

Staffing and Patient-related Factors Affecting in-patient Fall-related Injury in a Psychiatric Hospital: A 5-year Retrospective Matched Case-control Study

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Abstract

Background: Incidence of fall-related injury of psychiatric in-patients was more frequent and the severity greater than in general units. Also, the risk factors were different and more complicated. The aim of this study was to investigate the staffing factors and patient-related factors that increase the likelihood of fall-related injury among psychiatric in-patients.

Methods: A five-year retrospective matched case-control study was used to select cases of in-patient fall which were reported to the hospital risk management system. The total sample consisted of 240 patients. Conditional logistic regression was used to analyze the data.

Results: Of the eighty fall-related injuries, 86.3% resulted in temporary harm and required intervention. The multivariate model showed that the three strongest predictors were having an acute psychotic condition (adjusted matched odds ratio (aOR)=5.40; 95%CI 4.22-6.90; $p < 0.001$), proportion of nurse staffing equal to nurse assistants (aOR=5.52; 95%CI 2.64-11.55; $p < 0.001$), and taking atypical antipsychotic drug (aOR=3.92; 95%CI 3.22-4.76; $p < 0.001$). In addition, the following factors all increased the risk of fall-related injury significantly: using more than four drugs, having a medical illness, having comorbid psychiatric disorder, taking lithium, anti-Parkinson, benzodiazepine, and anti-convulsant drugs. Regarding staffing factors, patient numbers in the unit of 25-50, and ≥ 51 , also significantly increased risk for fall than having patient numbers of 25 or fewer. Nurse to patient ratios of 1:16-30, and 1: 31-45 significantly increased the fall risk compared to ratios of 1: 1-15.

Conclusions: The risk factors found are expected to be of use for assessing fall risk and managing staff workload in psychiatric units.

Introduction

In-patient fall is an indicator representing quality of care and patient safety issues that are preventable. Incidence of falls in psychiatric units were 3–4 times falls in general medical units [1]. Compared with nursing home and medical-surgical units, in-patient fall in a psychiatry setting has a higher incidence and greater severity [2]. Among all in-patient falls, physical injury was reported thirty percent of the time [3], and four percent involved serious injury [4].

Fall-related injury was a significant cause of morbidity and mortality among psychiatric patients. Injurious falls affect recovery from the illness, increase the length of hospital stay, and increase the healthcare financial cost. Moreover, the additional cost of lawsuits from injured patients' families against hospital administrators are significant [3]. In particular in case of serious fall-related injuries, the results are loss of function, loss of life, and financial burden [5]. A study reported that operational costs for fallers with serious injury are \$ 13,316 more than those of non-fallers and the length of stay in hospital is longer by up to 6.3 days [6]. A psychological impact of falling, is fear of a repeated fall, causing patients to restrict their activities.

Factors increasing risk of fall in a psychiatric setting are complex. Currie [7] classified risk factors of fall and injurious fall to intrinsic and extrinsic factors. Intrinsic factors are those that have a physiological origin, and extrinsic factors are those that result from environmental or other hazards. Previous studies identified various conditions as intrinsic factors that contributed to psychiatric in-patient falls. A previous 5-year control study reported that more physical complaints on the day of fall, and the prescription of Clonazepam were the most significant predictors of faller status [8]. Of the physical complaints, urinary frequency, generalized weakness, mental status impairment, and dizziness were more frequency among the faller versus non-fallers. In addition, presence of an acute medical condition, more medication, and being prescribed anti-hypertensive medication, were found as differences between fallers and non-fallers. It was found that depressed patients aged 20 years and under have lower risk (relative risk 0.45), and patients aged between 60 and 70 years old with psychosis seemed to have higher risk (risk relative 2.86), than patients in the respective age groups without these diagnoses [9].

Regarding psychotropic medication, although the medications are essential for healing patient symptoms, controversially such medication was the strongest predictor of fall. As found in a study among psychiatric geriatric in-patients, those aged ≥ 70 and taking a typical antipsychotic or antidepressants were associated with fall incidents [10]. Liperoti et al. [11] also found that elderly institutionalized patients had increased risk of hospitalization for femur fracture from using both atypical and typical antipsychotics compared to nonusers. A prospective matched case-control study [12] reported three out of four factors relating medicine to increased risk of fall including Parkinson scores of the extrapyramidal syndrome rating scale, equivalent dosage of benzodiazepines used, and medication changes within 24 hours. In addition, the significant factors were associated with injurious fall including history of fall in the past six months, and a lack of history of medical problems.

Most previous studies have shown that patient factors associated with increasing fall in psychiatric units are intrinsic factors. Also, the assessment tools and strategies to prevent falls are generated from intrinsic factors or patient factors. However, a number of studies have addressed the importance of system-level or organization-level on reduction of fall incidences in psychiatric units. Particularly, from the perception of the nursing staff on patient safety in psychiatric in-patient care, they noted the crucial role of the care environment and adequate staffing resources [13, 14].

