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Fall and risk factors for veterans and nonveterans inpatients over the age of 65: 14 years of long-term data analysis

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ABSTRACT

Introduction: Falls are one of the most important causes of injuries and accidental deaths among this segment of over the age of 65 years.

The long-term follow-up study of fall-related injuries was conducted in elderly veterans over the age of 65 years, and the risk of falls in veterans and non-veterans was compared.

Methods: This study used the National Health Insurance Research Database for the period from 2000-2013 in Taiwan. this longitudinal study tracked falls in veterans over the age of 65 years, designated a control group (non-veterans), using 1:2 pairing on the basis of sex and time receiving medical care, and used Cox regression to analyze and compare the risk of falls among veterans and non-veterans.

Results: This study subjects consisted of 35,454 of the veterans had suffered falls (9.5%), as had 55,037 of the non-veterans (7.4%). After controlling for factors such as comorbidities/complications, the veterans had 1.252 times the risk of falls of the non-veterans, Furthermore, among persons in the 75-84-year-old age group, veterans had 1.313 times the risk of falls of non-veterans, and among persons with mental illnesses and diseases of the eyes, veterans had 1.300 and 1.362 times the risk of falls of non-veterans. In

addition, each veteran had an average of 4.07 falls during the 2000-2013 period, which was significantly higher than in the case of non-veterans (3.88 falls).

Conclusions: Veterans' risk of falls and recurrent falls were both higher than those of non-veterans, and age level, comorbidities/complications, and level of urbanization were all important factors affecting veterans' falls. The responsible authorities should, therefore, use appropriate protective measures to reduce the risk of falls and medical expenses in high-risk groups.

Keywords：Veteran; Falls; National Health Insurance Research Database.

Strengths and limitations of this study

►► This is the first nationwide population-based cohort study to assess the falls injury associations between Veterans and nonveterans.

►►The strengths of this study include a sufficiently large research sample and a tracking period of 14 years, as well as the ability to compare the risk of falls among veterans and non-veterans and confirm factors affecting falls in veterans.

►► This study cohort is large enough to examine each risks of fall injury among subgroups.

►► The limitation of this study is the lack of information on the detailed patient characteristics and could not obtain other important information related to falls (such as the living environment, muscular endurance, and degree of disability).

INTRODUCTION

Falls are the second leading cause of death among accidental injuries worldwide. According to 2018 WHO data, as many as 646,000 persons die from falls annually, and elderly persons over the age of 65 constitute the age group with the highest incidence of fall-related deaths.[1] In Taiwan, according to the 2017 annual report on the cause of death statistics issued by the Ministry of Health and Welfare, Executive Yuan, falls were the second leading cause of death among accidental injuries in 2017.[2] According to data from the Veterans Affairs Council, as of the end of 2017, veterans over the age of 65 years accounted for approximately 50% of all veterans and 6.14% of Taiwan's elderly population over the age of 65 years.[3] Furthermore, the health insurance participation of veterans over the age of 65 years accounts for 7.7% of that of all persons over the age of 65 years in Taiwan.[4] As a consequence, veterans constitute an important subgroup of elderly persons with relatively high healthcare needs.

According to research conducted in the United States, in 2012, 3.2 million people were injured in non-fatal falls (incurring medical expenses of US$ 30.3 billion), and 24,190 people died due to falls (incurring direct medical expenses of US$ 616.5 million); these figures increased to US$ 31.3 billion and US$ 637.5 million in 2015, and the incidence of falls and total medical expenses increased with age.[5] A research survey of elderly people in the US found that 78% of falls could be attributed to two or more risk factors,

and the greater the number of risk factors was, the greater the probability of a fall;[6] risk factors for falls include sex, age, socioeconomic status, environment, and physiological condition (poor vision, chronic illness, and poor balance).[7-9] According to the 2014 research of Clegg et al., risk factors for falls include a poor living environment, use of multiple medications, lack of vitamin D, comorbidities, sarcopenia or frailty, and impaired sensory system.[10] In addition, a 2017 cross-sectional study (Paliwal et al) of the relationship between chronic disease and falls among community seniors over the age of 65 years, involving the use of the Behavioural Risk Factor Surveillance System (BRFSS), found that the incidence of falls during the previous one-year period among people with such chronic diseases, such as stroke (adjusted OR=1.61), chronic kidney disease (adjusted OR=1.27), arthritis (adjusted OR=1.61), depression (adjusted OR=2.26), and diabetes (adjusted OR=1.32), was uniformly higher than in people without these diseases,[11] and whether assistive equipment was used was also a factor affecting falls.[12] In Taiwan, according to Chien et al., the 518,601 elderly persons hospitalized for injuries between 2005 and 2007 had an average age of 76.1, and 209,860 of these people (40.5) had fall-related injuries, making falls the chief cause of injuries.[13] Furthermore, in a study analysing factors associated with falls among 940 veterans at four veteran's care centres in eastern Taiwan during the 2009-2010 period, Ku et al. found that falls and recurrent falls had incidences of 17.2% and 6.9%, respectively; age, depression,

stroke, gouty arthritis, and cataracts were independent risk factors for falls, and depression was a risk factor for recurrent falls (adjusted OR=1.22).[14] In summary, a few large studies have examined veterans as subjects, and most of the research consisted of cross-sectional studies and questionnaire surveys. In contrast, we employed a long-term longitudinal study to analyse the risk of fall-related injuries, and we hope that this approach can help mitigate the shortcomings of the foregoing literature.

In Taiwan, after their discharge, veterans who spent their careers in the armed forces to contribute to their country face diseases of old age, and their fall-related injuries are also an issue of concern. Jobless veterans receive various benefits from the Veterans Affairs Council and enjoy exemption from health insurance co-payments.[3] While some literature has investigated issues such as chronic diseases acquired after discharge,[15] mental illness,[16] life satisfaction,[17] and medical utilization[18, 19] in some elderly veterans with wartime experience, there has been an absence of long-term follow-up studies of fall-related injuries in veterans. What is the risk of a fall among veterans? Does the risk of a fall among veterans differ from that among the general population? This study sought to investigate these questions. Accordingly, veterans over the age of 65 years during the 2000-2013 period were included as subjects in a long-term follow-up epidemiological study of fall-related injuries, and the risks of falls among veterans and non-veterans were compared.

METHODS

Data sources

Taiwan's National Health Insurance (NHI), which was introduced in 1995, records the medical data of all insured people, covering more than 99% of the 23 million people in Taiwan. As a result, the NHI data constitute an important resource for research concerning clinical medicine and public health.[20-21] Because the outpatient and emergency care files in the National Health Insurance Research Database (NHIRD) provide only injury diagnostic data, but not the causes of injuries, while hospitalization files provide information concerning the causes of injuries, this study accordingly performed string analysis of data in the NHIRD's "inpatient expenditures by admissions (DD)," "registry for contracted medical facilities (HOSB)," "major injury and illness (HV)," and "underwriting data details (ID)" files for the period from 2000 to 2013. This study was

approved after a complete ethical review by the Institutional Review Board of National Defense Medical Center Tri-Service General Hospital and the informed consent was not necessary.

Patient and Public Involvement

Patient and public involvement Participants were not involved in the design or conduct of this study.

Study design and participants

This study included "jobless" veterans ("veterans") over the age of 65 years as the members of the case group. To ensure that the cases represented newly occurring falls, we excluded falls during the 1997-1999 period, and the study period was extended from January 1, 2000 to December 31, 2013 (tracking end point). We employed a matching control design in which 1:2 pairing was performed on the basis of the veterans' sex and time receiving medical care, and we selected non-veterans with the corresponding criteria to serve as the control group.

Event occurrence

All cases were tracked to a fall accident (ICD-9-CM E code 880-888), loss of case during the research period (loss to follow up), or to the research end point on December 31, 2013.

