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Which factors influence the prevalence of institution-acquired falls? Results from an international, multi-center, cross-sectional survey

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Abstract

Purpose: Falls are a highly prevalent problem in hospitals and nursing homes with serious negative consequences such as injuries, increased care dependency, or even death. The aim of this study was to provide a comprehensive insight into institution-acquired fall (IAF) prevalence and risk factors for IAF in a large sample of hospital patients and nursing home residents among five different countries.

Design: This study reports the outcome of a secondary data analysis of cross-sectional data collected in Austria, Switzerland, the Netherlands, Turkey, and the United Kingdom in 2017 and 2018. These data include 58,319 datapoints from hospital patients and nursing home residents.

Methods: Descriptive statistics, statistical tests, logistic regression, and generalized estimating equation (GEE) models were used to analyze the data.

Findings: IAF prevalence in hospitals and nursing homes differed significantly between the countries. Turkey (7.7%) had the highest IAF prevalence rate for hospitals, and Switzerland (15.8%) had the highest IAF prevalence rate for nursing homes. In hospitals, our model revealed that IAF prevalence was associated with country, age, care dependency, number of medical diagnoses, surgery in the last two weeks, and fall history factors. In nursing homes, care dependency, diseases of the nervous system, and fall history were identified as significant risk factors for IAF prevalence.

Conclusions: This large-scale study reveals that the most important IAF risk factor is an existing history of falls, independent of the setting. Whether a previous fall has occurred within the last 12 months is a simple question that should be included on every (nursing) assessment at the time of patient or resident admission. Our results guide the development of tailored prevention programs for persons at risk of falling in hospitals and nursing homes.

KEYWORDS
accidental falls, hospital, institutional fall, nursing home, prevalence, risk factors

BACKGROUND

A fall is defined as 'an unexpected event in which the person comes to rest on the ground, floor or a lower level', irrespective of whether an injury occurs (Kellogg International Work Group, 1987). Falls are highly prevalent in health and social care settings, especially in older people (Sharif et al., 2018). More than 50% of people older than 80 years fall at least once a year (Bor et al., 2017).

Falls can lead to serious consequences, such as injuries, increased care dependency, or even death (Alamgir et al., 2012; Evans et al., 2015). More than 20% of falls in older adults require a hospital visit (Alamgir et al., 2012; Milat et al., 2011). In addition, the increased utilization of health care associated with falls, such as surgery or hospitalization, increases costs associated with falls (Alekna et al., 2015).

In the international literature, many studies have been conducted to examine the prevalence of institution-acquired falls (IAFs) and risk factors in different countries. In hospital settings, an IAF prevalence of 1.9%–17.1% was reported (Rao et al., 2018). In nursing home settings, IAF prevalence ranged from 13.0% to 92.5% (Bor et al., 2017; Zhang et al., 2018). These large ranges can be explained using different definitions, instruments, and measurement methods to assess IAFs. Most studies have been conducted with specific groups of patients and residents (e.g. stroke patients [Cox et al., 2017] or residents with dementia [Kosse et al., 2015]), whereas some studies have been carried out on older people. The most frequently investigated IAF risk factors were the use of specific medications (Pelaez et al., 2015; Westerlind et al., 2019) (e.g. benzodiazepines, anticonvulsants), followed by age (Bor et al., 2017; Mazur et al., 2016). Having a fall history (Mazur et al., 2016), impairments in mobility (Mazur et al., 2016; Zhang et al., 2018) as well as high care dependency and functional limitations (O'Neil et al., 2018) are also frequently mentioned IAF risk factors.

The literature provides a wealth of knowledge on both IAF prevalence and risk factors in acute care and long-term care settings, but certain research gaps still exist. First, no recent studies have analyzed international data on the IAF prevalence and risk factors using the same standardized method. Second, no studies provide an insight into IAF prevalence in different healthcare settings (i.e., both hospitals and nursing homes). Third, most studies have been carried out on specific patient or resident groups. A comprehensive, general overview of IAF prevalence and risk factors for hospital patients and nursing home residents is still lacking.