As Thailand is an upper-middle income country, health resources are limited in many aspects such as medicine, equipment, financial and staffing. Regarding in-patient falls, time spent to provide attention from health workers is a crucial factor, therefore, the number of patients per health staff is associated with patients' safety [15]. Evidence of a systematic review has shown that higher nurse-patient ratios are associated with decreased in-patient mortality [16]. In case of in-patient falls, the association between staffing in terms of number of RN hours, and mixed staff hours with in-patient falls were unequivocal. A few exceptional recent studies reported the association between RN staffing and the rate of injurious fall varies by unit type [17]. In addition, Lake, Shang, Klaus, Dunton [18] presented the negative association between RN staffing levels and fall rates in Intensive care units. Conversely, the level of non-nurse staffing both License Practice Nurses and assistant nurses had positive association with fall rates in non-

ICUs. As in psychiatric units, evidence in relation to staffing factors and fall rates is rare. This current study considers nursing staff and unlicensed nurse assistants in term of staff to patient ratio, and proportion of skill mix to be extrinsic factors related to injurious falls. Meanwhile, intrinsic factors were included in this current study as well. Therefore, the aim of this study was to explore characteristics of fall-related injury and investigate the patient-related factors and staffing factors that increase the likelihood of fall-related injury among psychiatric in-patients. Our results may lead to a better understanding of the multiple factors affecting in-patient fall. It provides evidence for policy decision on patient safety care in psychiatric hospitals.

Methods

A retrospective matched case-control study of psychiatric in-patients who had injurious fall and non-fallers which matched 1 case: 2 control samples. The study was conducted at a psychiatric hospital located in Bangkok, Thailand.

Definitions

In this study, falls were defined as an event resulting in a person coming to rest inadvertently on the ground or floor or other lower level. Fall-related injuries may be fatal or non-fatal, exclude falls due to assault and self-harm, though most are non-fatal [19]. Intentional falls in which a patient intentionally descends to the floor were also excluded [20]. Fall incidents data that were reported to the hospital risk management system were used to investigate injury falls. Also, the impact of fall injury was categorized into 5 levels of harm (Level E to I) based on the National Coordinating Council for Medication Error Reporting and Prevention classification system [21]. The description of each level is: Level E = resulted in temporary harm to the patient and required intervention, F = resulted in temporary harm to the patient and required initial or prolonged hospitalization, G = resulted in permanent patient harm, H = required intervention necessary to sustain life, and I = resulted in the patient's death. However, in this study, the level of harm was obtained from level E to Level G.

Sample size

To yield a statistic power ($1-\beta$) of 80%, and to relate the prevalence of in-patient fall 0.15 and fall status with a match odds ratio (mOR) 2.5 or higher using conditional logistic regression at a 5% significance level (α) [12]. Therefore, this matched case-control study was designed to enroll 80 fall cases and 160 non-fall matched controls (1:2 ratio).

Setting

The study was conducted at a psychiatric hospital, governed by the Department of Mental Health, Ministry of Public Health. The hospital is located in Bangkok, and was established in 1889. The hospital is a training institute in mental health, psychiatry, and neuropsychiatry for health professionals. The in-patient service has 800 beds, divided into four 15- to 20-bedded private units; four 60- to 80-bedded ordinary units, and two 50- to 60-bedded units for elderly patients. In addition, the hospital has a 12 bed-

pre ICU unit. Due to a policy of deinstitutionalization since 2010, indicator of 28 days-length of stay of in-patient is implemented.

Data

Cases were defined as psychiatric in-patient, aged 18 years or older, having a documented fall between January 1st, 2011 and December 31st, 2014 that was reported to the hospital's risk management center. If a patient fell more than once during an admission or other admission in the period of data collection, only the first fall of the first admission was used. Cases were matched to two control patients from the same hospital (1:2) by age (± 5 years), sex, and admission year. The reason for using double control per one case was the rarity of case with fall-related injury in the hospital. The 5-year fall cases report toll was 120 cases. However, the fall case reports that could be used for analysis were 80 cases, because the researchers could not find the information and record files of 40 cases equal to 28% of the total cases. Therefore, the samples in control group were 160. Characteristic of the samples are shown in Table 1.

