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Association between length of hospital stay and fractures in the spine, pelvis, and lower extremity among patients after intentional fall from a height: an analysis of the Japan Trauma Databank

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ABSTRACT

Objective This study investigated the association between the number of regions with fractures in the spine, pelvis, and lower extremity (NRF) and the proportion of patients with a length of hospital stay (LOS) ≥30 days among those who attempted suicide by falling from a height.

Methods Data recorded between January 1, 2004 and May 31, 2019 in the Japan Trauma Databank of patients aged ≥18 years injured by suicidal falls from a height and with ≥72 hours of LOS (period from admission to discharge home or to another hospital) were analyzed. Patients with an Abbreviated Injury Scale score ≥5 in the head region or those who died after admission were excluded. Multivariate analyses including clinically relevant variables as covariates were performed to determine the association, expressed as risk ratio with 95% CI, between NRF and LOS.

Results Among 4724 participants, the multivariate analysis revealed significant factors related to LOS ≥30 days, including NRF=1 (1.64, 95% CI 1.41 to 1.91), NRF=2 (2.00, 95% CI 1.72 to 2.33), NRF=3 (2.01, 95% CI 1.70 to 2.38), systolic blood pressure in the emergency department (ED; 0.999, 95% CI 0.998 to 0.9997), heart rate in the ED (1.002, 95% CI 1.00 to 1.004), Injury Severity Score (1.007, 95% CI 1.00 to 1.01), and intubation in the ED (1.21, 95% CI 1.10 to 1.34). However, history of psychiatric diseases was not a significant factor.

Conclusion An increase in NRF was associated with an increase in LOS of patients injured by intentional falls from a height. This finding can help both emergency physicians and psychiatrists in acute care hospitals to develop better treatment strategies with attention to time constraints. Further investigation of the association between LOS and both trauma and psychiatric treatment is required to evaluate the effect of NRF on treatment in acute care hospitals.

Level of evidence Level III, retrospective study with up to two negative criteria.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Psychotic disorders and some sociodemographic factors such as occupational status affect the length of hospital stay (LOS) among patients who attempted suicide by falling from a height.
⇒ The number of injuries is also associated with LOS.
⇒ These findings are reported for a small sample size in a single-center, retrospective cohort.

WHAT THIS STUDY ADDS

⇒ This study showed that the number of regions with fractures in the spine, pelvis, and lower extremities (NRF) was associated with LOS ≥30 using a nationwide trauma database with a large sample size.
⇒ NRF was available in the early phase of admission regardless of patient conditions.
⇒ The results of this study add complementary significance to those from previous studies as the latter had not considered trauma patterns in detail.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Patients after intentional falls from a height often need trauma and psychiatric care, and sharing information on the factors associated with prolonged LOS would help attending physicians, including psychiatrists, develop an appropriate treatment strategy in acute care hospitals where clinical care is afflicted by time constraints.

INTRODUCTION

Falling from a height is a frequent suicide method. Patients who attempt suicide by intentionally falling from a height are commonly brought to emergency departments (EDs) and often transferred as patients with severe trauma that may eventually cause death or significant disability.[1 2] More than half of the patients injured by intentionally falling from a height have some psychiatric diseases, such as mood disorders, personality disorders, and schizophrenia.[3 4] Therefore, patients injured due to intentional falling from a height require both trauma and psychiatric care in the acute phase of hospitalization.

In Japan, the protocol for treating emergency patients often involves acute care, followed by transfer of most patients with severe trauma from acute care hospitals to other non-acute care hospitals for continued rehabilitation. However, coordinating between hospitals for patients with suicide

attempts is often difficult because most non-acute care hospitals do not have both rehabilitation and psychiatric wards. Interventions by psychiatrists in acute care hospitals would improve this situation. In psychiatric care, the time between initiating treatment and evaluating its effectiveness is often longer than that in trauma care. Thus, it is useful to share with the attending physicians, including psychiatrists, the expected length of hospital stay (LOS) as soon as possible after admission.