Standards and definitions

The three age groups in this study consisted of 65-74 years, 75-84 years, and over 85 years. The severity of falls was judged on the basis of a trauma severity greater than 16 points in the major injury and illness category in the major injury and illness (HV) files. Because comorbidities/complications [10, 11, 18], mental illness [11, 16, 22, 23] and diseases of the eyes[11, 14, 24] are also risk factors for falls in the elderly, to clarify the influence of illnesses on falls among veterans and non-veterans, this study included

commonly seen comorbidities/complications of the elderly in its regression model and controlled for mental illness (ICD-9-CM 290-319) and diseases of the eyes (ICD-9-CM 360-379). In addition, among environmental variables, the level of urbanization was classified as high, moderate, and low,[25] the season was classified as spring (March-May), summer (June-August), fall (September-November), and winter (December-February), the grade of hospital where the subject received care was classified as a medical centre or a non-medical centre, and the hospital was classified as a veteran hospital or a non-veteran hospital. In accordance with the external factor code (ICD-9-CM E-code (E880-888)), the causes of injuries were classified as three types: fall from a height (E800-884), fall on the same level (E885-886), and other falls (E887-888). Recurrent falls were defined as two or more falls occurring within the research period (from 2000 to the end of 2013).

Statistical analysis

This study included veterans over the age of 65 years as research subjects, tracked the cause of their falls during the 2000-2013 period and type of injury, and found factors affecting the occurrence of their falls. Data analysis was performed using SPSS 22 statistical software (SPSS, Inc., Chicago, IL, USA); the Chi-square test was employed to compare categorical variables and the t-test was used to compare continuous variables in the two groups. Factors affecting falls were analysed by Cox's regression, while hazard

ratios (HRs), 95% confidence intervals (CIs), and Kaplan-Meier survival curves were used to extract differences between the veteran and non-veteran groups. A P-value<0.05 was considered the standard for the assessment of significance.

RESULTS

Fig. 1 shows the case selection (inclusion and exclusion) and a tracking result flowchart. During the 2000-2013 period, a total of 2,974,621 elderly people over the age of 65 years were hospitalized in Taiwan; after excluding 163,737 people who were hospitalized for falls during the period from 1997-1999, a total of 2,810,884 persons remained, which included 374,057 veterans and 748,114 non-veterans over the age of 65 years.

Table 1 shows the basic characteristics of the entire sample of 1,122,171 people (374,057 veterans and 748,114 non-veterans) at the tracking end point. The percentage of veterans who suffered falls was significantly higher than that of non-veterans (9.5% vs. 7.4%, P<0.001), and they also had a significantly higher probability (risk) of falls during the first year than non-veterans (log-rank test, P<0.001) (Fig.2). In addition, a significantly higher percentage of veterans than non-veterans lived in areas with a moderate level of urbanization and received care at a medical centre or a veteran's hospital.

Table 1. Characteristics of study in the endpoint

	Group			
	Total	Veterans	Non veterans	
	1,122,171(100)	374,057(33.3)	748,114(66.7)	
Variables	N (%)	N (%)	N (%)	*P-value*
Falls				<0.001
Without	1,031,680(91.9)	338,603(90.5)	693,077(92.6)	
With	90,491(8.1)	35,454(9.5)	55,037(7.4)	

Gender				<0.001
Female	228,402(20.4)	73,298(19.6)	155,104(20.7)	
Male	893,769(79.6)	300,759(80.4)	593,010(79.3)	
Age	78.0 ± 7.2	80.1 ± 6.5	77.0 ±7.3	<0.001
Age group (years)				<0.001
65-74	408,190(36.4)	84,862(22.7)	323,328(43.2)	
75-84	514,627(45.9)	203,872(54.5)	310,755(41.5)	
≥85	199,354(17.8)	85,323(22.8)	114,031(15.2)	
Season				0.147
Spring	380,246(33.9)	126,741(33.9)	253,685(33.9)	
Summer	278,254(24.8)	92,434(24.7)	185,820(24.8)	
Autumn	197,359(17.6)	66,188(17.7)	131,171(17.5)	
Winter	266,132(23.7)	88,694(23.7)	177,438(23.7)	
Urbanization				<0.001
High	310,836(27.7)	82,269(22.0)	228,567(30.6)	
Midian	561495(50.0)	230,791(61.7)	330,704(44.2)	
Low	249,840(22.3)	60,997(16.3)	188,843(25.2)	
Level of care				<0.001
Non-Medical center	713,792(63.6)	220,496(58.9)	493,296(65.9)	
Medical center	408,379(36.4)	153,561(41.1)	254,818(34.1)	
Veterans Hospital				<0.001
Without	949,503(84.6)	249,175(66.6)	700,328(93.6)	
With	172,668 (15.4)	124,882(33.4)	47,786(6.4)	
ISS≥16				<0.001
Without	1116,550(99.5)	372,822(99.7)	743,728(99.4)	
With	5,621(0.5)	1,235(0.3)	4,386(0.6)	
Comorbidities				
Mental disorder	146,081(13.0)	61,850(16.5)	84,231(11.3)	<0.001
Eye disease	124,737(11.1)	58,711(15.7)	66,026(8.8)	<0.001
HTN	618430(55.1)	226751(60.6)	391679(52.4)	<0.001
Hyperlipidemia	98,427(8.8)	32,259(8.6)	66,168(8.8)	<0.001
Atherosclerosis	27848(2.5)	10458(2.8)	17390(2.3)	<0.001
COPD	310,717(27.7)	114,072(30.5)	196,645(26.3)	<0.001
IHD	319,667(28.5)	120,945(32.3)	198,722(26.6)	<0.001
HF	178,935(15.9)	65,725(17.6)	113,210(15.1)	<0.001
CD	307,914(27.4)	103,809(27.8)	204,105(27.3)	<0.001
RA	49,639(4.4)	19,159(5.1)	30,480(4.1)	<0.001
PUD	62,556(5.6)	24,517(6.6)	38,039(5.1)	<0.001
Liver disease	107,109(9.5)	32,387(8.7)	34,722(10.0)	<0.001
DM	336,143(30.0)	112,864(30.2)	223,279(29.8)	<0.001
Hemiplegia	55,355(4.9)	17,852(4.8)	37,503(5.0)	<0.001
CKD	207,519(19.5)	68,396(18.3)	139,123(18.6)	<0.001
Cancer	300,719(26.8)	96,669(25.8)	204,050(27.3)	<0.001

Chi-square/Fisher exact test on category variables and t-test on continue variables.
The comorbidities listed in the Table S1.

Table 2 shows the results of the univariate and multivariate analysis for factors affecting falls. After controlling for factors such as comorbidities/complications, veterans' subsequent (14 years) risk of falls was 1.252 times (P<0.001)that of non-veterans; the subsequent risk of falls among those in the 75-84 and 85-year-old and over age groups were 1.081 times (P<0.001)and 1.057 times (P<0.001)that of people in the 65-74-year-old age group; and the subsequent risk of falls of people living in areas with moderate and low urbanization were 1.170 times (P<0.001) and 1.136 times (P<0.001)that of people living in areas with high urbanization. People with mental illness had a risk of falls 1.730 times (P<0.001) that of persons not suffering from mental illness. People suffering from diseases of the eyes had 1.225 times (P<0.001) the risk of falls of people not suffering from diseases of the eyes.