Table 1
Fall incident characteristics

Descriptions	Number of falls	%
Impact of fall Injury	69	86.3
Level E	10	12.5
Level F	1	1.3
Level G		
Year of falls (A.D.)	8	3.3
2010	52	21.7
2011	60	25.0
2012	54	22.5
2013	66	27.8
2014		
Day of week	9	11.3
Monday	22	27.5
Tuesday	11	13.8
Wednesday	14	17.5
Thursday	8	10.0
Friday	8	10.0
Saturday	8	10.0
Sunday		
Time periods of fall incidents	33	41.3
Daytime (7.00 am -8.00 pm)	47	58.8
Nighttime (8.00 pm.-7.00 am)		

Level E = resulted in temporary harm to the patient and required intervention;

Level F = resulted in temporary harm to the patient and required initial or prolonged hospitalization;

Level G = resulted in permanent patient harm

Descriptions	Number of falls	%
Shift Work	18	22.5
Morning shift (8.00 am.-16.00 pm.)	16	20.0
Afternoon shift (16.00 pm.-24.00 pm.)	46	57.5
Night shift (24.00 pm.-8.00 am.)		
Unit Type	53	66.3
Ordinary unit	26	32.5
Special or extraordinary unit	1	1.3
Pre-ICU		
Number of days from admission to fall	25	30.1
Within 7 days after admission	12	14.5
Between 8–14 days after admission	46	55.4
≥ 14 days after admission		
Activity during falls	16	20.0
1 Walking	24	30.0
2 Getting up from bed/chair/wheelchair	34	42.5
3 Slipping/ falling in bathroom	2	2.5
4 Falling down from bed	3	3.8
5 Running	1	1.3
6 Climbing up		

Level E = resulted in temporary harm to the patient and required intervention;

Level F = resulted in temporary harm to the patient and required initial or prolonged hospitalization;

Level G = resulted in permanent patient harm

Descriptions	Number of falls	%
Location of falls	30	37.5
1 Bedrooms	3	3.8
2 Relaxation room	35	43.8
3 Bathrooms	7	8.8
4 Walking area (Corridors)	2	2.5
5 Dining room	3	3.8
6 Outdoor areas		
Consciousness before fall	66	82.5
Alert	14	17.5
Confused		

Level E = resulted in temporary harm to the patient and required intervention;

Level F = resulted in temporary harm to the patient and required initial or prolonged hospitalization;

Level G = resulted in permanent patient harm

Descriptions	Number of falls	%
Major diagnosis based on ICD-10	42	52.5
1. Schizophrenia	8	10.0
2. Bipolar disorder	4	5.0
3. Major depressive disorder	3	3.8
4. Substance abuse	3	3.8
5. Alcohol dependence	2	2.5
6. Dementia or Alzheimer's disease	8	10.0
7. Psychosis due to medical condition	8	10.0
8 Mental retardation with psychosis	2	2.5
9. Acute psychosis		
Level E = resulted in temporary harm to the patient and required intervention;		
Level F = resulted in temporary harm to the patient and required initial or prolonged hospitalization;		
Level G = resulted in permanent patient harm		

Regarding fall characteristic, data were obtained from the hospital incident reports for the risk management system. The fall incidents data included level of injury impact, day of the week (Monday to Sunday), time of the day, type of the unit (special, ordinary, and pre-ICU). Demographic and clinical data (patient-related factors) both in case and control sample were collected from the patients' history folders. Staffing-related data were obtained from nursing administrator records of the hospital. All data were extracted and recorded by a trained nursing staff member who has worked for 20 years at the hospital. The record form for data collection has 3 parts as follows. Part 1, demographic data, comprised of sex, age, marital status, education level, fall history, consciousness before fall occurred, level of fall injury. Part 2, clinical data consisted of diagnosis both of psychiatric disorders and others, all medications received within the previous 24 hours, number of medications prescribed, duration of time from admission to fall occurring. Part 3, staffing data were comprised of number of nurses on duty, number of patients in the shift, number of unlicensed nurse assistants (ULNs), duration of on duty hours both the nurses and ULNs.

In staff-related factors, nurse to patient ratio was calculated by dividing the total number of patients on the unit by the total number of registered nurses during the shift. For the purpose of analysis, we

categorized the nurse-to-patient ratio into 3 levels, including 1 nurse per 1–15 patients, 1 nurse per 16–30 patients, and 1 nurse per 31–45 patients. Score of Mix skills was calculated by summing total working hours of total nurses on the shift divided by the summed total working hours of the ULNs on the same shift. In this study, proportions of mix skill were calculated to be four values including .33, .50, .67 and 1.00. The number of total patients staying in the unit were categorized into four groups, including equal or lower than 20, 20–40, 40–60, and more than 60 patients. The number of nurses and number of ULNs on duty were categorized into two groups by at least number of the staffs working on the shift, one nurse and above, two ULNs and above respectively.

Ethics

This study was reviewed and approved by the faculty of Nursing Institutional Review Board (COA No. IRB-NS 2015/282.3004) and Review Board committees of the psychiatric hospital. The data history of fall cases and the control group were accessed and recorded in the data collecting form by hospital staff who were trained to collect data from patients' folders.

Statistical analyses

Descriptive statistics were used to analyze fall incident characteristics and demographic data of the case and control group. Using the matched pairs of case and control sample, we used univariate and multivariate conditional (fixed-effects) logistic regression with 95% confidence intervals (CI) to evaluate the association of patient-related factors and staff factors with the risk of fall-related injury, displayed as odds ratios. A $p < 0.05$ was considered statistically significant. All p values were two-tailed. The statistical software used for all analyses was Stata16.1.