Studies that investigated the factors associated with longer LOS among patients injured by intentional falls from a height are limited,[3 5] whereas several studies have examined mortality-associated factors.[5 6] Todorov *et al*,[5] in a single-center, retrospective chart review of jumping from a height that investigated the association between LOS and mainly sociodemographic factors, including psychiatric disorders, found that psychotic disorder prolonged the LOS. However, factors related to trauma and associated with prolonged LOS have not been descriptively investigated. Trauma patterns could be potential factors that are associated with prolonged LOS. Several studies have reported that patients who intentionally fall have a characteristic trauma pattern: fractures in the lower extremity, spine, and pelvis,[1 4 6–9] which often require longer rehabilitation period until hospital discharge. In addition, trauma patterns are easy to obtain in the early phase of admission regardless of patient conditions. Thus, examination of an association between trauma patterns and LOS can add complementary significance to the results of previous studies. Therefore, we evaluated the association between the number of regions with fractures in the pelvis, spine, and lower extremity (NRF) and prolonged LOS among patients after a suicidal fall from a height.

METHODS

The Strengthening the Reporting of Observational Studies in Epidemiology guideline was used to ensure proper reporting of methods, results, and discussion .[10]

Study design

This was a multicenter, nationwide, retrospective cohort study.

Data source

The Japan Trauma Databank (JTDB) is a multicenter, nationwide trauma registry in Japan that was established in 2003 by the Japanese Association for the Surgery of Trauma and the Japanese Association for Acute Medicine to improve the quality of trauma care in Japan. In principle, trauma patients who are transported to the participating hospitals and have an Abbreviated Injury Scale (AIS) score ≥3 are registered in the JTDB. Two hundred and ninety-two acute care hospitals that provide trauma care throughout Japan were the participating centers of the JTDB as of December 31, 2021. Data are entered into the JTDB by physicians or medical assistants who are trained in AIS coding and include various items such as prehospital care, initial treatment, diagnosis, in-hospital treatment, and clinical outcomes (eg, mortality and LOS). In this study, we used the JTDB data that were released in 2021 and included trauma patients treated between January 1, 2004 and May 31, 2019.

Participants

The inclusion criteria were as follows: (1) age ≥18 years, (2) intentional fall from a height, and (3) LOS ≥72 hours. Patients who had an AIS score ≥5 in the head region, those who died after admission, or those whose Injury Severity Score (ISS) data were missing were excluded from this study. However, those who died after admission were included in the sensitivity analysis with a competing risk model, which is discussed in the Statistical analysis section.

Data collection

Data related to patient and hospital information were obtained from the JTDB, which included information on the demographics; prehospital, ED, and in-hospital treatments; AIS scores; ISS; and clinical outcomes.

Exposure

NRF was developed based on our previous study[7] which investigated the differences in trauma injury patterns and severity between intentional and accidental falls from a height. In the intentional fall group, the trauma severity increased in the lower extremities and pelvic region as the ISS increased, whereas in the accidental fall group the trauma severity in the head region increased. The intentional fall group with ISS <16 showed more fractures of the lower extremity, pelvis, and spine (lumbar) compared with the accidental fall group. NRF reflected these characteristics.

Definitions of the variables

The AIS provides an internationally accepted tool for ranking injury severity and is an anatomically based global severity scoring system that classifies an individual injury by body region according to its relative severity on a 6-point scale (1=minor; 6=lethal). In this study, AIS 98 was used.[10] Moreover, the AIS provides the basic framework for the ISS, which is a recognized tool for assessment of overall injury severity. The ISS is the sum of the squares of the highest AIS code in each of the three most severely injured ISS body regions.[10 11] The medical history of each patient was identified by the data registered in the JTDB. The presence or absence of a medical history of psychiatric disorders was recorded. However, psychiatric diseases were not descriptively recorded; therefore, data on the types of psychiatric diseases, such as depression and schizophrenia, were unavailable. Trauma-specialized hospitals were defined by the number of severe trauma patients with ISS ≥16 who were registered in the JTDB since January 1, 2004, in each participating hospital; hospitals where the number of these patients was in the top half of all participating hospitals were defined as trauma-specialized hospitals. The LOS included only the duration of the hospital stay during which the patient was registered in the JTDB. The distribution of fractures was identified by the AIS code registered for each patient. The regions in the lower extremity included the femur, patella, tibia, fibula, and foot. The NRF was calculated and ranged from 0 to 3.

