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# Geriatric Falls: A Registry-Based Study in the Netherlands

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**BACKGROUND:** Falls in people 65 years and older evaluated in the emergency department are increasing. Of all unintentional injury-related deaths among older people, 55% are due to falls. The impact of falls, especially concerning Dutch older people with the highest proportion of living independently worldwide, is unclear.

**OBJECTIVE:** To identify the influence of age, gender, health conditions, and type of fall on the severity of injury, hospital length of stay, mortality, and discharge destination.

**METHODS:** A total number of 6,084 patients from a comprehensive regional trauma care system, 65 years and older and hospitalized after a fall, were included. Groups were compared for patient-related factors and multivariable logistic regression analysis to explore the consequences.

**RESULTS:** Mean age was 82 years (*SD* = 8.3), and 70% were female. Most falls (66.4%) were due to "slipping and tripping" or "falls on the same level," 57.4% had Injury Severity Scores between 9 and 12, and 43.3% were discharged home. Higher age and type of fall increased the likelihood of severe injuries. Men experienced shorter hospital stays than women and were less frequently discharged home. Mortality was higher in males (10.8%) than in females (6.7%) and increased with the American Society of Anesthesiologists scores for preexisting health conditions.

**CONCLUSION:** Advanced age, gender, type of fall, and prior health status play a significant role in the severity of injuries, length of hospital stay, 30-day mortality, and higher discharge destination to care homes in older people hospitalized after a fall.

**KEY WORDS:** Fall incident consequences, Injury severity, Mortality, Older people, Preexisting health conditions

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## BACKGROUND

A fall incident is defined as an unintentional and unexpected event in which a person comes to rest on the ground or at a lower level (Lamb et al., 2005). In the United States, the rate of fall incidents in people 65 years and older, who were evaluated at the emergency department (ED), increased by 27% over the period 2003–2010 (Shankar et al., 2017). Furthermore, 55% of all unintentional injury-related deaths among older people in the United States in 2012–2013 were due to falls (Kramarow et al., 2015). A recent study showed an upward trend in fatal and nonfatal injuries among older people and reported 25% revisits after 1 year (Liu et al., 2015).

Death from accidental fall incidents also increased sharply in the Netherlands. In women, the absolute numbers increased from 1,008 in 1990 to 2,843 in 2019, whereas in men, the absolute numbers rose from 576 in 1990 to 1,880 in 2019 (Centraal Bureau voor de Statistiek, 2020a). The incidence of falls in older people evaluated at the ED went up by 12% over the last 5 years (Draisma, 2015). The *Safety NL* (Dutch knowledge center for injury prevention) stated that more older people will die from a fall, and most of them will not survive a fall by 2030 (Draisma, 2015). The aging population, high case fatality rate, and increasing number of falls with moderate to severe injuries in the population 65 years and older represent a serious challenge to health care services (Ambrose et al., 2013).

In the Netherlands, older people are encouraged by the Ministry of Health, Welfare, and Sport to live independently for as long as possible (Government of the

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The authors declare no conflicts of interest.

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**KEY POINTS**

- The Netherlands has the highest proportion (93.4%) of older people worldwide who live independently (United Nations, 2017).
- More people 60 years or older are living independently in the Netherlands (94.9% females and 91.6% males) compared with the United States (69.9% females and 73.4% males) (United Nations, 2017).
- Falls among the elderly remain a serious health care burden worldwide.
- This Netherlands study found that the type of fall combined with preexisting health conditions in the geriatric population has clear impact on injury severity, short-term mortality, hospital length of stay, and discharge destination.
- Further research on senior fall risk factors and the resulting higher morbidity and mortality is needed to inform fall prevention, treatment, and rehabilitation for this high-risk population.



Netherlands, 2015). To enable that, access to primary care is well facilitated. If their health status changes, suitable housing and community-based nursing care are available to remain living independently for longer. The Netherlands has the highest proportion (93.4%) of older people worldwide who live independently (United Nations, 2017). Specifically, more people 60 years or older are living independently in the Netherlands (94.9% females and 91.6% males) compared with the United States (69.9% females and 73.4% males) (United Nations, 2017). The policy intention by the government cannot be seen separately from the aging aspect of the population. For example, aging is one of the reported risk factors for a fall (Carpenter et al., 2014). According to Statistics Netherlands, life expectancy has increased from 77 years in 1990 to 82 years in 2019 (Centraal Bureau voor de Statistiek, 2018). Therefore, the increasing age and number of older people who live independently may impact the rate of injuries from fall incidents.