The current study was conducted to provide an overview of IAF prevalence and IAF risk factors in hospital patients and nursing home residents in Austria (AT), Switzerland (CH), the Netherlands (NL), Turkey (TR), and the United Kingdom (UK).

METHODS

Design

This study involved a secondary data analysis of data collected in the *International Prevalence Measurement of Care Quality* (Landelijke Prevalentiemeting Zorgkwaliteit, LPZ study) (van Nie-Visser et al., 2013), which is a cross-sectional study carried out to measure care quality in AT, NL, CH, TR, and the UK. Data were collected each year on one specific day (14 November 2017 and 13 November 2018) in all countries.

In the LPZ study, the prevalence, preventive measures, and treatment options associated with nursing care problems, such as pressure injuries, continence, malnutrition, falls, restraints, and pain are measured. Participating hospitals and nursing homes in AT, TR, and the UK as well as hospitals in CH are required to measure falls, while hospitals and nursing homes in NL and nursing homes in CH can choose which nursing care problems they want to measure.

Each country has a national coordinator who is responsible for the study design, training, and adaptation of the questionnaires, as part of the International LPZ Research Group.

Setting and sample

National coordinators annually invite health and social care institutions to participate in the study. In CH, all acute-care hospitals are required to participate in the measurement. In all other countries, participation is voluntary. Long-term care settings are called either nursing homes or care homes in these countries, but all meet the internationally accepted definition of the nursing home (Sanford et al., 2015). Data gathered from all types of hospitals (e.g., general

or academic) (AT, CH, NL, TR) and nursing homes (AT, CH, NL, TR, UK) in 2017 and 2018 were included in the study.

Data collection

Participating hospitals and nursing homes collected data for this study. These were invited to training sessions organized by the national coordinator, at which they were provided with comprehensive training materials, standardized questionnaires, and informed consent forms.

Patients and residents were considered eligible for study inclusion if they were present in the respective ward on the morning of the measurement and their oral informed consent (CH, UK, NL) or written informed consent (AT, TR) could be obtained. In the UK, the LPZ study is conducted as part of service improvement and development work and, therefore, is an exempt from formal consent procedures. In CH, the Canton of Bern ethics committee declared that the LPZ measurement was not subject to the Swiss Human Research Act, and approval was deemed unnecessary. In the remaining jurisdictions (AT, NL, and TR) the ethical committees gave their approval for the study protocol annually.

Data collection was performed by pairs of trained nurses working in the participating organizations. One nurse worked on the ward of the patient/resident, and one nurse worked on another ward. If the nurses disagreed about an answer on the questionnaire, the nurse from the other ward made the final decision. To ensure comparable data collection procedures in all participating hospitals and nursing homes in all countries, the data collection procedure was standardized (e.g., the same manual with explanations for the questionnaire was used in each country).

Variables in the data collection process

The original Dutch LPZ questionnaire was developed based on the literature, guidelines, and expert opinions. It was forward and back-translated into the native languages of the participating countries (English, German, Italian, French, Turkish), and feasibility tests were performed. The questionnaire includes recent, evidence-based guidelines and is regularly updated by the International LPZ Research Group to foster face validity (van Nie-Visser et al., 2013).

Several studies on the reliability and validity of the included scales as well as on specific questions, such as those on pressure ulcers and falls (Bours et al., 1999; Halfens et al., 2011; van Nie-Visser et al., 2013) have been performed. For example, the interrater reliability in terms of Cohen's Kappa of the pressure ulcer grading system was reported to vary between different health care institutions from 0.49 to 0.97 (Bours et al., 1999). Overall, the inter-rater reliability of the questionnaire was 0.87 and found to be good (Meijers et al., 2009), which is a good support for adequate psychometric properties.

