no statistically significant difference in the mean TSFI score between hospitalized and discharged patients.

Study Design and Setting

This prospective, single-center, cross-sectional study enrolled patients aged ≥65 years who presented to the ED with blunt trauma. We categorized the patients into two groups based on the old and new WHO age classifications. Group I included patients aged 65–79 years (elderly according to the old classification and middle-aged according to the new classification), and group II included patients aged ≥80 years (elderly according to the new classification).

We included 169 consecutive patients aged ≥65 years who presented to the ED with trauma between June and December 2020. We obtained written informed consent from the study participants. In the case of nonresponsive patients, we obtained information from close relatives. We provided all patients with information regarding TSFI and its use for assessing the pre-injury health condition.

Data Collection and Tools

We recorded demographics (age and sex), presenting complaints, comorbidities (e.g., cancer, hypertension, diabetes mellitus, coronary heart disease, dementia, and stroke), mechanism of injury, and outcome (discharge or hospitalization). We applied traditional injury scoring systems (e.g., the Glasgow coma scale score [GCS], injury severity score [ISS], and revised trauma score [RTS]) at admission to determine trauma severity. We compared the TSFI and traditional injury scoring system

TABLE 1. Trauma-Specific Frailty Index

Comorbidities					
Cancer	Yes (1)		No (0)		
Hypertension	Yes (1)		No (0)		
Coronary heart disease	MI (1)	CABG (0.75)	PCI (0.75)	Medication (0.25)	No (0)
Dementia	Severe (1)	Moderate (0.5)	Mild (0.25)	No (0)	
Stroke	Yes (1)		No (0)		
Diabetes mellitus	Yes (1)		No (0)		
Chronic pulmonary disease	Yes (1)		No (0)		
Daily activities					
Help with grooming	Yes (1)		No (0)		
Help managing money	Yes (1)		No (0)		
Help doing household work	Yes (1)		No (0)		
Help in toilet	Yes (1)		No (0)		
Help walking	Wheelchair (1)	Walker (0.75)	Cane (0.75)	No (0)	
Spending half of the day in bed due to any health condition	Yes (1)		No (0)		
Reduction in normal activity (over last 1 month)	Yes (1)		No (0)		
Nutrition					
Albumin	<3 (1)		≥3 (0)		

at admission among the patient groups. Furthermore, we analyzed the correlations between TSFI and traditional injury scoring system scores to determine their relationship with prognosis.

TSFI

Fifteen variables with the strongest association with unfavorable discharge were included in the TFSI [8]. Table 1 demonstrates the modified 15-variable TSFI scores of the study participants.

Statistical Analysis

The required sample size, calculated using G*Power (version 3.1.6) based on previous studies [8, 10–12], was 169 patients to detect significant differences among patient groups with a power of 95% and an alpha error of 5%.

We analyzed the data using SPSS software (version 15.0 for Windows; IBM Corp., Armonk, NY, USA). The quantitative variables (e.g., GCS, ISS, RTS, and TSFI score) were expressed as mean±standard deviations or as a median with minimum and maximum values. Categorical variables (sex and age) are expressed as numbers (n) and percentages (%). We compared the groups using the Mann-Whitney U-test with Bonferroni correction for non-normally distributed data (group 1 vs group II, and female vs male). We used a Pearson's correlation analysis to evaluate the relationship among numerical variables in cases when the parametric test condition was fulfilled. We set statistical significance at $p<0.05$.

RESULTS

Table 2 presents the demographic and clinical characteristics of the study patients. The study included 169 geriatric trauma patients (68 males [40.2%] and 101 females [59.8%]). The mean age was 79.20±7.80 (age range: 65–97). Group I comprised 81 patients aged 65–79 years, including 44 females (54.32%) and 37 males (45.68%). Group II comprised 88 patients aged ≥80 years, including 57 females (64.77%) and 31 males (35.23%). The mean ages of the patients in groups I and II were 72.20±3.90 and 85.60±4.10, respectively.