Earlier research revealed various risk factors for falls, such as environmental determinants (e.g., weather conditions), aging, sedentary behavior, previous falls, living alone, disability, use of a walking aid, depression, cognitive deficits, and the use of more than six types of medication (Carpenter et al., 2014; Deandrea et al., 2013). In general, no single risk factor increases the risk of falling, but a complex interplay of these risk factors (Ambrose et al., 2013). For example, a cardiovascular condition or serious infection can impair consciousness, leading to a fall incident (Demircan et al., 2017). In addition, older age is associated with weaker muscles and impaired balance, which may influence the severity and medical consequences of the fall (Trevisan et al., 2017).

Fall-related risk factors and associated preventative measures have been described comprehensively in earlier research (Pillay et al., 2021). In addition, research underlies the importance of gaining more insights into the specific impact of patient-related factors and fall characteristics on the consequences of a fall incident (severity of injuries, hospital length of stay, discharge destination, and short-term mortality) (Ek et al., 2020). Especially, it is unknown what this impact is on the Dutch elderly, with the highest proportion worldwide of people living independently (United Nations, 2017). Insights into the impact of these patient-related factors and the fall characteristics on the consequences of a fall incident can uncover the impact and burden on older people evaluated at the ED, their relatives, and the health care system. Better insights will help guide preventive strategies, (advanced) care planning, and rehabilitation.

## OBJECTIVE

The objective of this study is to describe the consequences of a fall in terms of severity of injury, hospital length of stay, discharge destination, and 30-day mortality in older people and explore the influence of age, gender, preexisting health conditions, and fall characteristics.

## METHODS

A registry-based study was conducted. Data were extracted from the Regional Trauma Registration Database in the Middle of the Netherlands (in Dutch: *Traumazorgnetwerk Midden-Nederland*). These trauma data are registered as an integral part of the trauma care system in the province of Utrecht (Traumazorgnetwerk Midden-Nederland, 2021). Data of patients registered between 2014 and 2017 were used for the current study.

### Setting and Sample

All patients 65 years and older evaluated at the ED after a fall and consecutively admitted to hospital for injury treatment were included in the study. Data were derived from routinely collected information of trauma patients living in the province of Utrecht, the Netherlands, representing one Level I trauma university hospital and three general hospitals, where Level II and III trauma care is provided.

### Study Outcomes

We collected data on the Injury Severity Score (ISS), length of stay in the hospital (days), location after discharge, and 30-day postinjury mortality to describe the consequences after the fall incident. The ISS varied between 0 (no injury) and 75 (lethal injury) (Baker et al., 1974; Reynolds et al., 2011). The following categories were applied: no injury (ISS 0), minor (ISS 1–3), moderate (ISS 4–8), serious (ISS 9–12), severe (ISS 13–15), dangerous (ISS 16–24), and critical injury (ISS

25–75) (Stevenson et al., 2001). The ISS higher than 15 indicated polytrauma defined as a trauma where there should be at least two injuries with an Abbreviated Injury Scale of 3, plus one or more of the following four physiological responses to injury: hypotension, diminished level of consciousness, acidosis, and coagulopathy (Butcher & Balogh, 2014).

The following factors were collected to explore the consequences of the fall: age, gender, health condition prior to the fall, and the kind of fall. The American Society of Anaesthesiologists (ASA) classification represents preexisting health conditions (Committee on Economics, 2020). The ASA classification ranged from I (healthy), II–IV (mild systematic disease toward severe systematic disease), to VI (declared brain dead) (Committee on Economics, 2020). This study only had ASA classification data ranging from I to IV. To classify the kind of fall, we used the *International Statistical Classification of Diseases and Related Health Problems* (*ICD-10*), in which falls are classified with 20 codes from W00 to W19 (World Health Organization, 2014). For pragmatic reasons, we condensed the 20 *ICD-10* codes into 10 clusters. We collected data on the fall location, classification, and high or low energetic fall impact to describe fall characteristics.