Outcomes

The primary endpoint was the association between the NRF and the proportion of patients with LOS ≥30 days. The secondary endpoint was the association between the NRF and the proportion of patients with LOS ≥60 days. These were determined based on the clinical significance from the viewpoint of psychiatrists. Patients who intentionally fall from a height often have a medical history of psychiatric diseases such as mood disorders and schizophrenia. Antidepressant therapy and modified electroconvulsive therapy require approximately 1 month between their initiation and evaluation. In other words, knowing that the patient is likely to be hospitalized for more than a certain period would help in the decision-making for initiating psychiatric treatment.

Statistical analysis

Continuous variables with normal distribution are expressed as mean±SD and as median (IQR) for non-parametric variables.[12] Categorical variables are presented as numbers and percentages. Continuous variables were compared using the Mann-Whitney U test, and categorical variables were compared using the χ^2 test.

The association between the NRF and the LOS was assessed in a multivariable model. Considering clinical relevance and prior studies,[1 3–9] the covariates for the logistic regression model were determined as follows: age, sex (male), medical history of psychiatric diseases, cerebrovascular diseases, chronic obstructive pulmonary disease, chronic heart failure (CHF), or chronic kidney dysfunction requiring hemodialysis, admission to trauma-specialized hospitals, transferred from other hospitals, systolic blood pressure (BP), respiratory rate, heart rate, body temperature, Glasgow Coma Scale (GCS) score, ISS, intubation in the ED, and admission to non-intensive care unit (ICU) wards. Vital signs were obtained from those measured in the ED. The height of falls and the condition of the ground were considered to be appropriate covariates, but these were unavailable in the JTDB. Instead, we used the ISS because it is associated with the height of falls.[9] Moreover, we assessed the association between the NRF and the LOS in a Kaplan-Meier analysis.

To address the issue of missing data, we used multiple imputations by a chained equation.[13] Ten complete data sets were created based on a multiple regression model that included variables with potential associations and were available in the data sets, and estimates were combined using Rubin's rules.[14] The number of imputed data sets was set above the percentage of patients with any missing data.[13]

We performed a predetermined sensitivity analysis to confirm the robustness of the primary analysis: a complete case analysis and a competing risk model (the Fine and Gray model).[15] In the competing risk model, patients who died after admission were included because death after admission is a competing risk event for hospital discharge (figure 1). The complete case analysis included the patients who were included in the primary analysis. The covariates were the same variables as those used in the primary analysis.

All analyses were performed using SPSS V.28 (IBM, Armonk, NY) and R V.3.6.3 (R Foundation for Statistical Computing, Vienna, Austria) with the "mice" package. OR, HR, and 95% CI were calculated as appropriate. Statistical tests were two-sided, with $p<0.05$ set to indicate statistical significance.

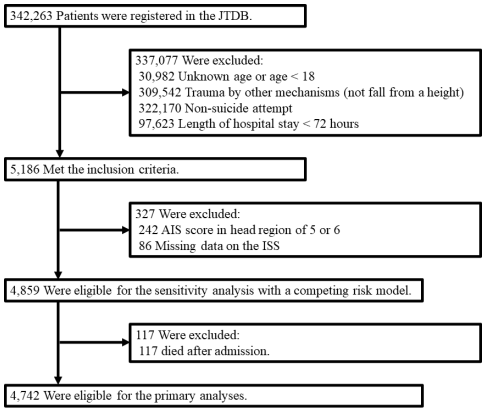

Figure 1 Participant enrollment flow chart. AIS, Abbreviated Injury Scale; ISS, Injury Severity Score; JTDB, Japan Trauma Databank.

RESULTS

Participant selection

Figure 1 summarizes the participant selection process of this study. Among the 342 263 patients registered in the JTDB, 4742 were eligible for inclusion in the primary analysis. Of these, 2793 (58.9%) patients were classified in the group with LOS ≥30 days (group 1) and 1949 (41.1%) in the group with LOS <30 days (group 2).

Participant characteristics

Table 1 shows the characteristics of the participants in each group. There were significant intergroup differences in age and NRF, but not in the medical history of psychiatric diseases, sex, transportation from other hospitals, or admission to trauma-specialized hospitals.