Table 2. Factors of falls by using multivariable Cox proportional hazard regression model

Variables	Crude HR	95% CI	P-value	Adjusted HR	95% CI	P-value
Groups						
Non veterans	Reference			Reference		
Veterans	1.369	1.351-1.388	<0.001	1.252	1.234-1.270	<0.000
Gender						
Female	Reference			Reference		
Male	0.599	0.590-0.608	<0.001	0.577	0.568-0.586	<0.001
Age group (years)						
65-74	Reference			Reference		
75-84	1.366	1.344-1.388	<0.001	1.081	1.064-1.099	<0.001
≥85	1.520	1.491-1.549	<0.001	1.057	1.036-1.078	<0.001
Season						
Spring	Reference			Reference		
Summer	1.064	1.046-1.083	<0.001	1.075	1.056-1.093	<0.001
Autumn	1.052	1.032-1.073	<0.001	1.046	1.026-1.066	<0.001
Winter	1.082	1.064-1.101	<0.001	1.079	1.061-1.098	<0.001
Urbanization						

High	Reference			Reference		
Medium	1.250	1.231-1.273	<0.001	1.170	1.149-1.190	<0.001
Low	1.439	1.418-1.472	<0.001	1.136	1.113-1.160	<0.001
Level of Care						
Non-Medical center	Reference			Reference		
Medical center	0.608	0.598-0.617	<0.001	0.706	0.694-0.718	<0.001
Hospital Type *vs* Without (Ref)						
Veterans Hospital	0.917	0.899-0.934	<0.001	0.870	0.851-0.890	<0.001
ISS≥16 *vs* Without (Ref)	2.988	2.826-3.158	<0.001	3.076	2.884-3.225	<0.001
Comorbidities *vs* Without (Ref)						
Mental disorder	2.305	2.271-2.340	<0.001	1.730	1.703-1.757	<0.001
Eye disease	1.404	1.379-1.429	<0.001	1.225	1.203-1.247	<0.001
HTN	2.073	2.043-2.104	<0.001	1.560	1.535-1.585	<0.001
Hyperlipidemia	1.210	1.185-1.235	<0.001	0.890	0.871-0.909	<0.001
Atherosclerosis	1.337	1.291-1.385	<0.001	1.064	1.027-1.102	<0.001
COPD	1.572	1.551-1.593	<0.001	1.249	1.231-1.267	<0.001
IHD	1.550	1.529-1.571	<0.001	1.120	1.117-1.101	<0.001
HF	1.535	1.512-1.559	<0.001	1.096	1.078-1.114	<0.001
CD	1.735	1.712-1.758	<0.001	1.258	1.239-1.276	<0.001
RA	1.770	1.728-1.813	<0.001	1.371	1.338-1.405	<0.001
PUD	1.632	1.596-1.668	<0.001	1.139	1.113-1.165	<0.001
Liver Disease	1.305	1.280-1.331	<0.001	1.164	1.142-1.188	<0.001
DM	1.441	1.421-1.460	<0.001	1.109	1.093-1.124	<0.001
Hemiplegia	1.475	1.439-1.511	0.027	1.029	1.003-1.055	<0.001
CKD	1.416	1.395-1.438	<0.001	1.140	1.122-1.158	<0.001
Cancer	0.900	0.886-0.914	0.061	1.015	0.999-1.030	<0.001

HR = Hazard ratio; CI = Confidence interval; Adjusted HR: Adjusted hazard ratio: Adjusted for the variables listed in Table 2.The comorbidities listed in the Table S1.

Table 3 shows the results of a stratified analysis of the variables and reveals that, after controlling for factors such as comorbidities/complications, regardless of sex, age, season, level of urbanization, hospital grade, whether hospitalization occurred at a veteran's hospital, severity of the injury, whether the subject suffered from mental illness, or whether the subject suffered from diseases of the eyes, veterans had a higher risk of falls than non-veterans, and their risk was 1.155-1.478 times higher than that of non-veterans. In particular, in the male group, veterans had 1.299 times (P<0.001) the risk of falls of non-veterans; in the 75-84-year-old age group, veterans had 1.313 times (P<0.001) the risk of falls of non-veterans; among those with diseases of the eyes, veterans had 1.362 times (P<0.001) the risk of falls of non-veterans; and among those suffering from mental illness, veterans had 1.300 times (P<0.001) the risk of falls of non-veterans. Furthermore, among comorbidities/complications, in the atherosclerotic disease group, veterans had 1.478 times (P<0.001) the risk of falls of non-veterans; and in the group with paralysis of the limbs, veterans had 1.356 times (P<0.001) the risk of falls of non-veterans.

Table 3. Factors of falls stratified by variables listed in the table by using Cox proportional hazard regression model

Falls (with vs. without)	Group						Adjusted		
	Veterans			Non Veterans					
Stratified	Event	PYs	Rate	Event	PYs	Rate	HR	95% CI	P-value
Total	35,454	2,765,101	1,282	55,037	5,917,965	930	1.252	1.234-1.270	<0.001
Gender									
Female	8,336	456,003	1,828	14,705	978,524	1,503	1.155	1.123-1.188	<0.001
Male	27,118	2,309,098	1,174	40,332	4,939,441	817	1.299	1.277-1.322	<0.001
Age group (years)									
65-74	6,134	562,055	1,091	17,155	2,241,756	765	1.279	1.240-1.320	<0.001
75-84	20,343	1,546,602	1,315	26,621	2,689,604	990	1.313	1.288-1.339	<0.001
≧85	8,977	656,444	1,368	11,261	986,605	1,141	1.197	1.161-1.234	<0.001
Season									
Spring	11,637	946,772	1,229	18,124	2,042,393	887	1.242	1.210-1.274	<0.001
Summer	8,970	680,735	1,318	13,782	1,458,123	945	1.279	1.242-1.316	<0.001
Autumn	6,153	490,355	1,255	9,637	1,006,877	957	1.227	1.1851.270	<0.001
Winter	8,694	647,239	1,343	13,494	1,410,573	957	1.260	1.224-1.298	<0.001
Urbanization									
High	7,599	593,925	1,279	12,570	1,773,595	709	1.399	1.358-1.440	<0.001
Midden	21,229	1,707,959	1,243	24,874	2,625,440	947	1.202	1.178-1.226	<0.001
Low	6,626	463,217	1,430	17,593	1,518,930	1,158	1.238	1.202-1.276	<0.001
Level of care	11,275	1,130,666	997	11,848	1,999,510	593	1.320	1.282-1.360	<0.001
Veterans Hospital	9,824	1,849,264	531	2,580	362,185	712	1.236	1.182-1.294	<0.001
ISS>16	323	8,403	3,844	940	32,190	2,920	1.170	1.022-1.339	<0.001
Mental disorder	10,949	480,604	2,278	13,006	699,930	1,858	1.300	1.264-1.336	<0.001
EYE disorder	7,953	511,495	1,555	7,083	578,155	1,225	1.362	1.314-1.411	<0.001
Atherosclerosis	1,468	85,603	1,715	1,808	154,270	1,172	1.478	1.371-1.595	<0.001
Hemiplegia	2,632	145,320	1,811	4,513	338,864	1,332	1.356	1.286-1.429	<0.001

PYs = Person-years; Adjusted HR = Adjusted Hazard Ratio: Adjusted for the variables listed in Table2.; Rate=per 100,000 PYs; CI = confidence interval.

The comorbidities listed in the Table S1.

In Table S2, Model 1 shows that veterans had 1.252 times (P<0.001) the risk of falls of non-veterans after controlling for factors such as comorbidities/complications, and Model 2 shows that when the stratification was performed based on the dependent variable (cause of fall-related injury), veterans had 1.171 times (P<0.001) the risk of falls from a height of non-veterans, and 1.193 times (P<0.001)the risk of falls on the same level of non-veterans. Model 3 shows that when the stratification was performed based on the number of falls, veterans had 1.229 times (P<0.001) the risk of a single fall of non-veterans and 1.290 times (P<0.001) the risk of recurrent falls of non-veterans.

DISCUSSION

This study was Taiwan's first long-term follow-up study seeking to gain an understanding of falls in veterans, and the results showed that 35,454 veterans suffered falls (9.5%) during the research period, while 55,037 non-veterans suffered falls (7.4%) during the same period, indicating that veterans had 1.252 times (P<0.001) the risk of falls of non-veterans. In a 2015 cross-sectional study of injuries in 287,113 veterans and non-veterans receiving emergency care, veterans had a higher incidence of emergency care than non-veterans (5.1% vs. 4.0 %, P<0.001) [26], which was consistent with the findings of this study. Moreover, another study of falls in veteran's care centres found a 17.2% incidence of falls,[14] which was higher than the incidence in this study (9.5%). The study in question consisted solely of a self-completed questionnaire survey (concerning falls) of 940 veterans in eastern Taiwan, the sample was small, and the study only investigated output information. In contrast, the present study focused on patients who had been hospitalized with confirmed physician's diagnoses and constituted a large sample, which may account for the differences in findings with the prior study. Most past research on veterans has consisted of cross-sectional studies or questionnaire surveys with a short study length and small sample size. There have been few longitudinal studies of falls in veterans. The findings of this study help to make up for the shortcomings of the aforementioned research.