### Data Analysis

Descriptive data were presented with means and standard deviations (SD). Categorical variables were described with frequencies and percentages. The two-sided independent *t* test (for continuous variables) and the $\chi^2$ test (for categorical variables) were applied to analyze if patient-related factors (age, gender, ASA score, and type of fall) differed between patient groups who were moderately or severely injured; had a normal (1–5 days) or prolonged hospital stay (≥6 days), were discharged home or elsewhere, and patients who died within 30 days post-injury or not. To explore the influence of combinations of patient-related factors and the type of fall on the consequences of a fall incident, we performed multivariable logistic regression analysis with odds ratios (ORs) as effect parameters, 95% confidence intervals (CIs), and *p* values. For the logistic regression, ISSs were converted to moderate injuries (ISS 1–8) and severe injuries (ISS ≥9); the length of hospital stay to 1–5 hospitalization days and six or more, because in the Netherlands, the mean hospitalization period in 2018 was 5.2 days (De Staat van Volksgezondheid, 2018). The discharge location was converted into other health care services or institutions and home. The level of significance was set at $p = .05$. Analyses were performed using SPSS (Version 25, IBM, Armonk, NY). The study involved clinical research that did not fall within the scope of the Medical Research Involving Human Subjects Act (in Dutch: *Wet Medisch-wetenschappelijk Onderzoek*) as approved by the Medical Ethics Review Committee of the Utrecht University Medical Center.

## RESULTS

A total of 6,084 patients 65 years and older were included in this study. Of them, 1,907 (31.1%) were hospitalized after a fall in 2014, 2,094 (34.4%) in 2015, and 2,083 (34.2%) in 2016. The mean age was 82 years (range 65–113 years), and 4,281 (70.4%) were female (see Table 1). Most patients scored 2,786 ASA II (46.9%) and 2,459 ASA III (41.4%), indicating mild systemic disease or severe systemic disease prior to the fall incident, respectively.

### Fall Characteristics

Most falls were registered as falls on the same level, 2,137 (35.3%), or falls due to slipping and tripping 1,885 (31.1%), see Table 2. In 2,859 (53.6%) patients, falls were of high energetic impact and in 2,478 (46.4%) of low energetic impact. The mean ISS was 8 (range 0–45), indicating moderate injury. A major part of 3,494 (57.4%) patients had ISSs between 9 and 12 and 1,256 (20.6%) had ISSs between 4 and 8.

**Table 1.** Baseline Characteristics of Patients

| | |
|---|---|
| Age | |
| *M* (*SD*) | 82 (8.34) |
| Min | 65 |
| Max | 113 |
| Gender, *n* (%) | |
| Male | 1,803 (29.6%) |
| Female | 4,281 (70.4%) |
| ASA score, *n* (valid %) | |
| I | 511 (8.6%) |
| II | 2,786 (46.9%) |
| III | 2,459 (41.4%) |
| IV | 190 (3.2%) |
| *Total missing* | *138 (2.3%)* |
| Fall location, *n* (valid %) | |
| Outside home | 2,480 (40.9%) |
| Home | 1,797 (29.7%) |
| Hospital | 315 (5.2%) |
| Nursing home | 139 (2.3%) |
| Referred by general practice center | 1,294 (21.4%) |
| Other | 34 (0.5%) |
| *Total missing* | *25 (0.4%)* |

*Note.* ASA = American Society of Anesthesiologists physical status classification system.