Association between NRF and the proportion of patients with LOS ≥30 days

Table 2 shows the results of the multivariable analysis. A higher NRF was associated with prolonged LOS, with NRF=1 (risk ratio (RR)=1.64, 95% CI 1.41 to 1.91), NRF=2 (RR=2.00, 95% CI 1.72 to 2.33), and NRF=3 (RR=2.01, 95% CI 1.70 to 2.38) all showing significant differences ($p<0.001$ for all). Other significant factors included lower systolic BP (RR=0.999, 95% CI 0.998 to 0.9997), higher heart rate (RR=1.002, 95% CI 1.00 to 1.004), higher ISS (RR=1.007, 95% CI 1.00 to 1.01), and intubation in the ED (RR=1.21, 95% CI 1.10 to 1.34). There was no significant difference in the medical history of psychiatric diseases. Kaplan-Meier analysis also revealed that patients with a higher NRF had longer LOS (figure 2).

Association between NRF and the proportion of patients with LOS ≥60 days

Table 3 demonstrates the results of the logistic regression analysis. A higher NRF was associated with longer LOS: NRF=1 (RR=2.11, 95% CI 1.64 to 2.70, $p<0.001$), NRF=2 (RR=2.79, 95% CI 2.18 to 3.57, $p<0.001$), and NRF=3 (RR=3.21, 95% CI 2.46 to 4.17, $p<0.001$). Higher age (RR=1.004, 95% CI 1.00 to 1.01, $p=0.038$), lower systolic BP at ED admission (RR=0.998, 95% CI 0.996 to 0.999, $p=0.045$), higher heart rate at ED admission (RR=1.003, 95% CI 1.001 to 1.006, $p=0.006$), higher ISS (RR=1.009, 95% CI 1.004 to 1.014, $p<0.001$), admission to non-ICU wards (RR=0.81, 95% CI 0.66 to 0.99, $p=0.04$), and intubation in the ED (RR=1.34, 95% CI 1.17 to 1.54, $p<0.001$) were also associated with the outcome.

Sensitivity analyses

A predefined sensitivity analysis was performed. Similar to the results of the primary analysis, the Fine and Gray regression analysis showed that a higher NRF was associated with longer LOS (HR=0.64, 95% CI 0.60 to 0.68, $p<0.001$; online supplemental table S1). However, unlike the outcome of the primary analysis, CHF (HR=5.70, 95% CI 1.58 to 20.4, $p=0.008$) and lower GCS scores (HR=0.996, 95% CI 0.994 to 0.998, $p<0.001$) prolonged the LOS.

DISCUSSION

In this study, we demonstrated that NRF was associated with longer LOS among patients who attempted suicide by jumping from a height. As the NRF increased, the proportion of patients with LOS ≥30 and ≥60 days increased. This multicenter, nationwide, large-sample cohort study is the first to investigate the relationship between factors associated with trauma patterns