The questionnaire used in the current study includes general questions on age, sex, surgery within the last two weeks (yes/no), medical diagnosis according to ICD-10, as well as additional diagnoses such as dementia (yes/no) and care dependency. Care dependency is described using the Care Dependency Scale (CDS) (Dijkstra et al., 1996). The CDS comprises 15 items covering basic Activities of Daily Living (ADL), which are scored on a five-point Likert scale (1 = completely dependent to 5 = completely independent). Lower scores indicate higher care dependency levels. Studies demonstrated good levels of reliability for the CDS, with Cronbach's alpha of 0.98 for geriatric clinics, 0.94 for home care and 0.96 for the nursing home setting (Dijkstra et al., 2012). The German version of the CDS in the hospital setting showed a Cronbach's alpha coefficient of 0.98, constituting a high degree of internal consistency (Lohrmann et al., 2003a,2003b). Moreover, the scores of the CDS correlates with the scores of two other instruments, indicating criterion-related validity (Lohrmann et al., 2003a,2003b). In the present study, the Cronbach's alpha for the CDS items range between 0.96 in CH, and 0.98 in AT hospitals, with an overall score of 0.97. Whereas the overall Cronbach's alpha score for the CDS in the nursing home setting was 0.97 ranging from 0.96 in UK up to 0.99 in TR.

The LPZ falls module includes a question about falls that have occurred in the host institution in the last 30 days (IAF) (yes/no/unknown); these answers were examined to determine the primary outcome of this data analysis. An additional question asks whether the person has experienced a fall in the last 12 months (falls history), which was treated as an independent variable in our analysis (yes/no). More specifically, a fall is defined as 'an unexpected event in which the participant comes to rest on the ground, floor or a lower level', irrespective of whether an injury occurs (Kellogg International Work Group, 1987).

Data analysis

Questionnaire responses collected from the five countries in 2017 and 2018 were merged into one data file. Data analyses were performed using SPSS version 26.0. Since the main outcome had three answer possibilities (yes/no/unknown), the answer option 'unknown' was treated as missing data. The level of significance was set at $p < 0.05$. For categorical variables, percentages and chi-square tests were used. For non-parametric continuous variables, medians and interquartile range (IQR) and Kruskal-Wallis tests were performed. Data were analyzed to explore relationships between baseline exposures and IAF, using a three-step, separate approach for hospitals and nursing homes. First, a bivariate analysis using chi-square tests and Mann-Whitney *U* tests was conducted to identify significant IAF risk factors. Second, IAF-associated variables in the bivariate analysis which did not show collinearity based on a variance inflating factor (VIF) less than four were tested against an outcome of falls using a univariable logistic regression. Third, significant variables in univariable logistic regression were included in the generalized estimating equation (GEE) models. The GEE model is useful to predict binary

outcomes (IAF yes/no) when clustered data are used (IBM Corp. Released, 2019). We assumed that patients and residents within a country were more similar to each other than patients and residents in different countries, due to e.g. different health care systems, so the country was used as a cluster (inner-subjects variable). The GEE model used a binary logistic model due to the binary outcome and exchangeable order. An exchangeable order for the working correlation matrix should be used to cluster data with no chronological order (Wakefield, 2009).

The following criteria were used to choose the model: (1) it had to converge to be reliable; (2) there had to be a low quasi-likelihood under the independence model criterion (QIC) to select the adequate mean model; and (3) non-significant variables in the GEE model were excluded.

RESULTS

Of 70,940 patients and residents who were admitted at the time of the measurement, 58,319 participated in the study (response rate: 82.2%). Of these, 34,361 (58.9%) were admitted to hospitals and 23,958 (41.1%) resided in nursing homes (Table 1).

The median ages of hospital patients and nursing home residents, respectively, were 70 and 85 years. Hospital patients had a median care dependency of 71, indicating that they were completely care independent, while nursing home residents had a median care dependency of 45, indicating that they were partially care dependent.

Hospital patients' ages differed significantly among the countries, with patients in NL being the oldest. In addition, we identified significant differences in care dependency levels among the hospital patients in most countries (the difference between TR and NL was insignificant). Hospital patients in CH had the highest care dependency levels.

Nursing homes residents also differed significantly with regard to their ages and care dependency levels in all countries. Residents in TR were the youngest (i.e., 74 years on average), and residents in the UK were the most care dependent.

IAF prevalence

IAF prevalence was 3.9% in hospitals and 11.9% in nursing homes (Table 2). IAF prevalence ranged from 2.8% to 7.7% in hospitals and between 6.0% and 15.8% in nursing homes with significant differences identified. The highest IAF prevalence rate for hospitals was found in TR (7.7%) followed by AT (4.0%). The highest IAF prevalence in nursing homes was found in CH a (15.8%) followed by AT (15.5%).