A stratified analysis by age revealed that veterans at all three age levels had a greater risk of falls than non-veterans, and veterans in the 75-84-year-old age group had 1.313 times the risk of falls of non-veterans. In contrast, a 2009 study of inpatient medical utilization by elderly fall patients over the age of 65 years indicated that the largest proportion of the patients were in the 75-84-year-old age group (46.5%)[27], but the study did not analyse veterans as a separate category. Furthermore, a 2016 paper concerning emergency care of injuries found that a higher percentage of male veterans receiving care for injuries were in the 75-84-year-old age group (51.7%, P<0.001) than the other age groups (65-74 years: 34.8%; ≥85 years: 13.5%) [26], which was similar to the finding of this study (54.5%); however, the previous study did investigate differences in risk of fall-related injuries between veterans and non-veterans. The present study discovered that veterans in the 75-84-year-old age group hospitalized for falls had a longer hospital stay than non-veterans (9.13 days vs. 8.75 days), had slightly higher average inpatient medical expenditures than non-veterans (NT$ 59,800 vs. NT$ 59,500), and was a high-risk group for recurrent falls. According to data from the Veterans Affairs Council, most veterans in the 75-84-year-old age group were senior veterans (born prior to 1934) and took part in the war of resistance against Japan;[3] it will be worthwhile to conduct a further longitudinal study determining whether the disabilities resulting from wartime service have caused these veterans to have a greater risk of falls than non-veterans.

This study found that a significantly higher percentage of veterans suffered from mental illness than non-veterans (16.5% vs. 11.3; P<0.001). A 2014 retrospective study of the psychological treatment of veterans using data from the US Veterans Health Administration (VHA) healthcare system discovered that the percentage of veterans receiving psychological treatment increased with age, and the frequency of psychological treatment also increased with time.[28] Our study found that veterans suffering from mental illness had 1.300 times the risk of falls of non-veterans. Past research has indicated that emotional disorders (such as depression and neurological disorders) may cause falls by affecting activities and the sense of balance.[16, 22, 23] This study's stratified analysis of the effect of mental illness further discovered that veterans with depression had 1.366 times the risk of falls of non-veterans (adjusted HR=1.366, 95%CI=1.283-1.454, P<0.001), while veterans with anxiety disorder had 1.317 times the risk of falls of non-veterans (adjusted HR=1.317, 95%CI=1.201-1.443; P<0.001). Furthermore, depression (adjusted HR=1.938, P<0.001, 95%CI=1.793-2.094) was a predictor of recurrent falls in veterans; this result was somewhat similar to the findings of past research, which found that depression is a risk factor for falls in veterans and also for recurrent falls.[14] A study of elderly persons in the community found that individuals with depression in conjunction with chronic diseases (cardiovascular disease, diabetes, arthritis) had a greater risk of falls than individuals who neither had depression nor

suffered from chronic disease (3.95 times, 4.25 times, 9.66 times).[29] Further analysis in this study found that elderly individuals with depression together with HT or COPD or CD or RA had a greater risk of falls (2.262 times, 1.829 times, 1.867 times, 1.849 times) than those elderly individuals who neither had depression nor suffered from chronic disease. In summary, apart from physiological (physical) issues, mental illness in veterans is a hidden problem that nevertheless should be taken seriously. This study infers that because veterans lose their social status after discharge, may have few interpersonal interactions, and may suffer from physiological stress due to the infirmity of old age, when veterans can no longer live independently, their unwillingness to leave their familiar environment and receive care in a veterans nursing home may be accompanied by mental illness such as depression and anxiety. The findings of this study support this phenomenon. In addition, the interaction of physiological and mental disorders will also increase the risk of falls. We therefore recommend that screening for mental illnesses such as depression be included when assessing risk of falls in the elderly.

A health survey of the residents of veteran's care centers in Taiwan found that 73% of veterans had vision not exceeding 0.1, which implies that they would have difficulty reading books and newspapers.[24] This study found that veterans with diseases of the eyes had a greater risk of falls than non-veterans, and among fall patients, significantly higher percentages of veterans had cataracts (12.7% vs. 4.7%; P<0.001) and glaucoma

(2.3% vs. 1.1%, P<0.001) than non-veterans. Further analysis revealed that veterans with cataracts had 1.378 times the risk of falls of non-veterans with cataracts (adjusted HR=1.378, 95%CI=1.306-1.453, P<0.001). Similarly, veterans with glaucoma had 1.414 times the risk of falls of non-veterans with glaucoma (adjusted HR=1.414, 95%CI=1.259-1.588, P<0.001). While research has indicated that cataracts are an independent risk factor for falls in veterans, [14], this study found that cataracts (adjusted HR=1.322, P<0.001, 95%CI=1.237-1.412) are also a predictor of recurrent falls in veterans. Further research is needed to verify whether veterans' diseases of the eyes are a consequence of the long-term exposure of the lens to UV radiation while participating in field training or at other times during their period of service, or a result of poor control of chronic diseases, or are induced by the severity of their diseases.

This study discovered that veterans had higher levels of all comorbidities/complications (including hypertension, cardiovascular disease, cerebrovascular disease, lung disease, arthritis, gastrointestinal disease, diabetes, liver disease, kidney disease, among others) than non-veterans. A 2013 cross-sectional study suggested that cerebrovascular disease and gouty arthritis are independent risk factors for falls in veterans, [14] which is consistent with this study. Foreign research has also indicated that veterans over the age of 65 years have more comorbidities/complications than veterans under the age of 65 years. [30] Our study findings indicate that among persons with

comorbidities/complications, veterans have a greater risk of falls than non-veterans, which underscores the importance of chronic disease prevention and rehabilitation exercises as veterans age.

This study made the further discovery that among fall-related injuries, veterans had a greater incidence of both falls from a height and falls at the same level than non-veterans. Furthermore, veterans had 1.29 times ($P<0.001$) the risk of recurrent falls of non-veterans, and during the 2000-2013 period, each veteran had 4.07 falls, which was significantly greater than the falls of non-veterans (3.88 times). Moreover, the average hospital stay (9.13 days) and medical expenditures (NT$ 59,000) of veterans with falls were both higher than those of non-veterans (8.77 days and NT$ 58,000), and the percentage of veterans who died while hospitalized (3.7%) was also higher than that of non-veterans (2.8%). To summarize the foregoing research findings, veterans constitute a high-risk group for falls among the general elderly population and have relatively high medical utilization after suffering falls.

The strengths of this study include a sufficiently large research sample and a tracking period of 14 years, as well as the ability to compare the risk of falls among veterans and non-veterans and confirm factors affecting falls in veterans. However, despite these strengths, this study also had the following limitations. First, this study was limited by the format of the data in the National Health Insurance Research Database and could not

obtain other important information related to falls (such as the living environment, patient weight, dietary intake, muscular endurance, and degree of disability). Second, this study analysed inpatient files in the National Health Insurance Research Database and was unable to estimate the percentages of individuals who did not receive care or who only received outpatient/emergency care; thus, this study may have underestimated the number of cases.

CONCLUSION

Veterans had 1.252 times the risk of falls and 1.290 times the risk of recurrent falls of non-veterans. In addition, veterans also had longer inpatient stays and higher medical expenditures and death rates than non-veterans. Age (especially the 75-84-year-old age group), comorbidities/complications, mental illness, and diseases of the eyes were risk factors for falls in veterans, and depression and cataracts were predictors of recurrent falls. Apart from implementing preventive measures targeting high-risk groups, the responsible authorities should also seek to reduce the risk of falls among veterans by resolving their psychological and physiological issues.