Results

Of the 80 fallers and 160 non-fallers, 67.5% were male, and 32.5% were female. The mean age of fallers was 47.38 years, \pm SD = 12.95 (range 20–70), and mean age of non-fallers was 47.01 years, \pm SD = 13.19 (range 18–70). The number of samples who had marital status as single, separated or divorced were 2–3 times greater than those who lived as a couple in both groups. Samples who graduated education of only primary school (6 years) were fewer in number than those who graduated education of secondary school or higher in both groups. In addition, nine persons of the group of faller had experience of falling in the past six months compared with no experience in the group of non-fallers.

Fall incident characteristics

The impact of fall-related injuries was 86.3% of the cases in level E, 12.5% level F and 1.3% level G. The Majority of fall incidents were reported in the year 2014 (27.8%). The day with the highest frequency of falls was Tuesday. The psychiatric unit of the hospital comprises three ward types, including ordinary or general, extraordinary, and pre-ICU type. The pre-ICU was established in the year 2012, for admission of patients who have severe violence toward themselves and others. Fall incidents occurred more frequently in the ordinary unit than in the special unit and pre-ICU unit. The level of consciousness of the fallers

during fall occurrence were 17.5% confused and 82.5% alert. Falls occurred more frequently in the night time (8.00 pm. – 7.00 am.) (58.8%) than in the daytime (41.3%). As the fall times indicate, fall incidents had the highest frequency in the night shift (12.00 pm. – 8.00 am.) (57.5%). 55.5% of the patients fell after two weeks of hospitalization and 25% of the patients fell within the first seven days of hospitalization. Locations of the fall occurring were most likely to be in the bedroom (43.8%) and the bathroom (37.5%). Also, activities during fall were bathroom-related (42.5%) and getting up from beds or chairs (30%) respectively. The patients who fell were most likely to be diagnosed schizophrenia (52.5%), followed by bipolar disorder, psychosis due to medical condition, and mental retardation with psychosis (10%). The Fall incident characteristics are shown in Table 1.

Univariate analysis and multivariate analysis estimated of independent risk factors to fall and non-fall were separately analyzed and presented in 3 groups including clinical factors, medication factors, and staffing factors.

Patient-related factors affecting fall-related injury

Regarding patient-related factors, we divided analysis into clinical factors and medication factors. In term of clinical factors, univariate analysis and multivariate modelling revealed that the largest factor increasing falling was having acute psychosis (cOR = 7.86, CI 6.69–9.23; aOR = 3.67, CI 3.02–4.47) as shown in Table 2. The second order was the number of drugs used equal to or greater than 5 kinds of medicine which significantly increased the risk of falling compared to taking 1–4 kinds of medicine (cOR = 5.00, CI 4.50–5.57; aOR = 3.47, CI 3.07–3.92). The number of total diseases also significantly increased the risk of injurious fall (cOR = 3.64, CI 3.27–4.05). However, in a move out of the estimation of multivariate model, as a result of collinearity, a Spearman's correlation coefficient between the number of total diseases and the number of medical illnesses was very high ($\rho = .84, p < .001$). In the case of medication factors, univariate analysis and multivariate modelling revealed that the largest factor for increased falling was taking an atypical antipsychotic drug (cOR = 3.51, CI 3.20–3.86; aOR = 5.91, CI 5.07–6.89) as shown in Table 3.

Table 2

Conditional (fixed-effects) univariate and multivariate logistic regression of clinical characteristics to cases and controls of injurious fall (weight)

Variables	Fallers	Nonfallers	Unadjusted matched OR			Adjusted matched OR		
	n (%)	n (%)	cOR	95% CI	P-value	aOR	95% CI	p-value
Psychiatric condition	60 (75.00)	151(94.38)	7.86	6.69– 9.23	.00***	3.67	3.02– 4.47	.00***
No acute psychosis*	20 (25.00)	9 (5.63)						
Having acute psychosis								
Number of total diseases	42 (52.50)	121 (75.63)	3.64	3.27– 4.05	.00***	-	-	-
1†	38 (47.50)	39 (24.38)						
2–4								
Number of psychiatric disorders	70 (87.50)	150 (93.75)	3.15	2.71– 3.68	.00***	1.43	1.13– 1.81	.00***
1†	10 (12.50)	10 (6.25)						
2								
Number of medical illnesses	49 (61.25)	131 (81.88)	3.08	2.77– 3.43	.00***	1.27	1.10– 1.45	.00***
0†	31 (38.75)	29 (18.13)						
1–3								
Number of drugs used	32 (40.00)	113 (70.63)	5.00	4.50– 5.57	.00***	3.47	3.07– 3.92	.00***
1–4†	48 (60.00)	47 (29.38)						
≥ 5								
cOR, crude odds ratio; aOR, adjusted odd ratio; CI, confidence interval; †reference group								
***p < 0.001								