Risk factors for IAF

The bivariate analysis of hospital patient data showed that sex and suffering from a motor disorder were not significantly associated with IAF; therefore, these factors were excluded from further testing (Table 3). Eleven variables for hospitals and ten variables for

TABLE 1 Sample characteristics (overall and by country) from hospitals and nursing homes

	Hospitals					
	Austria (n = 6337)	**Switzerland (n = 26,603)**	**The Netherlands (n = 251)**	**Turkey (n = 1170)**	**United Kingdom (n = 0)**	**Total sample (N = 34,361)**
Sex % (n)*						
Male	48.3 (3063)	50.7 (13,478)	47.8 (120)	50.3 (589)	–	50.2 (17,250)
Female	51.7 (3274)	49.3 (13,125)	52.2 (131)	49.7 (581)	–	49.8 (17,111)
Median age in years (IQR)*	69 (23)	70 (23)	73 (12)	65 (23)	–	70 (24)
Median number of medical diagnosis (IQR)*	2 (3)	3 (2)	3 (2)	2 (2)	–	3 (3)
Median care dependency (IQR)*	74 (11)	70 (14)	72 (11)	72 (25)	–	71 (14)
	Nursing homes					
	Austria (n = 666)	**Switzerland (n = 221)**	**Netherlands (n = 19,563)**	**Turkey (n = 1830)**	**United Kingdom (n = 1678)**	**Total sample (N = 23,958)**
Sex % (n)*						
Male	26.6 (177)	40.7 (90)	30.5 (5975)	55.4 (1014)	30.7 (515)	32.4 (7771)
Female	73.4 (489)	59.3 (131)	69.5 (13,588)	44.6 (816)	69.3 (1163)	67.6 (16,187)
Median age in years (IQR)*	86 (11)	83 (14)	85 (11)	74 (17)	86 (11)	85 (12)
Median number of medical diagnosis (IQR)*	5 (3)	4 (3)	2 (3)	3 (2)	2 (2)	2 (3)
Median care dependency (IQR)*	44 (28)	51 (34.5)	46 (28)	56 (46)	36 (29)	45 (30)

Abbreviation: IQR, interquartile range.

*$p < 0.05$ difference between the countries.

TABLE 2 Institution-acquired fall (IAF) prevalence for each country and the total sample separated into hospital patients and nursing home residents

	Hospitals % (*n*)					
	Austria (*n* = 6326)	Switzerland (*n* = 26,484)	The Netherlands (*n* = 251)	Turkey (*n* = 1163)	United Kingdom (*n* = 0)	Total sample (*N* = 34,224)[a]
IAF % (*n*)*	4.0 (250)	3.7 (974)	2.8 (7)	7.7 (90)	–	3.9 (1321)
	Nursing homes % (*n*)					
	Austria (*n* = 665)	Switzerland (*n* = 221)	The Netherlands (*n* = 8483)	Turkey (*n* = 1828)	United Kingdom (*n* = 1608)	Total sample (*N* = 12,805)[a]
IAF % (*n*)*	15.5 (103)	15.8 (35)	12.3 (1046)	6.0 (110)	14.2 (228)	11.9 (1522)

[a]Only data from 34,224 hospital patients and 12,085 nursing home residents are used; for the remaining patients and residents, it was unknown whether they had fallen in the last 30 days within the institution.

*$p < 0.05$ difference between the countries; Kingdom.

TABLE 3 Results of bivariate analysis, multicollinearity test, and univariable logistic regression of IAF risk factors in the hospitals and nursing homes