Table 1 Comparison of participant characteristics in each group

	Missing cases, n (%)	LOS ≥30 days (n=2793)	LOS <30 days (n=1949)	P value
Age, years, median (IQR)	0 (0)	37 (27–49)	34 (25–46)	<0.001
Sex, male, n (%)	1 (0.0)	1140 (40.8)	776 (39.8)	0.48
Medical history*, n (%)				
Psychiatric diseases	0 (0)	1714 (61.4)	1191 (61.1)	0.86
COPD	0 (0)	4 (0.1)	3 (0.2)	0.92
Chronic heart failure	0 (0)	3 (0.1)	3 (0.2)	0.66
Cerebrovascular diseases	0 (0)	39 (1.4)	18 (0.9)	0.14
CKD on HD	0 (0)	4 (0.1)	3 (0.2)	0.92
Vital signs in the ED, median (IQR)				
Systolic BP, mm Hg	56 (1.2)	110 (91–130)	120 (104–136)	<0.001
Respiratory rate, per minute	247 (5.1)	23 (18–28)	22 (18–26)	<0.001
Heart rate, beats per minute	91 (1.9)	100 (85–119)	93 (80–108)	<0.001
Body temperature, °C	453 (9.3)	36.4 (35.7–36.9)	36.5 (35.9–37.0)	<0.001
GCS score	165 (3.4)	14 (12–15)	14 (13–15)	<0.001
RTS, median (IQR)	350 (7.2)	7.55 (6.61–7.84)	7.84 (7.11–7.84)	<0.001
Intubation in the ED, n (%)	0 (0)	841 (30.1)	224 (11.5)	<0.001
Transferred from other hospitals, n (%)	64 (1.3)	286 (10.4)	192 (10.0)	0.70
Admission to trauma-specialized hospitals†, n (%)	0 (0)	1478 (52.9)	997 (51.2)	0.23
Admission to non-ICU wards, n (%)	0 (0)	268 (9.6)	321 (16.5)	<0.001
ISS, median (IQR)	0 (0)	22 (13–32)	14 (9–22)	<0.001
TRISS, Ps, median (IQR)	418 (8.6)	0.96 (0.87–0.99)	0.986 (0.96–0.993)	<0.001
Number of regions with fractures in the spine, pelvis, and lower extremity, median (IQR)	0 (0)	2 (1–2)	1 (1–2)	<0.001
Spine, n (%)	0 (0)	1591 (57.0)	951 (48.8)	<0.001
Pelvis, n (%)	0 (0)	1477 (52.9)	634 (32.5)	<0.001
Lower extremity, n (%)	0 (0)	1638 (58.6)	748 (38.4)	<0.001
AIS score, head, n (%)	0 (0)			<0.001
1		122 (6.3)	103 (3.7)	
2		54 (2.8)	71 (2.5)	
3		220 (11.3)	374 (13.4)	
4		135 (6.9)	226 (8.1)	
5		0 (0)	0 (0)	
6		0 (0)	0 (0)	
AIS score, face, n (%)	0 (0)			<0.001
1		175 (9)	231 (8.3)	
2		159 (8.2)	370 (13.2)	
3		18 (0.9)	50 (1.8)	
4		1 (0.1)	9 (0.3)	
5		0 (0)	0 (0)	
6		0 (0)	0 (0)	
AIS score, neck, n (%)	0 (0)			0.73
1		8 (0.4)	12 (0.4)	
2		4 (0.2)	9 (0.3)	
3		2 (0.1)	3 (0.1)	
4		0 (0)	0 (0)	
5		1 (0.1)	0 (0)	
6		0 (0)	0 (0)	
AIS score, thorax, n (%)	0 (0)			<0.001
1		48 (2.5)	41 (1.5)	
2		62 (3.2)	81 (2.9)	
3		379 (19.4)	576 (20.6)	
4		266 (13.6)	516 (18.5)	
5		30 (1.5)	103 (3.7)	
6		0 (0)	0 (0)	
AIS score, abdomen, n (%)	0 (0)			<0.001
1		28 (1.4)	39 (1.4)	
2		166 (8.5)	286 (10.2)	
3		83 (4.3)	184 (6.6)	
4		22 (1.1)	81 (2.9)	
5		8 (0.4)	11 (0.4)	
6		0 (0)	0 (0)	
AIS score, spine, n (%)	0 (0)			<0.001
1		7 (0.4)	2 (0.1)	
2		540 (27.7)	828 (29.6)	
3		410 (21)	695 (24.9)	
4		72 (3.7)	159 (5.7)	
5		38 (1.9)	101 (3.6)	
6		1 (0.1)	2 (0.1)	
AIS score, upper extremity, n (%)	0 (0)			<0.001
1		105 (5.4)	122 (4.4)	
2		295 (15.1)	546 (19.5)	
3		139 (7.1)	365 (13.1)	
4		0 (0)	0 (0)	
5		0 (0)	0 (0)	
6		0 (0)	0 (0)	
AIS score, lower extremity, pelvis, and buttocks, n (%)	0 (0)			<0.001
1		100 (5.1)	46 (1.6)	
2		578 (29.7)	735 (26.3)	
3		366 (18.8)	943 (33.8)	
4		96 (4.9)	340 (12.2)	
5		64 (3.3)	251 (9)	
6		0 (0)	0 (0)	