Table 3

Conditional (fixed-effects) univariate and multivariate logistic regression of medication administration to cases and controls 24 hours prior to injurious fall (weight)

Variables	Fallers	Non-fallers	Unadjusted matched OR			Adjusted matched OR		
	n (%)	n (%)	cOR	95% CI	P-value	aOR	95% CI	p-value
Medication	47 (58.75)	69 (43.13)	.46	0.42– 0.50	.00***	1.82	1.56– 2.11	.00***
Typical psychiatric	33 (41.25)	91 (56.88)	3.51	3.20– 3.86	.00***	5.91	5.07– 6.89	.00***
Not						1.84		.00***
Yes	30 (37.50)	97 (60.63)	1.61	1.19– 1.49	.00***	1.96	1.59– 2.13	.00***
Atypical psychiatric	50 (62.50)	63 (39.38)	1.51	1.45– 1.80	.00***	1.37	1.74– 2.21	.00***
Not	64 (80.00)	131 (81.88)	1.29	1.37– 1.66	.00***	1.32	1.23– 1.53	.00***
Yes			2.06		.00***	1.20		.121
Antidepressants	16 (20.00)	29 (18.13)	2.16	1.04– 1.55	.00***	1.39	1.63– 2.51	.00***
Not	14 (17.50)	39 (24.38)	2.28	1.14– 1.47	.00***	1.58	1.13– 1.54	.00***
Yes								
Benzodiazepines	66 (82.50)	121 (75.63)		2.00– 2.90			.95– 1.52	
Not	49 (61.25)	113 (70.63)		1.81– 2.57			1.12– 1.73	
Yes								
Anticonvulsants	31 (38.75)	47 (29.38)		2.02– 2.57			1.33– 1.87	
Not	77 (96.25)	153 (95.63)						
Yes								
Lithiums (weight)	3 (3.75)	7 (4.38)						
Not	13 (16.46)	28 (17.61)						
Yes	66 (83.54)	131 (82.39)						
Antiparkinsons	72 (90.00)	151 (94.38)						
Not								
Yes	8 (10.00)	9 (5.63)						

cOR, crude odds ratio; aOR, adjusted odd ratio; CI, confidence interval; †reference group

* p < 0.05; ** p < 0.01; ***p < 0.001

	Fallers	Non-fallers	Unadjusted matched OR	Adjusted matched OR
Antidiabetic agents	73 (91.25)	153 (95.63)		
Not		7 (4.38)		
Yes		137 (85.63)		
Anticholesterol agents		23 (14.38)		
Not	7 (8.75)			
Yes	60 (75.00)			
Cardiovascular agents	20 (25.00)			
Not				
Yes				

cOR, crude odds ratio; aOR, adjusted odd ratio; CI, confidence interval; †reference group

* p < 0.05; ** p < 0.01; ***p < 0.001

Staffing factors affecting fall-related injury

As shown in Table 4, univariate analysis revealed that for proportion of skill mix, having the number of nurses equal to the number of ULNs 1:1 significantly increased the risk of fall compared to having a skill mix proportion of .33 (one nurse to three ULNs). Regarding staffing factors that could reduce the risk of fall significantly these included nurse to patient ratio and number of patients in the unit. The results showed that 1 nurse per number of patients 16–30 and 1 nurse per number of patients 31–45 compared to 1 nurse per number of patients 1–15 decreased risk of fall .41 and .08 times respectively. Also, the number of patients in the unit 26–50 and equal 51 and over compared to number of patients in the unit equal 25 or lower could decrease risk of fall .31 and .63 times respectively. While the number of nursing staff and the number of ULNs in the shift were not associated significantly. After that, four significant staffing factors were included in the multivariate analysis. The model revealed that the proportion of skill mix, number of nurse staffing equal to the number of ULNs in the shift (1.00) and number of nurse staffing equal to half the number of ULNs (.50) compared to number of nurse staffing of one third of the number of ULNs (.33) have significantly increased risk of fall (aOR = 3.05; CI 1.74–5.33; aOR = 2.28; CI 1.32–3.93). In addition, the nurse to patient ratio range from one nurse per 16 to 30 patients and one nurse per 31 to 45 patients have significantly reduced risk of fall than one nurse per 1 to 15 patients (aOR = .64, CI .54-.77 & aOR = .01, CI .01 - .02). Having the number of patients in the unit equal to or greater than 51 patients, and ranging from 26 to 50, compared with the number of patients equal to 25 or less significantly reduced risk of fall (aOR = .48, CI .34-.68; aOR = .16, CI 11-.22). Researchers combined the type of unit with group staffing factors, because in the context of caring, the number of patients per unit

and the number of staff on duty differ depending on the type of unit. According to univariate and multivariate analysis, the patients staying in extraordinary and pre ICU ward had significantly increased risk of fall compared to those in an ordinary ward (cOR = 1.86 CI 1.69–2.04; aOR = .69 CI .55-.86).