Declarations

Authors' Contributors

All authors (PHJ, YLC, CHC, Kao, CWC) designed the study. Data analyses and interpretation were performed by PHJ, and CWC. Kao and CWC drafted and revised the manuscript. All authors read and approved the final manuscript.

Funding

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Competing interests

The authors declare that they have no competing interests.

Patient Consent

Not required.

Ethics approval

The study protocol was approved by the approval institutional review board, Tri-Service General Hospital. (TSGHIRB No. 1-105-05-142).

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

No additional unpublished data from this study.

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Figure 1. The flowchart of study sample selection from National Health Insurance Research Database in Taiwan

Figure 2. Kaplan-Meier for cumulative risk of fall in 14-year tracking stratified by Veterans with log-rank test

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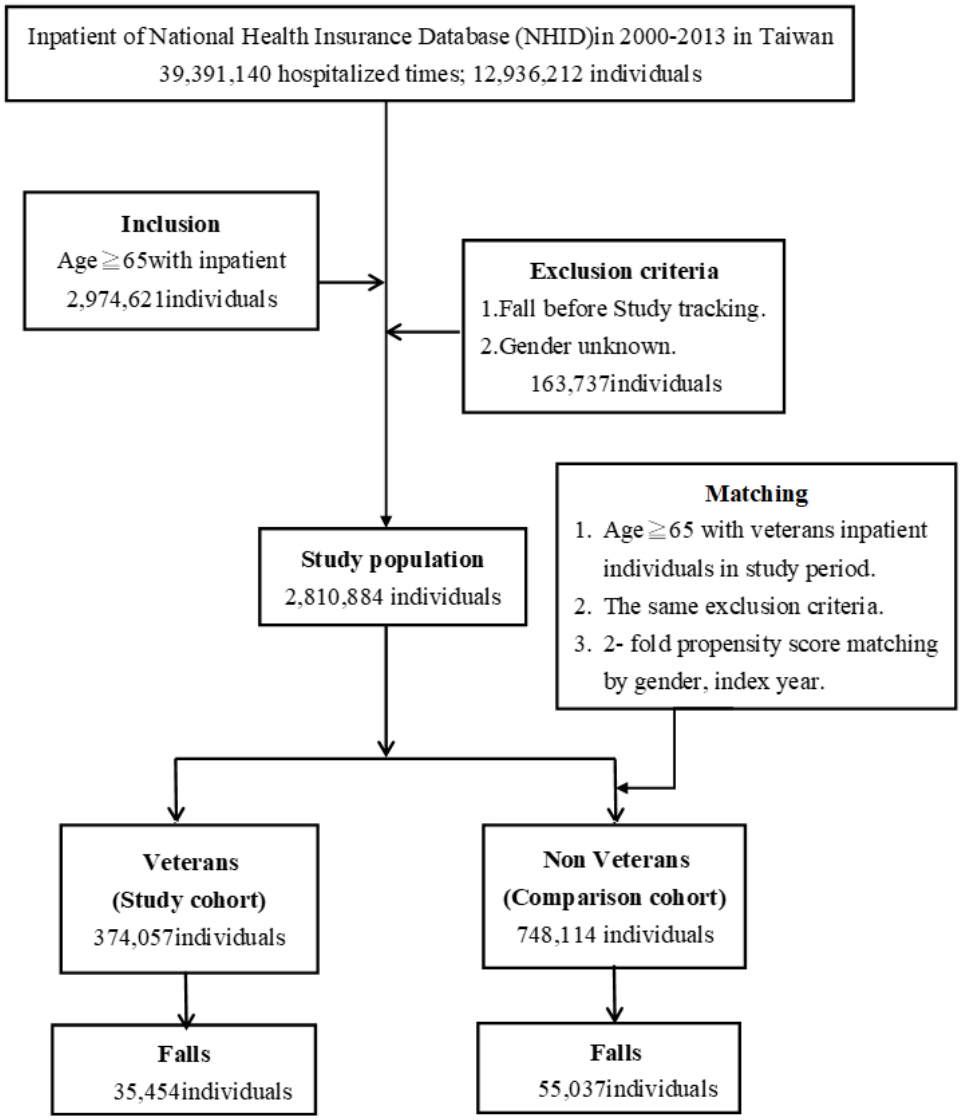

Figure1.The flowchart of study sample selection from National Health Insurance Research Database in Taiwan

131x149mm (144 x 144 DPI)

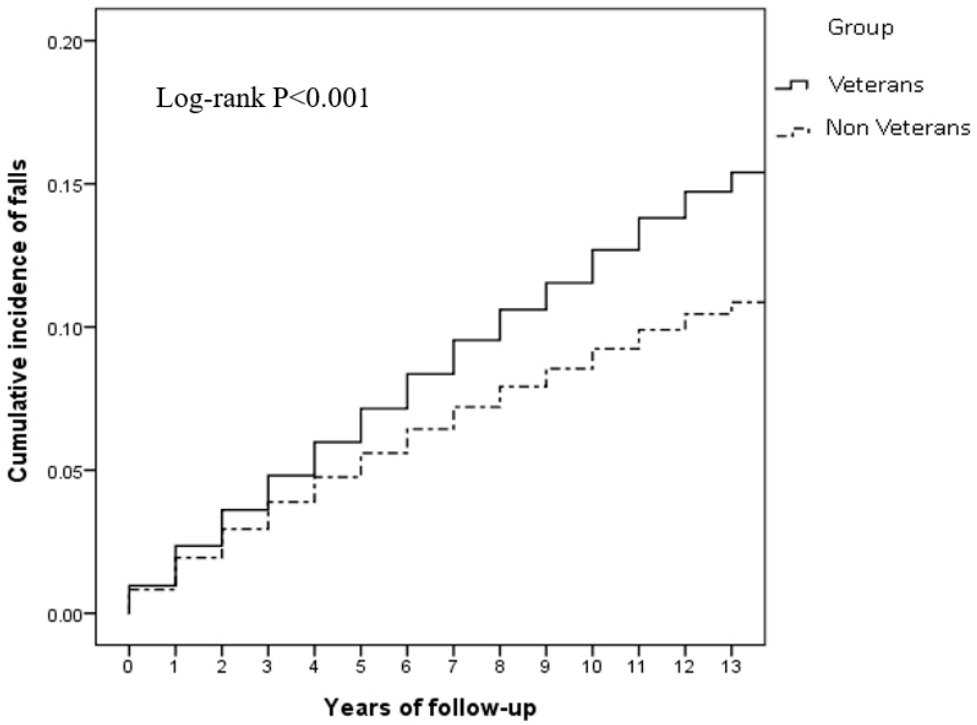

Figure2.Kaplan-Meier for cumulative risk of fall in 14-year tracking stratified by Veterans with log-rank test

144x107mm (144 x 144 DPI)

Appendices:

Table S1. Abbreviation and ICD-9-CM / NHI order code

	Abbreviation	ICD-9-CM / NHI order code
Events		
Falls		880-888
From the different level		880-884
On the same level		885-886
Unspecified		887-888
Comorbidities		
Mental disorder		290-319
Eye disease		360-379
Hypertension	HTN	401–405
Hyperlipidemia		272
Atherosclerosis		440
Chronic obstructive pulmonary disease	COPD	490–496
Ischemic heart disease	IHD	410–414
Heart failure	HF	428
Cerebrovascular disease	CD	430-438
Rheumatism	RA	725-729
Peptic ulcer disease	PUD	533
Liver disease		571
Diabetes mellitus	DM	250
Hemiplegia		342-344
Chronic kidney disease	CKD	580-589
Cancer		140–239

Table S2. Factors of falls by using Cox proportional hazard regression in different model

Model	Variables	Adjusted HR	95% CI	P-value
Model 1	Falls	1.252	1.234-1.270	<0.001
Model 2	Falls			
	From the different level	1.171	1.122-1.222	<0.001
	On the same level	1.193	1.171-1.215	<0.001
	Unspecified	1.451	1.410-1.493	<0.001
Model 3	Single Fall	1.229	1.208-1.249	<0.001
	Recurrent Falls	1.290	1.250-1.331	<0.001

HR=hazard ratio, CI=confidence interval, Adjusted HR: Adjusted for the variables listed in Table 2.