*Medical history was obtained from the JTDB.
†Trauma-specialized hospitals were defined by the number of severe trauma patients with ISS ≥16 registered in the JTDB since January 1, 2004, for each participating hospital. Hospitals with the number of these trauma patients in the top half of all participating hospitals were defined as trauma-specialized hospitals.
AIS, Abbreviated Injury Scale; BP, blood pressure; CKD, chronic kidney dysfunction; COPD, chronic obstructive pulmonary disease; ED, emergency department; GCS, Glasgow Coma Scale; HD, hemodialysis; ICU, intensive care unit; ISS, Injury Severity Score; JTDB, Japan Trauma Databank; LOS, length of hospital stay; Ps, probability of survival; RTS, Revised Trauma Score; TRISS, Trauma and Injury Severity Score.

Table 2 Multivariable analysis for patients with a length of hospital stay ≥30 days

	RR (95% CI)	P value
NRF*=0	1.00	
NRF=1	1.64 (1.41 to 1.91)	<0.001
NRF=2	2.00 (1.72 to 2.33)	<0.001
NRF=3	2.01 (1.70 to 2.38)	<0.001
Age, years	1.000 (0.999 to 1.001)	0.07
Sex, male	1.03 (0.95 to 1.12)	0.42
Transferred from other hospitals	0.98 (0.86 to 1.11)	0.75
Admission to trauma-specialized hospitals†	0.99 (0.92 to 1.07)	0.89
Intubation in the ED	1.21 (1.10 to 1.34)	<0.001
Medical history		0.76
Psychiatric diseases	1.00 (0.93 to 1.08)	0.95
COPD	0.86 (0.32 to 2.30)	0.76
Chronic heart failure	0.66 (0.21 to 2.06)	0.47
Cerebrovascular diseases	1.03 (0.75 to 1.42)	0.86
CKD on HD	0.93 (0.35 to 2.49)	0.88
Vital signs in the ED		
Systolic BP	0.999 (0.998 to 0.9997)	0.03
Respiratory rate	0.999 (0.99 to 1.004)	0.68
Heart rate	1.002 (1.00 to 1.004)	0.03
Body temperature	0.99 (0.95 to 1.02)	0.45
GCS score	0.998 (0.99 to 1.01)	0.81
ISS	1.007 (1.00 to 1.01)	<0.001
Admission to non-ICU wards	0.91 (0.80 to 1.04)	0.15

*NRF ranges from 0 to 3.
†Trauma-specialized hospitals were defined by the number of severe trauma patients with ISS ≥16 registered in the JTDB since January 1, 2004, for each participating hospital. Hospitals with the number of trauma patients in the top half of all participating hospitals were defined as trauma-specialized hospitals.
BP, blood pressure; CKD, chronic kidney dysfunction; COPD, chronic obstructive pulmonary disease; ED, emergency department; GCS, Glasgow Coma Scale; HD, hemodialysis; ICU, intensive care unit; ISS, Injury Severity Score; JTDB, Japan Trauma Databank; NRF, number of regions with fractures in the spine, pelvis, and lower extremity; RR, risk ratio.

Table 3 Multivariable analysis for patients with a length of hospital stay ≥60 days

	RR (95% CI)	P value
NRF*=0	1.00	
NRF=1	2.11 (1.64 to 2.70)	<0.001
NRF=2	2.79 (2.18 to 3.57)	<0.001
NRF=3	3.21 (2.46 to 4.17)	<0.001
Age, years	1.004 (1.00 to 1.01)	0.038
Sex, male	1.07 (0.96 to 1.2)	0.22
Transferred from other hospitals	1.02 (0.86 to 1.21)	0.83
Admission to trauma-specialized hospitals†	0.92 (0.83 to 1.02)	0.11
Intubation in the ED	1.34 (1.17 to 1.54)	<0.001
Medical history		
Psychiatric diseases	1.07 (0.95 to 1.19)	0.75
COPD	0.80 (0.20 to 3.22)	0.75
Chronic heart failure	0.41 (0.06 to 2.92)	0.37
Cerebrovascular diseases	1.15 (0.75 to 1.76)	0.53
CKD on HD	0.91 (0.23 to 3.66)	0.90
Vital signs in the ED		
Systolic BP	0.998 (0.996 to 0.999)	0.045
Respiratory rate	0.998 (0.991 to 1.01)	0.59
Heart rate	1.003 (1.001 to 1.006)	0.006
Body temperature	1.00 (0.95 to 1.05)	0.998
GCS score	0.99 (0.97 to 1.01)	0.33
ISS	1.009 (1.004 to 1.014)	<0.001
Admission to non-ICU wards	0.81 (0.66 to 0.99)	0.04