Table 4

Conditional (fixed-effects) univariate and multivariate logistic regression analysis of staffing factors to cases and controls of injurious fall (weight)

Variables	Fallers n (%)	Nonfallers n (%)	Unadjusted matched OR			Adjusted matched OR		
			cOR	95% CI	P-value	aOR	95% CI	p-value
Number of nurses on duty	35 (43.75)	76 (47.50)	1	0.93–1.14	.526	-	-	-
1†	45 (56.25)	84 (52.50)	1.03					
2–4								
Nurse-to-Patient ratio	20 (25.00)	17(10.63)	1	.36-.47	.00***	.64	.54-.77	.00***
1:1–15†	43 (53.75)	96(60.00)	.41	.21-.75	.00***	.01	.01-.02	.00***
1:16–30		47(29.38)	.08					
1:31–45	17 (21.25)							
Number of patients	34 (42.50)	53 (33.13)	.31	.28-.36	.00***	.16	.11-.22	.00***
≤ 25†	22 (27.50)	59 (36.88)	.63	.55-.71	.00***	.48	.34-.68	.00***
26–50		48 (30.00)						
≥51	24 (30.00)							
No of ULNs	45 (56.25)	94 (58.75)	.93	0.83–1.03	.16	-	-	-
2†	35 (43.75)	66 (41.25)						
3–5								

ULNs = unlicensed nurse assistants

cOR, crude odds ratio; aOR, adjusted odd ratio; CI, confidence interval; †reference group;

***p < 0.001

Variables	Fallers n (%)	Nonfallers n (%)	Unadjusted matched OR			Adjusted matched OR		
			cOR	95% CI	P-value	aOR	95% CI	p-value
Proportion of skill mix 1.00	1 (1.25)	5 (3.13)	1.56	.96-2.54	.08	2.28	1.32-3.93	.00***
	34(42.50)	72 (45.00)	.93		.78	1.37		.26
	24(30.00)	61(38.13)	3.63	.57-1.52	.00***	3.05	.80-2.35	.00***
	21(26.25)	22(13.75)		2.19-6.00			1.74-5.33	
Type of unit	53 (66.25)	118(73.75)	1.86	1.69-2.04	.00***	.69	.55-.86	.00***
Ordinary ward†	27 (33.75)	42 (26.25)						
Special ward & pre-ICU								
ULNs = unlicensed nurse assistants								
cOR, crude odds ratio; aOR, adjusted odd ratio; CI, confidence interval; †reference group;								
***p < 0.001								

Multivariate analysis of risk factors for falling

A multivariate model based on patient-related and staffing risk factors was derived as shown in Table 5. Three clinical characteristic, six kinds of medication and four staffing factors have significantly increased or reduced risk of fall. In-patients having diagnosis with acute psychosis, taking atypical antipsychotic drug and taking lithium were the top three variables increasing risk of fall-related injury significantly (aOR = 5.40, CI 4.22–6.90; aOR = 3.92, CI 3.22–4.76; aOR = 2.97, CI 2.29–3.85 respectively).

Table 5

Conditional (fixed-effects) multivariate model estimation with fall-related injury of patient related factor, medication and staffing factors (weight)

Variables	Adjusted Matched OR	95% CI	P-value
Clinical characteristic	5.40	4.22–6.90	.00***
Acute psychosis condition			
No †			
Yes			
Number of drugs used	2.31	1.92–2.80	.00***
1–4†			
≥ 5			
Number of medical illnesses	1.99	1.61–2.45	.00***
Non†			
1–3			
Number of psychiatric disorders	1.31	.99-1.74	.06
1†			
2			
Medication	3.92	3.22–4.76	.00***
Atypical psychiatics (yes vs.not)			
Lithiums (yes vs not)	2.97	2.29–3.85	.00***
Antiparkinsons (yes vs. not)	2.02	1.64–2.50	.00***
Benzodiazepines (yes vs. not)	1.65	1.37–1.99	.00***
Anticonvulsants (yes vs. not)	.64	.54-.76	.00***
Antidepressants (yes vs. not)	.85	.69-1.04	.12
Anticholesterol agents (yes vs. not)	1.47	1.12–1.91	.01**
Cardiovascular agents (yes vs. not)	.80	.62-1.04	.09

cOR, crude odds ratio; aOR, adjusted odd ratio; CI, confidence interval; †reference group

** p < 0.01; ***p < 0.001

Variables	Adjusted Matched OR	95% CI	P-value
Staffing factors	1.00	1.40–5.55	.00***
Ratio of Skill mix (weight)	2.79	1.35–5.32	.01**
.33†	2.68	2.64–11.55	.00***
.50	5.52		
.67			
1.00			
number of patients	.13	.08-.20	.00***
≤ 25†	.46	.28-.77	.00***
25–50			
≥51			
nurse-to-Patient ratio (weight)	.38	.29-.48	.00***
1:1–15† (.417-.067)	.12	.08-.18	.00***
1:16–30 (.063-.033)			
1:31–45 (.032-.022)			
Type of unit	.36	.24-.54	.00***
Ordinary ward †			
Special ward & ICU			
cOR, crude odds ratio; aOR, adjusted odd ratio; CI, confidence interval; †reference group			
** p < 0.01; ***p < 0.001			

Discussion

Psychiatric in-patient fall-related injury was associated with multiple risk factors. Our findings support some existing evidence and highlight the challenges for improving in-patient service. The results reveal that patient-related factors in term of clinical characteristic and certain medication use, combined with some staffing factors increased risk of injurious fall in psychiatric hospitalization.