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (*b*) For matched studies, give matching criteria and number of exposed and unexposed	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	8-9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (*b*) Describe any methods used to examine subgroups and interactions (*c*) Explain how missing data were addressed (*d*) If applicable, explain how loss to follow-up was addressed (*e*) Describe any sensitivity analyses	10
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	11
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	11-13
Outcome data	15*	Report numbers of outcome events or summary measures over time	14-15

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	15-16
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	17
Discussion			
Key results	18	Summarise key results with reference to study objectives	18-23
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	23-24
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	24
Generalisability	21	Discuss the generalisability (external validity) of the study results	24
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	25

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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Fall and risk factors for veterans and nonveterans inpatients over the age of 65: 14 years of long-term data analysis

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Fall and risk factors for veterans and nonveterans inpatients over the age of 65: 14 years of long-term data analysis

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ABSTRACT

Introduction: Falls are one of the most important causes of injuries and accidental deaths among this segment of over the age of 65 years.

The long-term follow-up study of fall-related injuries was conducted in elderly veterans over the age of 65 years, and the risk of falls in veterans and non-veterans was compared.

Methods: This study used the National Health Insurance Research Database for the period from 2000-2013 in Taiwan. this longitudinal study tracked falls in veterans over the age of 65 years, designated a control group (non-veterans), using 1:2 pairing on the basis of sex and time receiving medical care, and used Cox regression to analyze and compare the risk of falls among veterans and non-veterans.

Results: This study subjects consisted of 35,454 of the veterans had suffered falls (9.5%), as had 55,037 of the non-veterans (7.4%). After controlling for factors such as comorbidities/complications, the veterans had 1.252 times the risk of falls of the non-veterans, Furthermore, among persons in the 75-84-year-old age group, veterans had 1.313 times the risk of falls of non-veterans, and among persons with mental illnesses and diseases of the eyes, veterans had 1.300 and 1.362 times the risk of falls of non-veterans. In addition, each

veteran had an average of 4.07 falls during the 2000-2013 period, which was significantly higher than in the case of non-veterans (3.88 falls).

Conclusions: Veterans' risk of falls and recurrent falls were both higher than those of non-veterans, and age level, comorbidities/complications, and level of urbanization were all important factors affecting veterans' falls. The responsible authorities should, therefore, use appropriate protective measures to reduce the risk of falls and medical expenses in high-risk groups.

Keywords：Veteran; Falls; National Health Insurance Research Database.

Strengths and limitations of this study

►► This is the first nationwide population-based cohort study to assess the falls injury associations between Veterans and nonveterans.

►►The strengths of this study include a sufficiently large research sample and a tracking period of 14 years, as well as the ability to compare the risk of falls among veterans and non-veterans and confirm factors affecting falls in veterans.

►► This study cohort is large enough to examine each risks of fall injury among subgroups.

►► The limitation of this study is the lack of information on the detailed patient characteristics and could not obtain other important information related to falls (such as the living environment, muscular endurance, and degree of disability).

INTRODUCTION

Falls are the second leading cause of death among accidental injuries worldwide. According to 2018 WHO data, as many as 646,000 persons die from falls annually, and elderly persons over the age of 65 constitute the age group with the highest incidence of fall-related deaths.[1] In Taiwan, according to the 2017 annual report on the cause of death statistics issued by the Ministry of Health and Welfare, Executive Yuan, falls were the second leading cause of death among accidental injuries in 2017.[2] According to data from the Veterans Affairs Council, as of the end of 2017, veterans over the age of 65 years accounted for approximately 50% of all veterans and 6.14% of Taiwan's elderly population over the age of 65 years.[3] Furthermore, the health insurance participation of veterans over the age of 65 years accounts for 7.7% of that of all persons over the age of 65 years in Taiwan. [4] As a consequence, veterans constitute an important subgroup of elderly persons with relatively high healthcare needs.

According to research conducted in the United States, in 2012, 3.2 million people were injured in non-fatal falls (incurring medical expenses of US$ 30.3 billion), and 24,190 people died due to falls (incurring direct medical expenses of US$ 616.5 million); these figures increased to US$ 31.3 billion and US$ 637.5 million in 2015, and the incidence of falls and total medical expenses increased with age.[5] A research survey of elderly people in the US found that 78% of falls could be attributed to two or more risk factors, and the

greater the number of risk factors was, the greater the probability of a fall;[6] risk factors for falls include sex, age, socioeconomic status, environment, and physiological condition (poor vision, chronic illness, and poor balance). [7-9] According to the 2014 research of Clegg et al., risk factors for falls include a poor living environment, use of multiple medications, lack of vitamin D, comorbidities, sarcopenia or frailty, and impaired sensory system.[10] In addition, a 2017 cross-sectional study (Paliwal et al) of the relationship between chronic disease and falls among community seniors over the age of 65 years, involving the use of the Behavioural Risk Factor Surveillance System (BRFSS), found that the incidence of falls during the previous one-year period among people with such chronic diseases, such as stroke (adjusted OR=1.61), chronic kidney disease (adjusted OR=1.27), arthritis (adjusted OR=1.61), depression (adjusted OR=2.26), and diabetes (adjusted OR=1.32), was uniformly higher than in people without these diseases,[11] and whether assistive equipment was used was also a factor affecting falls.[12] In Taiwan, according to Chien et al., the 518,601 elderly persons hospitalized for injuries between 2005 and 2007 had an average age of 76.1, and 209,860 of these people (40.5) had fall-related injuries, making falls the chief cause of injuries.[13] Furthermore, in a study analysing factors associated with falls among 940 veterans at four veteran's care centres in eastern Taiwan during the 2009-2010 period, Ku et al. found that falls and recurrent falls had incidences of 17.2% and 6.9%, respectively; age, depression, stroke, gouty arthritis, and cataracts were

independent risk factors for falls, and depression was a risk factor for recurrent falls (adjusted OR=1.22).[14] In summary, a few large studies have examined veterans as subjects, and most of the research consisted of cross-sectional studies and questionnaire surveys. In contrast, we employed a long-term longitudinal study to analyse the risk of fall-related injuries, and we hope that this approach can help mitigate the shortcomings of the foregoing literature.

In Taiwan, after their discharge, veterans who spent their careers in the armed forces to contribute to their country face diseases of old age, and their fall-related injuries are also an issue of concern. Jobless veterans receive various benefits from the Veterans Affairs Council and enjoy exemption from health insurance co-payments. [3] While some literature has investigated issues such as chronic diseases acquired after discharge, [15] mental illness, [16] life satisfaction, [17] and medical utilization [18, 19] in some elderly veterans with wartime experience, there has been an absence of long-term follow-up studies of fall-related injuries in veterans. What is the risk of a fall among veterans? Does the risk of a fall among veterans differ from that among the general population? This study sought to investigate these questions. Accordingly, veterans over the age of 65 years during the 2000-2013 period were included as subjects in a long-term follow-up epidemiological study of fall-related injuries, and the risks of falls among veterans and non-veterans were compared.