**Table 2.** Fall Characteristics and Consequences of a Fall Incident

| **Fall Characteristics** | |
|---|---|
| Type of fall (*ICD-10*), *n* (valid %) | |
| W00-01: Slipping tripping falls | 1,885 (31.1%) |
| W02-04: Involving skates/skis/other person | 26 (0.4%) |
| W05-08: Involving wheelchair/furniture | 581 (9.6%) |
| W10: From the stairs and steps | 562 (9.3%) |
| W09; W11–W17: Other specified fall | 146 (2.4%) |
| W18: Other fall on the same level | 2,137 (35.3%) |
| W19: Unspecified fall | 721 (11.9%) |
| *Total missing* | *26 (0.4%)* |
| Fall impact, *n* (valid %) | |
| Low energetic | 2,478 (46.4%) |
| High energetic | 2,859 (53.6%) |
| *Total missing* | *747 (12.3%)* |
| **Consequences of a Fall Incident** | |
| ISS | |
| *M* (*SD*) | 8 (4.80) |
| Min | 0 |
| Max | 45 |
| *n* (%) | |
| ISS 0: No injury | 3 (0.0%) |
| ISS 1;3: Minor injury | 838 (13.8%) |
| ISS 4;8: Moderate injury | 1,256 (20.6%) |
| ISS 9;12: Serious injury | 3,494 (57.4%) |
| ISS 13;15: Severe injury | 119 (2%) |
| ISS 16;24: Dangerous injury | 247 (4.1%) |
| ISS 25+: Critical injury | 127 (2.1%) |
| Polytrauma, *n* (%) | |
| Yes | 374 (6.1%) |
| No | 5,710 (93.9%) |
| Length of stay in hospital (days) | |
| *M* (*SD*) | 8 (6.53) |
| Min | 0 |
| Max | 96 |
| *n* (%) | |
| 1–5 days | 2,359 (38.8%) |
| ≥6 days | 3,725 (61.2%) |
| Discharge location from ED, *n* (valid %) | |
| Nursing home | 1,221 (24.4%) |
| Home | 2,171 (43.3%) |
| Rehabilitation clinic | 749 (15%) |
| Died | 479 (9.5%) |
| Other[a] | 392 (7.8%) |
| *Total missing* | *1,072 (17.7%)* |
| Mortality (30-day postinjury mortality), *n* (%) | |
| Death in hospital | 325 (5.4%) |
| Death after discharge | 154 (2.5%) |
| Total | 479 (7.9%) |

*Note.* ED = emergency department; *ICD-10* = *International Classification of Diseases-10,* ISS = Injury Severity Score.

[a]Other hospital, left against advice, intensive care, unknown.

In 374 (6.1%) patients, the injury was registered as polytrauma.

### Consequences of a Fall Incident

Patients were hospitalized for a mean duration of 8 days (range 0–96 days). A total of 2,171 (43.3%) patients were discharged home, 1,221 (24.4%) to a nursing home, and 749 (15%) to a rehabilitation clinic. A total of 479 patients (9.5%) died, of whom 325 (5.4%) were in the hospital (see Table 2).

### Patient Group Comparisons

The mean age in older people who were moderately (ISS 1–8) and severely injured (ISS >8) differed 0.6 years, $p = .003$ (see Table 3). Hospitalization days, discharge location, and 30-day postinjury mortality differed significantly, $p < .000$, between male and female older people. Hospitalization days, discharge location, and 30-day postinjury mortality differed significantly between ASA categories, $p < .001$. Mild ASA categories I and II for preexisting conditions were more frequently observed in patients with short hospital length of stay, discharge to nonhome destination, and 30-day postinjury survivors. The reported type of falls in patients who died 30 days after injury differed from those who survived, $p = .01$. The 30-day postinjury mortality was higher in males (10.8%; 194/1,792) than in females (6.7%, 285/4,255).

### Multivariable Results

Age had a small influence (OR = 1.01) on injury severity, $p = .003$ (see Table 4). The OR [95% CI] for falls classified as W00-01 "slipping and tripping" was 1.22 [1.02, 1.46], $p = .02$, and for "other specified falls" was 1.47 [1.00, 2.18], $p = .05$. The likelihood of a longer hospital stay (≥6 days) was lower in males, OR [95% CI] = 0.80 [0.71, 0.90], $p < .000$, and increased with ASA III and ASA IV scores, OR [95% CI] 1.37 [1.13, 1.66], $p = .001$, and OR [95% CI] = 1.70 [1.19, 2.43], $p = .003$, respectively. The likelihood of discharge to home was statistically lower in males, and increased with ASA III and ASA IV scores. The likelihood