In total, 67 (39.60%) patients presented to the outpatient department; the remaining 102 patients (60.40%) arrived by ambulance. Spontaneous fall, traffic accident, and assault caused the trauma in 91.1% of the patients (n=154), 8.3% (n=14), and 0.6% (n=1), respectively. In terms of clinical outcome, 57 patients (33.7%) and 112 patients (66.3%) were hospitalized and discharged from the ED, respectively. In total, 25 (30%) and 32 (36%) patients in groups I and II were

Table 2. Patient demographic and clinical characteristics

Characteristics	Group I		Group II	
	n	%	n	%
Total (n=169)	81	47.92	88	52.07
Sex				
Male	37	45.68	31	35.23
Female	44	54.32	57	64.77
Age, years (mean±SD, 79.20±7.80)	72.20±3.90		85.60±4.10	
Trauma mechanism				
Spontaneous fall (n=154)	71	42.01	83	49.11
Traffic accident (n=14)	9	5.32	5	2.95
Assault (n=1)	1	0.60	0	0.00
Clinical outcome				
Hospitalized (n=25)	25	14.79	32	18.93
Discharged (n=112)	56	33.14	56	33.14

SD: Standard deviation; Data are expressed as numbers (n), percentages (%), and means±standard deviations (SD); Group I: patients aged 65–79 years; Group II: aged ≥80 years.

Table 3. Comparison of traditional trauma scores (ISS, RTS and GCS) and TSFI score between males and females

	Patients		Female		Male		
Trauma scores	Mean±SD	Max–Min	Mean±SD	Max–Min	Mean±SD	Max–Min	p*
ISS	5.75±5.93	48–1	5.46±4.51	20–1	6.18±7.58	48–1	0.803*
RTS	7.80±0.31	7.84–4.09	7.82±0.14	7.84–6.90	7.77±0.46	7.84–4.09	1.000*
GCS	14.86±0.40	15–11	14.95±0.41	15–11	14.91±0.41	15–13	0.183*
TSFI	3.42±2.75	11.25–0	3.83±2.81	10–0	2.82±2.57	11.25–0	0.025*

Data are expressed as means±standard deviations (SD) with maximum and minumum values. *: Subgroup analyses were conducted using Mann–Whitney U test. ISS: Injury Severity Score; RTS: Revised Trauma Score; GCS: Glasgow Coma Scale; TSFI: Trauma-Specific Frailty Index.

hospitalized, respectively (Table 2). A total of 51 multi-trauma patients (30.7%) and 118 mono-trauma patients (69.3%) were evaluated. In addition, 63, 23, 31, 5, 96, and 17 had trauma to the head and neck, face, thorax, abdomen, extremity, and other regions, respectively. The mean ISS, RTS, GCS, and TSFI scores of the patients were 5.75±5.93, 7.80±0.31, 14.86±0.40, and 3.42±2.75, respectively. Table 3 conveys the TFSI and trauma system scores of the patients.

The mean ISS, RTS, and GCS scores for females were 5.46±4.51, 7.82±0.14, and 14.95±0.41, respectively. The mean ISS, RTS, and GCS scores for males were 6.18±7.58, 7.77±0.46, and 14.91±0.38, respectively. No significant differences were observed between males and females in terms of mean ISS, RTS, and GCS scores (p=0.803, p=1.000, and p=0.183, respectively) (Table 3). The mean TSFI scores for all patients, for females, and for males were 3.42±2.75 (range: 0.0–11.25), 3.83±2.81, and 2.82±2.57, respectively. The mean TSFI score was significantly higher among females than males (p=0.025) (Table 3).