METHODS

Data sources

Taiwan's National Health Insurance (NHI), which was introduced in 1995, records the medical data of all insured people, covering more than 99% of the 23 million people in Taiwan. As a result, the NHI data constitute an important resource for research concerning clinical medicine and public health.[20-21] Because the outpatient and emergency care files in the National Health Insurance Research Database (NHIRD) provide only injury diagnostic data, but not the causes of injuries, while hospitalization files provide information concerning the causes of injuries, this study accordingly performed string analysis of data in the NHIRD's "inpatient expenditures by admissions (DD)," "registry for contracted medical facilities (HOSB)," "major injury and illness (HV)," and "underwriting data details (ID)" files for the period from 2000 to 2013. This study was approved after a complete ethical review by the Institutional Review Board of National Defense Medical Center Tri-Service General Hospital and the informed consent was not necessary. (TSGHIRB No:1-105-05-142)

Patient and Public Involvement

Patient and public involvement Participants were not involved in the design or conduct of this study.

Study design and participants

This study included "jobless" veterans ("veterans") over the age of 65 years as the members of the case group. To ensure that the cases represented newly occurring falls, we excluded falls during the 1997-1999 period, and the study period was extended from January 1, 2000 to December 31, 2013 (tracking end point). We employed a matching control design in which 1:2 pairing was performed on the basis of the veterans' sex and time receiving medical care, and we selected non-veterans with the corresponding criteria to serve as the control group.

Event occurrence

All cases were tracked to a fall accident (ICD-9-CM E code 880-888), loss of case during the research period (loss to follow up), or to the research end point on December 31, 2013.

Standards and definitions

The three age groups in this study consisted of 65-74 years, 75-84 years, and over 85 years. The severity of falls was judged on the basis of a trauma severity greater than 16 points (Injury Severity Score(ISS > 16) in the major injury and illness category in the major injury and illness (HV) files. [22,23]Because comorbidities/complications [10, 11, 18], mental illness [11, 16, 24, 25] and diseases of the eyes [11, 14, 26] are also risk factors for falls in the elderly, to clarify the influence of illnesses on falls among veterans and non-veterans, this study included commonly seen comorbidities/complications of the elderly in its regression model and controlled for mental illness (ICD-9-CM 290-319) and diseases of

the eyes (ICD-9-CM 360-379). In addition, among environmental variables, the level of urbanization was classified as high, moderate, and low, the urbanization level of residence was defined according to the population and various indicators of the level of development. High was defined as a population of >1,250,000 and a specific designation as a political, economic, cultural, and metropolitan development. Medium was defined as a population between 500,000 and 1,249,999 and as playing an important role in the political system, economy, and culture. Low was defined as a population <499,999.[27,28] the season was classified as spring (March-May), summer (June-August), fall (September-November), and winter (December-February), the grade of hospital where the subject received care was classified as a medical centre or a non-medical centre, and the hospital was classified as a veteran hospital or a non-veteran hospital. In accordance with the external factor code (ICD-9-CM E-code (E880-888)), the causes of injuries were classified as three types: fall from a height (E800-884), fall on the same level (E885-886), and other falls (E887-888). Recurrent falls were defined as two or more falls occurring within the research period (from 2000 to the end of 2013).

Statistical analysis

This study included veterans over the age of 65 years as research subjects, tracked the cause of their falls during the 2000-2013 period and type of injury, and found factors affecting the occurrence of their falls. Data analysis was performed using SPSS 22 statistical software

(SPSS, Inc., Chicago, IL, USA); the Chi-square test was employed to compare categorical variables and the t-test was used to compare continuous variables in the two groups. Factors affecting falls were analysed by Cox's regression, while hazard ratios (HRs), 95% confidence intervals (CIs), and Kaplan-Meier survival curves were used to extract differences between the veteran and non-veteran groups. A P-value<0.05 was considered the standard for the assessment of significance.

RESULTS

Fig. 1 shows the case selection (inclusion and exclusion) and a tracking result flowchart. During the 2000-2013 period, a total of 2,974,621 elderly people over the age of 65 years were hospitalized in Taiwan; after excluding 163,737 people who were hospitalized for falls during the period from 1997-1999, a total of 2,810,884 persons remained, which included 374,057 veterans and 748,114 non-veterans over the age of 65 years.

Table 1 shows the basic characteristics of the entire sample of 1,122,171 people (374,057 veterans and 748,114 non-veterans) at the tracking end point. The percentage of veterans who suffered falls was significantly higher than that of non-veterans (9.5% vs. 7.4%, P<0.001), and they also had a significantly higher probability (risk) of falls during the first year than non-veterans (log-rank test, P<0.001) (Fig.2). In addition, a significantly higher percentage of veterans than non-veterans lived in areas with a moderate level of urbanization and received care at a medical centre or a veteran's hospital.

Table 1. Characteristics of study in the endpoint

Variables	Group Total 1,122,171(100) N (%)	 Veterans 374,057(33.3) N (%)	 Non veterans 748,114(66.7) N (%)	*P-value*
Falls				<0.001
Without	1,031,680(91.9)	338,603(90.5)	693,077(92.6)	
With	90,491(8.1)	35,454(9.5)	55,037(7.4)	
Gender				<0.001
Female	228,402(20.4)	73,298(19.6)	155,104(20.7)	
Male	893,769(79.6)	300,759(80.4)	593,010(79.3)	
Age	78.0 ± 7.2	80.1 ± 6.5	77.0 ±7.3	<0.001
Age group (years)				<0.001
65-74	408,190 (36.4)	84,862(22.7)	323,328(43.2)	
75-84	514,627 (45.9)	203,872(54.5)	310,755(41.5)	
≥85	199,354 (17.8)	85,323(22.8)	114,031(15.2)	
Season				0.147
Spring	380,246 (33.9)	126,741(33.9)	253,685(33.9)	
Summer	278,254 (24.8)	92,434(24.7)	185,820(24.8)	
Autumn	197,359 (17.6)	66,188(17.7)	131,171(17.5)	
Winter	266,132 (23.7)	88,694(23.7)	177,438(23.7)	
Urbanization				<0.001
High	310,836 (27.7)	82,269(22.0)	228,567(30.6)	
Medium	561495 (50.0)	230,791(61.7)	330,704(44.2)	
Low	249,840 (22.3)	60,997(16.3)	188,843(25.2)	
Level of care				<0.001
Non-Medical center	713,792 (63.6)	220,496(58.9)	493,296(65.9)	
Medical center	408,379 (36.4)	153,561(41.1)	254,818(34.1)	
Veterans Hospital				<0.001
Without	949,503 (84.6)	249,175(66.6)	700,328(93.6)	
With	172,668 (15.4)	124,882(33.4)	47,786(6.4)	
ISS≥16				<0.001
Without	1116,550(99.5)	372,822(99.7)	743,728(99.4)	
With	5,621(0.5)	1,235(0.3)	4,386(0.6)	
Comorbidities				
Mental disorder	146,081(13.0)	61,850(16.5)	84,231(11.3)	<0.001
Eye disease	124,737(11.1)	58,711(15.7)	66,026(8.8)	<0.001
HTN	618430(55.1)	226751(60.6)	391679(52.4)	<0.001
Hyperlipidemia	98,427(8.8)	32,259(8.6)	66,168(8.8)	<0.001
Atherosclerosis	27848(2.5)	10458(2.8)	17390(2.3)	<0.001
COPD	310,717(27.7)	114,072(30.5)	196,645(26.3)	<0.001
IHD	319,667(28.5)	120,945(32.3)	198,722(26.6)	<0.001
HF	178,935(15.9)	65,725(17.6)	113,210(15.1)	<0.001
CD	307,914(27.4)	103,809(27.8)	204,105(27.3)	<0.001
RA	49,639(4.4)	19,159(5.1)	30,480(4.1)	<0.001
PUD	62,556(5.6)	24,517(6.6)	38,039(5.1)	<0.001
Liver disease	107,109(9.5)	32,387(8.7)	34,722(10.0)	<0.001
DM	336,143(30.0)	112,864(30.2)	223,279(29.8)	<0.001
Hemiplegia	55,355(4.9)	17,852(4.8)	37,503(5.0)	<0.001

CKD	207,519(19.5)	68,396(18.3)	139,123(18.6)	<0.001
Cancer	300,719(26.8)	96,669(25.8)	204,050(27.3)	<0.001

Chi-square/Fisher exact test on category variables and t-test on continue variables.
The comorbidities listed in the Table S1.