**Table 3.** Group Comparisons for Patient Characteristics and Fall Outcomes

| | ISS | | Hospital Length of Stay | | Discharge Destination | | 30-Day Postinjury Mortality | |
|---|---|---|---|---|---|---|---|---|
| | Moderate (1–8) | Severe (9–75) | 1–5 Days | ≥6 Days | Home | Other | Yes | No |
| Age | | | | | | | | |
| *n* (%) | 2,097 (34.5%) | 3,987 (65.5%) | 2,359 (38.8%) | 3,725 (61.2%) | 3,865 (63.5%) | 2,219 (36.5%) | 479 (7.9%) | 5,568 (92%) |
| *M* (*SD*) | 81.6 (8.462) | 82.2 (8.268) | 81.8 | 82.1 | 82 | 82 | 81.3 | 82.1 |
| *p* value | $p = .003$ | | $p = .071$ | | $p = .898$ | | $p = .057$ | |
| Gender | | | | | | | | |
| Male | 621 (29.6%) | 1,182 (29.6%) | 765 (32.4%) | 1,038 (27.9%) | 1,063 (27.5%) | 740 (33.3%) | 194 (40.5%) | 1,598 (28.7%) |
| Female | 1,476 (70.4%) | 2,805 (70.4%) | 1,594 (67.6%) | 2,687 (72.1%) | 2,802 (72.5%) | 1,479 (66.7%) | 285 (59.5%) | 3,970 (71.3%) |
| *p* value | $p = .979$ | | $p < .000$ | | $p < .000$ | | $p < .000$ | |
| ASA | | | | | | | | |
| ASA I | 178 (8.7%) | 333 (8.5%) | 225 (9.8%) | 286 (7.8%) | 295 (7.8%) | 216 (10%) | 20 (4.2%) | 485 (8.9%) |
| ASA II | 944 (46.1%) | 1,842 (47.2%) | 1,113 (48.4%) | 1,673 (45.9%) | 1,714 (45.3%) | 1,072 (49.5%) | 133 (30.6%) | 2,621 (48.2%) |
| ASA III | 858 (41.9%) | 1,601 (41.1%) | 901 (39.2%) | 1,558 (42.7%) | 1,637 (43.3%) | 822 (38%) | 262 (55.6%) | 2,188 (40.2%) |
| ASA IV | 66 (3.2%) | 124 (3.2%) | 61 (2.7%) | 129 (3.5%) | 136 (3.6%) | 54 (2.5%) | 45 (9.6%) | 145 (2.7%) |
| *p* value | $p = .886$ | | $p = .001$ | | $p < .000$ | | $p < .000$ | |
| Type of fall[a] | | | | | | | | |
| W (00-01) | 619 (29.7%) | 1,266 (31.9%) | 722 (30.7%) | 1,163 (31.3%) | 1,183 (30.7%) | 702 (31.8%) | 113 (27.8%) | 1,729 (31.2%) |
| W (02-04) | 5 (0.2%) | 21 (0.5%) | 12 (0.5%) | 14 (0.4%) | 14 (0.4%) | 12 (0.5%) | 1 (0.2%) | 25 (0.5%) |
| W (05-08) | 188 (9%) | 393 (9.9%) | 235 (10%) | 346 (9.3%) | 383 (9.9%) | 198 (9%) | 47 (9.8%) | 530 (9.6%) |
| W (10) | 210 (10.1%) | 352 (8.9%) | 228 (9.7%) | 334 (9%) | 352 (9.1%) | 210 (9.5%) | 66 (13.8%) | 491 (8.9%) |
| W (09,11,17) | 45 (2.2%) | 101 (2.5%) | 56 (2.4%) | 90 (2.4%) | 98 (2.5%) | 48 (2.2%) | 10 (2.1%) | 136 (2.5%) |
| W (18) | 746 (35.8%) | 1,391 (35%) | 829 (35.3%) | 1,308 (35.3%) | 1,359 (35.3%) | 778 (35.3%) | 156 (32.6%) | 1,981 (35.7%) |
| W (19) | 271 (13%) | 450 (11.3%) | 266 (11.3%) | 455 (12.3%) | 463 (12%) | 258 (11.7%) | 65 (13.6%) | 651 (11.7%) |
| *p* value | $p = .056$ | | $p = .769$ | | $p = .660$ | | $p = .011$ | |

*Note.* ASA = American Society of Anesthesiologists physical status classification system; ISS = Injury Severity Score.

[a]W00-01: Slipping tripping falls; W02-04: Involving skates/skis/other person; W05-08: Involving wheelchair/furniture; W10: From the stairs and steps; W09; W11-W17: Other specified fall; W18: Other fall on the same level; W19: Unspecified fall.

of death within 30 days post-injury was higher in males, OR [95% CI] = 1.60 [1.31, 1.95], $p < .000$. Further, it was elevated for ASA III, OR [95% CI] = 2.90 [1.82, 4.63], $p < .000$, and ASA IV, OR [95% CI] = 7.75 [4.42, 13.60], $p < .000$.