In group I, the mean ISS, RTS, and GCS scores were 5.41±4.57, 7.77±0.44, and 14.95±0.27, respectively. In group II, the mean ISS, RTS, and GCS scores were

TABLE 4. Comparison of traditional trauma scores (ISS, RTS and GCS), and TSFI values between group I and group II patients

Trauma scores	Group I (aged 65–79 years)		Group II (aged ≥80)		
	Mean±SD	Max–Min	Mean±SD	Max–Min	p*
ISS	5.41±4.57	20–01	6.06±6.69	48–01	0.807
RTS	7.77±0.44	7.84–4.09	7.83±0.10	7.84–6.9	0.149
GCS	14.95±0.27	15–13	14.92±0.48	15–11	0.934
TSFI	2.99±2.74	11.25–0	3.82±2.73	10–0	0.021

Data are expressed as means±standard deviations (SD) with maximum and minumum values. *: Subgroup analyses were conducted using Mann–Whitney U test. ISS: Injury Severity Score; RTS: Revised Trauma Score; GCS: Glasgow Coma Scale; TSFI: Trauma-Specific Frailty Index.

6.06±6.96, 7.83±0.10, and 14.92±0.48, respectively. The mean ISS, RTS, and GCS scores were not significantly different between groups I and II (p=0.910, p=0.789, and p=0.359, respectively) (Table 4). The mean TSFI scores for groups I and II were 2.99±2.74 and 3.82±2.73, respectively, and they were significantly higher for group II than group I (p=0.021) (Table 4).

We observed no significant correlation between the TSFI and ISS scores in group I (rho=0.136 and p=0.227) (Table 5) or II (rho=-0.190 and p=0.075) (Table 5). In addition, there was no significant correlation between the TSFI score and RTS and GCS scores in group I (rho=-0.192 and p=0.065; rho=-0.192 and p=0.086, respectively) (Table 5) or in group II (rho=-0.195 and p=0.069; and rho=-0.081 and p=0.456, respectively) (Table 5).

The mean TSFI scores for hospitalized and discharged patients were 3.84±2.77 and 3.22±2.73, respectively, with no statistically significant difference (p=0.131). However, we observed a significant difference between the TSFI scores of hospitalized vs. discharged patients in group I (4.12±2.81 vs. 2.49±2.57, respectively, p=0.005). However, in group II, the TSFI score was not significantly different between hospitalized and discharged patients (3.62±2.77 vs. 3.94±2.72, respectively, p=0.526).

DISCUSSION

To the best of our knowledge, ours was the first study to evaluate the use of TSFI for predicting trauma severity and prognosis in geriatric trauma patients aged ≥80 years (considered elderly according to the new WHO age classification).

TABLE 5. Correlations of TSFI values with the traditional trauma scores (ISS, RTS and GCS) in group I and group II patients

Trauma scores	TSFI	ISS	GCS	RTS
Group I (aged 65–79 years)				
TSFI				
rho*	1	0.136	-0.192	-0.192
p		0.227	0.086	0.085
ISS				
rho*	0.136	1	0.062	0.104
p	0.227		0.582	0.356
GCS				
rho*	-0.192	0.062	1	0.943
p	0.086	0.582		0
RTS				
rho*	-0.192	0.104	0.943	1
p	0.085	0.356	0	
Group II (aged ≥80)				
TSFI				
rho*	1	-0.190	-0.081	-0.195
p		0.075	0.456	0.069
ISS				
rho*	-0.190	1	-0.244	0.032
p	0.075		0.022	0.768
GCS				
rho*	-0.081	-0.244	1	0.872
p	0.456	0.022		0
RTS				
rho*	-0.195	0.032	0.872	1
p	0.069	0.768	0	

The statistical relationship between variables was conducted using Pearson's Correlation Coefficient. ISS: Injury Severity Score; RTS: Revised Trauma Score; GCS: Glasgow Coma Scale, TSFI; Trauma-Specific Frailty Index.