	Hospitals				Nursing homes			
	Bivariate analysis			Univariable logistic regression	Bivariate analysis			Univariable logistic regression
	p-value	*n*	VIF	*p*-value	*p*-value	*n*	VIF	*p*-value
Country	0.00	34,224	<4	0.00	0.00	12,805	<4	0.00
Age	0.00		<4	0.00	0.00		<4	0.00
Care dependency sum score	0.00		<4	0.00	0.00		<4	0.00
No. of medical diagnoses	0.00		<4	0.00	0.0		<4	0.00
Sex	0.16		–	–	0.53		–	–
Surgery	0.00		<4	0.00	0.01		<4	0.02
Cancer	0.00		<4	0.00	0.08		–	–
Cardiovascular diseases	0.00		<4	0.00	0.09		–	–
Dementia	0.00		<4	0.00	0.00		<4	0.00
Motor disorders	0.35		–	–	0.01		<4	0.01
Diseases of the nervous system	0.00		<4	0.00	0.00		<4	0.00
Stroke	0.00		<4	0.00	0.03		<4	0.03
Fall history[a]	0.00	32,761	<4	0.00	0.00	11,868	<4	0.00

Abbreviation: IAF, institution-acquired fall; VIF, variance inflating factor.

[a]In total, it was unknown whether 1462 patients and 937 residents had fallen in the last 12 months within the institution.

nursing homes were identified as statistically significant; therefore, these were included in the GEE models (Table 4).

Different risk factors for hospitals and nursing homes contributed to a higher risk of an IAF. Outcomes of the GEE models showed that hospital patients in AT, CH, and NL had a lower IAF risk as compared to patients in TR. In addition, having a fall history increased the risk two-fold (OR 2.814) of experiencing an IAF in this setting. The analysis of nursing home data indicated that a higher care dependency score (i.e., a lower care dependency) was associated with an IAF risk (OR 0.992). Furthermore, having a fall history increased the risk of an IAF in the nursing homes by 26 times (OR 26.026).

DISCUSSION

This study was carried out to explore prevalence and risk factors associated with IAFs in hospital and nursing home settings in several European countries. We found that hospitals in TR had the highest prevalence of IAFs (7.7%), whereas hospitals in NL had the lowest prevalence (2.8%). The highest prevalence of IAFs in nursing homes was seen in CH (15.8%) and the lowest, in TR (6.0%). The application of our model revealed several significant IAF risk factors, whereby the history of a fall in the last year was identified as the most important risk factor in both settings.

TABLE 4 GEE models on IAF for hospitals and nursing homes

	Hospitals ($N = 32,761$)		Nursing homes ($N = 11,868$)	
	Odds ratio	95% CI	Odds ratio	95% CI
Country				
Austria	0.526	0.401–0.688	0.658	0.488–0.886
Switzerland	0.402	0.312–0.517	0.743	0.451–1.225
The Netherlands	0.432	0.195–0.960	0.895	0.749–1.069
Turkey (reference hospital)	1	–	0.768	0.568–1.038
United Kingdom (reference nursing homes)[a]	–	–	1	–
Age	1.010	1.006–1.015	1.005	0.998–1.012
Care dependency sum score	0.976	0.972–0.979	0.992	0.989–0.996
No. of medical diagnoses	1.107	1.077–1.138	0.993	0.954–1.034
Surgery				
Yes	0.705	0.612–0.813	1.646	0.973–2.785
No (reference)	1	–	1	–
Diseases of the nervous system				
Yes	–	–	1.309	1.103–1.553
No (reference)	1	–	1	–
Fall history				
Yes	2.814	2.472–3.202	26.026	21.681–31.243
No (reference)	1	–	1	–

Abbreviation: IAF, institution-acquired fall.

[a]No hospitals participated in the UK.

The literature includes a range of IAF prevalence in hospitals (1.9%–17.1%) and nursing homes (13.0%–92.5%) (Carryer et al., 2017; Pelaez et al., 2015). Our study results for hospitals agree with those presented in the literature. Even though we found statistical significance between the countries, our samples are comparable in terms of age and care dependency. More specifically as an example, TR had median CDS score of 72, which lies in the range of the other countries (70–74).

However, our results from nursing homes (6.0% and 15.8%) were lower. This difference might be due to the fact that TR residents who took part in the study were relatively young and had low care dependency levels or that different definitions and measurements methods were used in our study as opposed to previous studies.

These study results revealed a significant difference in IAF prevalence between the countries, but these differences cannot exclusively be explained by country-specific differences in demographic variables. The GEE models used treats countries as clusters. Because differences in IAF prevalence between the countries were not affected by country-specific adjustments of data or the inclusion of other influencing factors such as age or care dependency, they must be explained by other factors.