## DISCUSSION

This study in 6,084 older people with a mean age of 82 years and hospitalized after a fall incident demonstrates that most falls (66.4%) were due to "slipping and tripping" or "falls on the same level," 57.4% of the patients had serious injuries (ISS between 9 and 12), and 43.3% were discharged home. The 30-day postinjury mortality was higher in males (10.8%) than in females (6.7%) and increased with the American Society of Anesthesiologists (ASA) scores for preexisting health conditions.

Although the amount of kinetic energy that emerges from "slipping and tripping" or from "falling on the same level" will not be high, frailty by older people could increase the risk of (severe) injury from these types of falls. Frailty was defined as a deterioration of physical, psychological, social, and cognitive functioning, which creates a delicate balance (Thompson et al., 2021). A low amount of kinetic energy may easily disturb this frailty balance, thereby increasing the vulnerability to adverse health outcomes. The prevalence of frailty is estimated at 17% in older people 65 years and older (Gale et al., 2016). Furthermore, frailty increases with age recently demonstrated in a modeling study of individual trajectories. In this study, the frailty index increased from a 0.05 score at age 65 to 0.10 at age 75 and 0.15 at age 85 (Raymond et al., 2020). In our sample, this increase may be represented by the mean age of 82 years, a high proportion (91.5%) of patients

had ASA II to IV scores prior to admission, and most of the included patients (65.6%) were seriously injured. Recent studies confirmed the impact of frailty in older trauma patients on mortality, hospital length of stay, and discharge destination (Gale et al., 2016; Wei & Hester, 2014).

Of the included older people, 43.3% were discharged home, whereas most were referred to a nursing home, rehabilitation center, or died. Although data on their residence prior to hospital admission are lacking, it is reasonable considering the large numbers of independently living people older than 70 years in the Netherlands in 2018 that a substantial part of the included older people were community dwelling prior to their hospital admission. Therefore, these findings imply major long-term consequences for older people, their relatives, and the health care system.

The proportion of female patients was high (70.4%) compared with the proportion of females in the general Dutch population of people 65 years and older (54.6%) (Centraal Bureau voor de Statistiek, 2020b). This proportion may seem skewed but aligns with previous studies on falls in older people. In the geriatric population, females may have an increased fall risk compared with males due to a higher incidence of incontinence and frailty (Rogers et al., 2020; Thompson et al., 2021). Therefore, gender must be included when fall prevention strategies are used (Chang & Do, 2015).

Our study stresses the importance of a systematic focus on early risk assessment and the implementation of preventive nursing programs for falls in community-dwelling older people, considering the high impact of falls in older people for the health care system in terms of mortality, prolonged hospital admissions, and discharge to nursing homes and rehabilitation units. Knowing that the general population is aging and continues to live independently at home for longer, we need to actively anticipate the increased risk of falls in the older population.

Our explorative study results signify the vulnerability of older people hospitalized after a fall. Therefore, future research should develop tailored nursing care for these frail older people in terms of prevention, rehabilitation programs, and more involvement of the older people and their family members. Also, considering the predicted aging of the worldwide population, combined with the anticipated shortage of nurses (Ambrens et al., 2020; World Health Organization, 2015a), these