*NRF ranges from 0 to 3.
†Trauma-specialized hospitals were defined by the number of severe trauma patients with ISS ≥16 registered in the JTDB since January 1, 2004, for each participating hospital. Hospitals with the number of trauma patients in the top half of all participating hospitals were defined as trauma-specialized hospitals.
BP, blood pressure; CKD, chronic kidney dysfunction; COPD, chronic obstructive pulmonary disease; ED, emergency department; GCS, Glasgow Coma Scale; HD, hemodialysis; ICU, intensive care unit; ISS, Injury Severity Score; JTDB, Japan Trauma Databank; NRF, number of regions with fractures in the spine, pelvis, and lower extremity; RR, risk ratio.

and prolonged LOS. Our findings imbue a complementary significance to the previously reported findings and may help psychiatrists develop more appropriate treatment plans with attention to LOS in acute care hospitals. For example, if psychiatrists discover immediately after admission that the LOS is likely to be more than 1 month, they will decide to commence psychiatric treatment immediately, even if it will require more than 1 month from initiation until evaluation. Conversely, discovering that the LOS is likely to be short would lead to the decision that psychiatric illness treatment should be initiated in a non-acute care hospital.

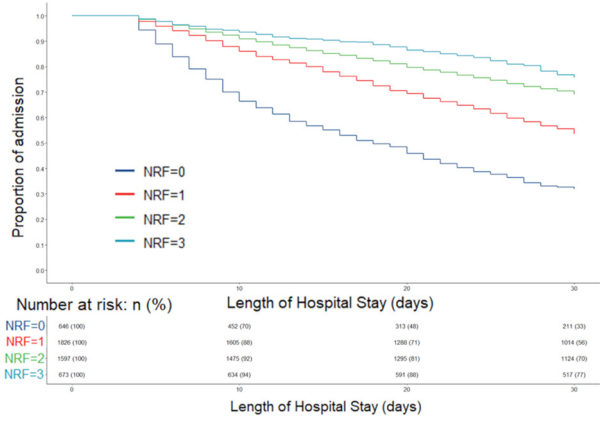

Figure 2 Kaplan-Meier curves for hospital discharge events in patients with NRF 0, 1, 2, or 3. NRF, number of regions with fractures in the spine, pelvis, and lower extremity.

Some studies have investigated LOS among patients injured by intentional falls from a height. Studies that compared LOS between intentional and non-intentional falls from a height showed that patients with intentional falls had longer LOS than those with non-intentional falls.[4 6] However, detailed investigations of factors that increase LOS in patients who are injured by intentional falls from a height are limited because most studies have focused on mortality as the primary endpoint.[5]

Todorov *et al* and Omi *et al*[3 5] performed single-center retrospective studies that focused mainly on the sociodemographic and psychiatric data of patients who attempted suicide by jumping from a height. Both studies demonstrated that psychotic disorders prolonged LOS. However, the limitations of these studies included heterogeneity in the clinical settings,[3] the small sample size, and the single-center design.[3 5]

The results of our study showed that a higher NRF was associated with longer LOS, which can be explained by the trauma pattern among patients with intentional falls. These patients are more likely to land on their heels on the ground when landing,[16]

which leads to a higher NRF.[1 6–9 17] Moreover, fractures in these regions need a longer LOS to recover the abilities necessary for daily activities than those with fractures in other regions. Similarly, fractures in the head and thoracic regions can necessitate long-term rehabilitation in patients with severe trauma that leads to complications, such as higher brain dysfunction due to brain injuries and a flail chest due to multiple rib fractures. Our target population included those who would require an evaluation and follow-up care by psychiatrists in acute care hospitals; thus, those who had severe head trauma were excluded. Therefore, a head injury would have little impact on LOS in our study, and this aspect is supported by the fact that the AIS score in the head region decreased as the NRF increased (table 1). Similarly, the impact of a thoracic injury would be explained by patient selection.[7] Previous studies have shown that patients who intentionally fell from a height had a higher NRF, and fatal cases were more likely to have severe head and thoracic trauma.[18–20] Then, patients with critically severe thoracic trauma could have been excluded due to the inclusion and exclusion criteria. In addition, our results demonstrate that psychiatric diseases were not associated with prolonged LOS, which contradicts the finding of a previous study that showed an association between schizophrenia and longer LOS.[3] These differences may be attributed to the diverse clinical settings in acute care hospitals and psychiatric wards.