The frequency of fall increased for each year of the sample period. This may be explained because this period coincided with improving the system of risk management recording in the hospital. Fall incidents were most likely to occur in the middle day of the week and at night time or on night shift. It was possibility that there were more staff per patient on Monday, and in the day time, than on the other days or at night. Also, there are many therapeutic activities, and increased patient flow and unit administration on the first day of the week and during the day time. According to activities before falling, doing activities leading to slipping or descent to the floor in the bathroom were the most frequent and the second rank was getting up from bed/chair/wheelchair in the bedroom were the most frequent activity leading to fall. The most frequent activities before falls were different from a report of in-patient fall with injury in psychiatric unit among veterans, the most frequent came from the getting up from a bed, chair or wheelchair (21.3%) and bathroom related was 9% [22]. It was possible that for bathrooms in general in Southeastern Asia included Thailand, the floor is most likely to get wet by taking a shower or leaving something on the floor. Therefore, the analysis of the cause of fall in different cultures is essential for improving fall prevention.

Considering clinical characteristic of the psychiatric in-patients, mental illness with acute psychosis condition was the largest increased risk of fall, follow by having co-occurring medical illness and having co-diagnosis of psychiatric disorder. The findings were in line with the prospective study reported that patients with more severe psychiatric symptoms were significantly associated with increased risks for fall related injury [12]. Also, lack of history of medical problems significantly decreased the risks for fall-related injury [12]. Simultaneously, patients taking polypharmacy or using five or more kinds of medication had greater risk of injurious fall.

Among the kinds of medication used, patients who took an atypical antipsychotic drug increased risk of fall approximately six times higher than that for those who were not taking an atypical antipsychotic drug. In addition, we found that among commonly used psychotropic medication significantly increased risk of fall occurred with typical antipsychotics, benzodiazepines, anticonvulsants, lithium, and anti-Parkinson agents. Nevertheless, administration of cardiovascular agents and anti-cholesterol agents combined with using psychotropic medication was also likely to increase risk of injurious fall of psychiatric in-patients. The study results supported those of previous studies reporting an influence of psychotropic medication prescription on the fall risk among psychiatric in-patients [3, 8, 23]. Also, this study confirmed that taking tricyclic antidepressant drugs, benzodiazepines, serotonin reuptake inhibitor was strongly associated with fall in general patients [24, 25, 26]. The effect of these medications might contribute to physiological instability leading to falls occurring [27].

Regarding staffing factors, the studies of nurse staffing and adverse outcomes in psychiatric units is very rare. In addition, the circumstance and the provision of care in psychiatric units are different from medical, surgical or other units. However, the previous studies in five different units in a general hospital found that the association between staffing levels and fall was not linear, but were cubic spline shape or curve shape and were varied by unit types especially on step down and medical units [17]. Of these units, the association between RN staffing and fall rates depended on the level of staffing: at lower staffing levels, the fall rate increased as staffing increased, but at moderate and high staffing levels, the fall rate decreased as staffing increased. The finding from this study also reinforced the previous studies that showed a non-linear relationship between nurse per patient ratio and risk of fall. A nurse per patient ratio of 1:16–30 (patients per nurse ratio = .063-.033) can reduce the risk of fall better than nurse per patient ratio of 1:31–45 (patients per nurse ratio = .032-.022) when compared to nurse per patient ratio of 1:1–15 (patients per nurse ratio = .417-.067). Also, the higher total number of nurses in the shift was not significantly associated with the risk of falls. This finding was consistent with a report from the study of in-patient falls in a general hospital that a higher number of nursing staff was not associated with falls occurring. [17]. The association between staffing and fall incidents in psychiatric units need to be considered in a further study.

Also, the proportion of skill mix in the multivariate model of staffing factors, proportion of nursing staff per ULN were not linearly associated with risk of fall. A proportion of the number of RNs per ULN equal 1.00 and .50 increased risk of fall approximately 3-fold and 2-fold when they were compared to a proportion of one third of nursing staff per ULN. Moreover, the greater proportion of RNs per ULN, the greater the risk of fall of in-patients of the psychiatric unit. As the demand of care of acute psychiatric in-patients requires surveillance 24 hours a day, nurse care manager and leadership skill are essential for caring for psychiatric in-patients. While, the other proportions was not significantly associated with fall incidents. This reason is supported by the result of Hanrahan, Kumar, & Aiken [28]. The presence of a nurse manager with leadership skill significantly reduced risk of fall in psychiatric in-patient units of general hospital, while the patient-to-psychiatric nurse staffing ratio did not affect the risk significantly.