**Table 4.** Multivariable Logistic Regression of Fall Consequences on Patient Profile

| | Severe Injury ISS ≥ 9 | | | Hospitalization ≥6 Days | | | Discharge to Home | | | 30-Day Postinjury Mortality | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OR | [95% CI] | *p* | OR | [95% CI] | *p* | OR | [95% CI] | *p* | OR | [95% CI] | *p* |
| Age (year) | 1.01 | [1.00, 1.01] | .003 | 1.00 | [0.99, 1.01] | .126 | 0.99 | [0.99, 1.00] | .827 | 0.99 | [0.98, 1.00] | .294 |
| Gender | | | | | | | | | | | | |
| Female (reference) | 1 | | | 1 | | | 1 | | | 1 | | |
| Male | 1.01 | [0.89, 1.13] | .883 | 0.80 | [0.71, 0.90] | <.000 | 0.74 | [0.66, 0.83] | <.000 | 1.60 | [1.31, 1.95] | <.000 |
| ASA | | | .904* | | | .001* | | | <.000* | | | <.000* |
| ASA I (reference) | 1 | | | 1 | | | 1 | | | 1 | | |
| ASA II | 1.03 | [0.84, 1.26] | .735 | 1.18 | [0.97, 1.43] | .081 | 1.17 | [0.96, 1.41] | .110 | 1.37 | [0.85, 2.21] | .193 |
| ASA III | 0.99 | [0.81, 1.21] | .930 | 1.37 | [1.13, 1.66] | .001 | 1.47 | [1.21, 1.79] | <.000 | 2.90 | [1.82, 4.63] | <.000 |
| ASA IV | 1.00 | [0.70, 1.43] | .964 | 1.70 | [1.19, 2.43] | .003 | 1.84 | [1.28, 2.65] | .001 | 7.75 | [4.42, 13.60] | <.000 |
| Type of fall[a] | | | .109* | | | .856* | | | .809* | | | .021* |
| W00-01 | 1.22 | [1.02, 1.46] | .029 | 0.95 | [0.80, 1.14] | .647 | 0.95 | [0.79, 1.14] | .602 | 0.76 | [0.55, 1.05] | .098 |
| W02-04 | 2.32 | [0.85, 6.31] | .098 | 0.76 | [0.33, 1.73] | .515 | 0.87 | [0.38, 2.00] | .753 | 0.39 | [0.05, 3.02] | .368 |
| W05-08 | 1.24 | [0.98, 1.57] | .068 | 0.86 | [0.68, 1.08] | .203 | 1.08 | [0.86, 1.37] | .486 | 0.87 | [0.58, 1.30] | .502 |
| W10 | 1.07 | [0.84, 1.35] | .571 | 0.90 | [0.71, 1.14] | .388 | 0.95 | [0.74, 1.20] | .670 | 1.31 | [0.89, 1.92] | .161 |
| W09;W11-W17 | 1.47 | [1.00, 2.18] | .050 | 1.01 | [0.69, 1.47] | .941 | 1.17 | [0.80, 1.73] | .408 | 0.68 | [0.33, 1.39] | .297 |
| W18 | 1.12 | [0.93, 1.33] | .211 | 0.92 | [0.77, 1.10] | .378 | 0.97 | [0.81, 1.16] | .784 | 0.77 | [0.57, 1.05] | .108 |
| W19 (reference) | 1 | | | 1 | | | 1 | | | 1 | | |

*Note.* ASA = American Society of Anesthesiologists physical status classification system; CI = confidence interval; ISS = Injury Severity Score; OR = odds ratio.

[a]W00-01: Slipping tripping falls; W02-04: Involving skates/skis/other person; W05-08: Involving wheelchair/furniture; W10: From the stairs and steps; W09; W11-W17: Other specified fall; W18: Other fall on the same level; W19: Unspecified fall.

*Overall *p* value.

programs should be smart and contain new technology such as telemedicine, virtual reality, or eHealth applications (Delbaere et al., 2021; Molhemi et al., 2021).

### Study Strengths

This was an explorative study on older people evaluated in the ED after a fall incident in a large region in the middle of the Netherlands, including both rural and urban areas. We described characteristics and the consequences of fall incidents, which are highly relevant as worldwide life expectancy is increasing. The number of people 60 years and older will more than double by 2050 (World Health Organization, 2015b). It urges the identification of older people at risk of falling and the development of tailored prevention programs and health care facilities (Centers for Disease Control and Prevention, 2020).

### Study Limitations

Some limitations should be addressed. First, we encountered various missing data from a predefined large database, which may lead to information bias. Second, we found that higher ASA scores increased the likelihood of longer hospitalization and a higher mortality rate in 30 days. We also found that higher ASA scores increased the likelihood of discharge to home, which may feel counterintuitive. But because these patients remained longer in the acute care, they may have progressed to bypass the rehabilitation process. Thereby, additional factors may play a role in the consequences of the fall incident that were not collected from the standardized trauma register nor considered in our statistical regression analysis. Finally, we only included older people who were evaluated in the ED after a fall and subsequently admitted to the hospital, not those discharged after evaluation in the ED. Adding this group of people to our sample would have enabled us to evaluate patient-related factors of hospital admission.

## CONCLUSION

This explorative study revealed that advanced age, gender, type of fall, and health conditions prior to hospital admission play a role in the severity of injuries, length of hospital stay, 30-day mortality, and higher discharge destination to care homes in older people who are hospitalized after a fall. These results should serve as a preamble for further research to clarify the influence of frailty and gender-specific risk factors on a fall incident consequences and create preventive tailored programs.

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