One possible explanation for these differences may be that CH hospitals only measure pressure ulcer and falls modules, and these two problems have been the focus of attention for years. This may have led to an increased awareness and to more interventions to prevent falls. In contrast, AT hospitals and nursing homes measure all six nursing care problems and can independently choose areas in which they want to initiate quality improvement projects.

Another explanation could be that the countries differ with regard to their hospital structure, design, equipment, and furnishings (e.g., light intensity). For example, a study showed a significantly increased fall incidence in a hospital with single rooms as compared to a facility with multi-bedded rooms (Singh et al., 2015). Another study showed that the nursing skill mix and registered nurse staffing ratio play important roles (Lucero et al., 2019). However, these aspects were not included in the LPZ measurement.

The GEE model results revealed a fall within the last year to be the most important IAF risk factor, with 2.824 individuals in hospitals and 26.026 in nursing homes identified as being at increased risk of falling. Various other studies have also showed an association between a positive fall history and the IAF prevalence but to lesser extent. As in our study, another study determined that hospital patients with a fall history had an approximately 2.5-higher chance of falling (Mazur et al., 2016). These results suggest that a simple question about fall occurrence in the last 12 months should be included in every comprehensive nursing/geriatric assessment, either when a patient is admitted to hospital or regularly in a nursing home. Our results also support those of a systematic review, which showed that risk assessment tools may be helpful but no more helpful than an experienced nurse's clinical view (Haines et al., 2007). Evidence-based guidelines also do not recommend the general use of a fall risk assessment tool (National Institute for Health and Care Excellence

[NICE], 2013). Our results strongly support the addition of at least one question about the patient's or resident's existing fall history, as this can help nurses identify risk groups more quickly and subsequently prevent IAFs.

This study is one of the first to describe IAF risk factors in different countries based on a large sample. One main strength of this study is that the data collection procedure was standardized; i.e. data were comparable between countries. This is especially relevant, as the findings of most identified studies in the literature are not comparable as they used different definitions, instruments, and data collection procedures. A fall is rarely the consequence of a single risk factor; for this reason, most IAFs result from interactions among various risk factors (NICE, 2013). By using the GEE model, we were able to adjust data for country while interpreting interactions among various risk factors.

LIMITATIONS

Nevertheless, the current study has some limitations. First, this study uses a convenience sample of hospitals (except in CH) and nursing homes, which may have led to an underestimation of prevalence rates. The sample may have included predominantly hospitals and nursing homes that already had an interest in improving their quality of care. In addition, patients and residents with a poor health status may not have been able or willing to participate, which might have led to selection bias. Since no hospitalized patients took part in the UK, a complete picture of this setting cannot be drawn. If we also had data from hospital patients in the UK, the statistical analyses could have identified other risk factors.

CONCLUSIONS

Data collected in hospitals and nursing homes in five countries were subjected to a secondary data analysis, resulting in a large sample size. We identified several IAF risk factors and found that the most important risk factor in both settings is an existing history of falls. The question of a previous fall within the last 12 months is a simple question that we recommend should be included in every nursing/geriatric assessment at the time of the patient's admission to hospital or regularly for nursing home residents. The results of this study can raise awareness and help health care professionals develop tailored prevention programs for persons at risk of falling. More multidimensional prevention programs need to be developed and tested to address the most important risk factors in both health care settings.

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AUTHOR CONTRIBUTIONS

All authors were involved in developing the study concept and design as well as in the implementation of the study. MH, DE, SB, and SO analyzed and interpreted the data and drafted the final manuscript. NB, IE, AG, BS, JS, and ST revised the manuscript, and all authors approved the final version.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

CLINICAL RESOURCES

- Center for Disease Control and Prevention, Older adult fall prevention. https://www.cdc.gov/falls/index.html
- National Institute for Health and Care Excellence "Falls in older people: assessing risk and prevention-Clinical guideline [CG161]". https://www.nice.org.uk/guidance/cg161
- National Prevalence Measurement of Quality of Care. https://gb.lpz-um.eu/en

DATA SHARING

The data collected for the study, including individual participant data and a data dictionary defining each field in the set, will not be made available to others.

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