Our study has some limitations. First, the JTDB does not constitute a population-based sample of all trauma patients. Patients who were not registered in the participating hospitals for some reason were not included in the JTDB. Therefore, the possibility of selection bias cannot be ruled out. Our study had a large sample size, and the characteristics of the patients would be similar to those of the general population. Second, psychiatric care in each participating hospital was not considered in the analysis due to the limitations of the database. The differences in various care systems in each hospital, including psychiatric care, would influence the criteria for hospital discharge. However, our result was derived from real-world data in Japan and remained clinically important regardless of this limitation. Third, the inaccuracies of the database itself may have influenced the results. Haas *et al*[21] highlighted the under-reporting of some items in a national trauma databank. The JTDB had similar limitations regarding factors such as AIS coding. However, the patients were registered in the JTDB by physicians or medical assistants who had attended lectures on AIS coding. Therefore, any inaccuracies within the JTDB would not have significantly influenced our results.

In conclusion, an increased NRF prolongs the LOS of patients who are injured by intentional falls from a height. This is clinically relevant and should assist both emergency physicians and psychiatrists to develop better treatment strategies in acute care hospitals where clinical care is afflicted by time constraints. Further studies that assess the association between LOS and both trauma and psychiatric treatment will be required to evaluate the effect of NRF on LOS in acute care hospitals.

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Patient consent for publication Not required.

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Data availability statement The data sets analyzed in this study are not publicly available due to ethical restrictions for protection of patient confidentiality and sharing of personally identifiable information.

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Table S1. Fine and Gray regression analysis for the number of regions with fractures in the spine, pelvis, and lower extremity and the length of hospital stay

	HR (95% CI)	*p*-value
NRF*	0.64 (0.60–0.68)	<0.001
Age, years	0.994 (0.991–0.997)	<0.001
Sex, male	0.99 (0.89–1.1)	0.85
Transferred from other hospitals	0.99 (0.83–1.17)	0.88
Admission to trauma-specialized hospitals†	0.97 (0.88–1.07)	0.59
Intubation at the ED	0.47 (0.39–0.56)	<0.001
Medical history		
Psychiatric diseases	1.04 (0.94–1.15)	0.47
COPD	0.77 (0.07–8.14)	0.83
Chronic heart failure	5.7 (1.58–20.4)	0.008
Cerebrovascular diseases	0.68 (0.39–1.19)	0.18
CKD on HD	0.67 (0.14–3.37)	0.63
Vital signs at the ED		
Systolic BP	0.977 (0.971–0.98)	<0.001
Respiratory rate	1.16 (1.01–1.32)	0.034
Heart rate	1.003 (1.001–1.005)	<0.001
Body temperature	1.005 (0.999–1.012)	0.12
GCS score	0.996 (0.994–0.998)	0.001
ISS	1.01 (0.97–1.06)	0.57
Admission to non-ICU wards	1.00 (0.98–1.02)	0.69

NRF, The number of regions with fractures in the three regions (spine, pelvis, and lower extremely); ED, emergency department; COPD, chronic obstructive pulmonary disease; CKD,

Chronic kidney dysfunction; HD, hemodialysis; BP, blood pressure; GCS, Glasgow Coma Scale; ISS, Injury Severity Score; ICU, intensive care unit; HR, hazard ratio; CI, confidence interval.

* NRF ranges from 0 to 3.

†Trauma-specialized hospitals were defined by the number of severe trauma patients with ISS of ≥16 registered in the JTDB since January 1, 2004, for each participating hospital. Hospitals with a number of trauma patients in the top half of all participating hospitals were defined as trauma-specialized hospitals.

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