The key findings of this study were as follows. First, geriatric trauma patients admitted to the ED were more commonly females (59.8%), and their trauma resulted, mainly, from spontaneous falling (91.1%). Second, the mean TSFI score was significantly higher among females than males. Third, no statistically significant differences were found between patients aged 65–79 and ≥80 years in terms of mean ISS, RTS, and GCS scores. In addition, the mean TSFI score was significantly higher among patients aged ≥80 years compared to those aged 65–79 years. Fourth, no significant correlation was observed between the TSFI, ISS, RTS, and GCS scores in group I or II. Finally, in group I, the mean TSFI score was significantly higher for hospitalized patients than for discharged patients. However, in group II, we observed no statistically significant difference in the mean TSFI score between hospitalized and discharged patients.

Various scoring systems can be used to estimate trauma severity, including ISS, RTS, and GCS scores. ISS is an anatomical system commonly used in cases of multiple injuries [13]. RTS has excellent predictive ability for clinical outcomes and prognosis. These scoring systems measure the static status and identify adverse effects of the injury to predict the outcomes in older patients. However, these systems correlate poorly with clinical outcomes [14].

Geriatric trauma patients significantly differ from younger individuals in terms of injury mechanisms. In geriatric patients, loss of balance and slow reflexes predispose individuals to trauma, such as falls and traffic accidents. In the present study, the most common causes of trauma were spontaneous fall (91.1%) and traffic accidents (8.3%); these findings are similar to the results of previous studies [15].

Bilotta et al. [16] reported that the prevalence of geriatric trauma was higher in women than men. Compared to geriatric men, geriatric women have lower physiological reserves and are less able to resist stressors due to cumulative declines in their physiological systems. This explains the higher proportion of women and the mean TSFI score in women compared to men in the present study.

TSFI scales consist of 40, 15, 50, and 23 variables and were developed to measure geriatric frailty [10–12]. TSFI is an independent predictor of in-hospital complications and adverse outcomes in geriatric trauma patients aged ≥65 years [8, 17]. In a study of 100 patients, Joseph et al. [15] used the 50-variable TSFI to evaluate geriatric trauma among patients aged ≥65 years and reported that TSFI was a reliable predictor of unfavorable discharge disposition. Therefore, the authors suggested that TSFI should be an integral part of assessing the discharge disposition of geriatric trauma patients. In a prospective study of 200 geriatric trauma cases, Joseph et al. [8] reported that the 15-variable TSFI was an independent predictor of unfavorable discharge disposition of geriatric trauma patients. The authors concluded that, when compared to the ISS and GCS scores, TSFI was simpler and more effective for planning the discharge of geriatric trauma patients. Similarly, we found that the mean 15-variable TSFI score was significantly higher in hospitalized compared to discharged geriatric patients aged 65–79 years (group I). However, we found no significant difference in the TSFI scores of hospitalized and discharged geriatric trauma patients aged ≥80 years (group II). In addition, there were no significant correlations between the TSFI, ISS, RTS, and GCS scores in group I or II. Finally, there were no statistically significant differences in the ISS, RTS, and GCS scores of patients aged 65–79 years and geriatric patients aged ≥80 years (according to the new WHO age classification). However, the TSFI scores were higher in geriatric patients, defined according to the new compared to the old WHO age classification. Our findings reveal that frail patients with high TSFI scores have more severe injuries and functional impairments and require hospitalization.

Conclusion

In conclusion, traffic accidents and falls are the leading causes of geriatric trauma. In our study, the frequency of geriatric trauma and the severity of frailty are higher in females compared to males. In addition, geriatric patients aged ≥80 years had higher TFSI scores compared to younger patients. The 15-variable TSFI score was superior to ISS, RTS, and GCS scores for guiding the treatment and predicting the discharge disposition in geriatric trauma patients aged 65–79 years.

Ethics Committee Approval: The Haseki Research and Training Hospital Clinical Research Ethics Committee granted approval for this study (date: 03.06.2020, number: 2020/34).

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