Considering the number of patients, the greater the number of patients staying in the unit, the less the risk of falling. Psychiatric in-patients staying in the unit have various severity phases. Some of them were in the acute phase, early stability phase and stability phase. The circumstance of psychiatric unit is to provide managed daily activities and an environment like living at a patient's home. Daily activities are scheduled in order to encourage the patients to improve their psychosocial functioning. The patients can ambulate around the unit, make relationship and help each other. Thus, the crowding of patients in the unit is not a risk factor of fall-related injury. However, when the acute patient was separated to care in a specialty unit, like pre-ICU, and the special ward this can reduce the risk of fall significantly.

Finally, the multivariate model revealed that the strongest predictor of fall incidents of psychiatric in-patients was having acute psychosis symptoms. The second and third order predictors were proportion of skill mix (nurse staffing equal to nurse assistants), polypharmacy and medication taking like atypical psychiatric, lithium, and anti-Parkinson agent. While the number of patients in the unit, the nurse to

patient ratio, and the type of unit decreased risk of fall. The research findings highlight the essential intrinsic and extrinsic factors that need to be considered. According to intrinsic factors, the fall risk assessment tool can detect the risk factors leading to prevention of falls. Regarding extrinsic factors, the staffing factors can be targeted to improve structure of the organizational level. Thailand is a country that lacks health manpower, psychiatric units are especially understaffed compared to the suggested norm of health manpower required for provision of adequate health facilities. According to the annual report of the Department of Mental Health, Ministry of Public Health, Thailand in 2012, there were 1.11 psychiatrists and 6.19 nurses per 100,000 of population, working in twelve mental health services in the Bangkok area [29]. While in the EU, there were over 24 nurses per 100,000 of population working in mental health [30]. So further studies need to focus on the staffing levels and staff mixes affecting patient outcomes in mental health services. Until now there is no standardized acuity tool available for planning and managing psychiatric staff in mental health units.

Limitation

This study examined a psychiatric hospital in an upper middle income country with shortage of psychiatric professionals. The study results may not be generalizable in other countries with different contexts. The staffing numbers considered in this paper did not exclude the number of staff who joined the hospital or who had meetings out of the unit, nor those who took the day off with the reasons of vacation, and had sickness. Although the study data were retrospective from the year 2010 through 2014, this study provides one of the first associations among patient and staffing factors with in-patient psychiatric fall-related injury.

Conclusion

Fall-related injury of psychiatric in-patients is a crucial problem. Our findings highlight the clinical and medication factors in prevention of fall. Also, organizational factors are essential as well: the ratio of staff per patient, not only of registered nurses, but also of unlicensed nurse assistants affects risk of fall among psychiatric in-patients.

Certainly, the assessment of fall risks and implementing strategies by using clinical nursing practice guideline for fall prevention in psychiatric units are necessary. However, administrators of psychiatric hospitals must determine manpower need for utilizing the staff availability to achieve adequate health outcome like no fall-related injury in the unit. Therefore, future studies are needed for analysis of adequate staff and skill mix that balance demand and supply for efficient quality of care to prevent adverse outcomes in psychiatric in-patients.

Relevance For Clinical Practice

Although, this study was conducted in one psychiatric hospital, the finding is useful for improving quality of care generally. Nursing staff have to be aware of the high-risk factors for falls of psychiatric in-

patients, especially patients who have an acute psychosis condition, having polypharmacy of more than four drug types, and having co-morbidity of a medical illness. Moreover, patients who take these kinds of drug including atypical antipsychotic, lithium, anti-Parkinson, and benzodiazepine need to be closely monitored for drug adverse events. Nursing and ULNs staffing factors also have potential to influence in-patients fall, and it is vital to manage these.

Declarations

Ethics approval and consent to participate

Ethics approval was obtained from Institutional Review Board Faculty of Nursing, Mahidol University (COA No. IRB-NS 2015/282.3004) and the ethical review board committees of the psychiatric hospital. As this study obtained data from the hospital incident reports for the risk management system and patients' medical records, consent to participate permission to obtain data was obtained from the director of the psychiatric hospital. The research conforms to the provisions of the Declaration of Helsinki, the Belmont Report, CIOMS Guidelines.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

AS contributed to conception, study design, analysis and interpret of data, drafting the manuscript and study coordination. CT conducted the analysis and interpretation of data, and provided feedback on the

initial analysis. WV, & PT involved in study coordination and provided feedback on the initial analysis. AS, CT, WV & PT revising it critically for important intellectual content, and final approval of the version to be published. All authors read and approved the final manuscript.

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