Table 2 shows the results of the univariate and multivariate analysis for factors affecting falls. After controlling for factors such as comorbidities/complications, veterans' subsequent (14 years) risk of falls was 1.252 times (P<0.001)that of non-veterans; the subsequent risk of falls among those in the 75-84 and 85-year-old and over age groups were 1.081 times (P<0.001)and 1.057 times (P<0.001)that of people in the 65-74-year-old age group; and the subsequent risk of falls of people living in areas with moderate and low urbanization were 1.170 times (P<0.001) and 1.136 times (P<0.001)that of people living in areas with high urbanization. People with mental illness had a risk of falls 1.730 times (P<0.001) that of persons not suffering from mental illness. People suffering from diseases

Table 2. Factors of falls by using multivariable Cox proportional hazard regression model

Variables	Crude HR	95% CI	P-value	Adjusted HR	95% CI	P-value
Groups						
Non veterans	Reference			Reference		
Veterans	1.369	1.351-1.388	<0.001	1.252	1.234-1.270	<0.000
Gender						
Female	Reference			Reference		
Male	0.599	0.590-0.608	<0.001	0.577	0.568-0.586	<0.001
Age group (years)						
65-74	Reference			Reference		
75-84	1.366	1.344-1.388	<0.001	1.081	1.064-1.099	<0.001
≥85	1.520	1.491-1.549	<0.001	1.057	1.036-1.078	<0.001
Season						
Spring	Reference			Reference		

of the eyes had 1.225 times (P<0.001) the risk of falls of people not suffering from diseases of the eyes.

Summer	1.064	1.046-1.083	<0.001	1.075	1.056-1.093	<0.001
Autumn	1.052	1.032-1.073	<0.001	1.046	1.026-1.066	<0.001
Winter	1.082	1.064-1.101	<0.001	1.079	1.061-1.098	<0.001
Urbanization						
High	Reference			Reference		
Medium	1.250	1.231-1.273	<0.001	1.170	1.149-1.190	<0.001
Low	1.439	1.418-1.472	<0.001	1.136	1.113-1.160	<0.001
Level of Care						
Non-Medical center	Reference			Reference		
Medical center	0.608	0.598-0.617	<0.001	0.706	0.694-0.718	<0.001
Hospital Type *vs* Without (Ref)						
Veterans Hospital	0.917	0.899-0.934	<0.001	0.870	0.851-0.890	<0.001
ISS≥16 *vs* Without (Ref)	2.988	2.826-3.158	<0.001	3.076	2.884-3.225	<0.001
Comorbidities *vs* Without (Ref)						
Mental disorder	2.305	2.271-2.340	<0.001	1.730	1.703-1.757	<0.001
Eye disease	1.404	1.379-1.429	<0.001	1.225	1.203-1.247	<0.001
HTN	2.073	2.043-2.104	<0.001	1.560	1.535-1.585	<0.001
Hyperlipidemia	1.210	1.185-1.235	<0.001	0.890	0.871-0.909	<0.001
Atherosclerosis	1.337	1.291-1.385	<0.001	1.064	1.027-1.102	<0.001
COPD	1.572	1.551-1.593	<0.001	1.249	1.231-1.267	<0.001
IHD	1.550	1.529-1.571	<0.001	1.120	1.117-1.101	<0.001
HF	1.535	1.512-1.559	<0.001	1.096	1.078-1.114	<0.001
CD	1.735	1.712-1.758	<0.001	1.258	1.239-1.276	<0.001
RA	1.770	1.728-1.813	<0.001	1.371	1.338-1.405	<0.001
PUD	1.632	1.596-1.668	<0.001	1.139	1.113-1.165	<0.001
Liver Disease	1.305	1.280-1.331	<0.001	1.164	1.142-1.188	<0.001
DM	1.441	1.421-1.460	<0.001	1.109	1.093-1.124	<0.001
Hemiplegia	1.475	1.439-1.511	0.027	1.029	1.003-1.055	<0.001
CKD	1.416	1.395-1.438	<0.001	1.140	1.122-1.158	<0.001
Cancer	0.900	0.886-0.914	0.061	1.015	0.999-1.030	<0.001

HR = Hazard ratio; CI = Confidence interval; Adjusted HR: Adjusted hazard ratio: Adjusted for the variables listed in Table 2.The comorbidities listed in the Table S1.

Table 3 shows the results of a stratified analysis of the variables and reveals that, after controlling for factors such as comorbidities/complications, regardless of sex, age, season, level of urbanization, hospital grade, whether hospitalization occurred at a veteran's hospital, severity of the injury, whether the subject suffered from mental illness, or whether the subject suffered from diseases of the eyes, veterans had a higher risk of falls than non-veterans, and their risk was 1.155-1.478 times higher than that of non-veterans. In particular, in the male group, veterans had 1.299 times (P<0.001) the risk of falls of non-veterans; in the 75-84-year-old age group, veterans had 1.313 times (P<0.001) the risk of falls of non-veterans; among those with diseases of the eyes, veterans had 1.362 times (P<0.001) the risk of falls of non-veterans; and among those suffering from mental illness, veterans had 1.300 times (P<0.001) the risk of falls of non-veterans. Furthermore, among comorbidities/complications, in the atherosclerotic disease group, veterans had 1.478 times (P<0.001) the risk of falls of non-veterans; and in the group with paralysis of the limbs, veterans had 1.356 times (P<0.001) the risk of falls of non-veterans.

Table 3. Factors of falls stratified by variables listed in the table by using Cox proportional hazard regression model

Falls (with vs. without)	Group						Adjusted		
	Veterans			Non Veterans					
Stratified	Event	PYs	Rate	Event	PYs	Rate	HR	95% CI	P-value
Total	35,454	2,765,101	1,282	55,037	5,917,965	930	1.252	1.234-1.270	<0.001
Gender									
Female	8,336	456,003	1,828	14,705	978,524	1,503	1.155	1.123-1.188	<0.001
Male	27,118	2,309,098	1,174	40,332	4,939,441	817	1.299	1.277-1.322	<0.001
Age group (years)									
65-74	6,134	562,055	1,091	17,155	2,241,756	765	1.279	1.240-1.320	<0.001
75-84	20,343	1,546,602	1,315	26,621	2,689,604	990	1.313	1.288-1.339	<0.001
≧85	8,977	656,444	1,368	11,261	986,605	1,141	1.197	1.161-1.234	<0.001
Season									
Spring	11,637	946,772	1,229	18,124	2,042,393	887	1.242	1.210-1.274	<0.001
Summer	8,970	680,735	1,318	13,782	1,458,123	945	1.279	1.242-1.316	<0.001
Autumn	6,153	490,355	1,255	9,637	1,006,877	957	1.227	1.1851.270	<0.001
Winter	8,694	647,239	1,343	13,494	1,410,573	957	1.260	1.224-1.298	<0.001
Urbanization									
High	7,599	593,925	1,279	12,570	1,773,595	709	1.399	1.358-1.440	<0.001
Medium	21,229	1,707,959	1,243	24,874	2,625,440	947	1.202	1.178-1.226	<0.001
Low	6,626	463,217	1,430	17,593	1,518,930	1,158	1.238	1.202-1.276	<0.001
Level of care	11,275	1,130,666	997	11,848	1,999,510	593	1.320	1.282-1.360	<0.001
Veterans Hospital	9,824	1,849,264	531	2,580	362,185	712	1.236	1.182-1.294	<0.001
ISS>16	323	8,403	3,844	940	32,190	2,920	1.170	1.022-1.339	<0.001
Mental disorder	10,949	480,604	2,278	13,006	699,930	1,858	1.300	1.264-1.336	<0.001
EYE disorder	7,953	511,495	1,555	7,083	578,155	1,225	1.362	1.314-1.411	<0.001
Atherosclerosis	1,468	85,603	1,715	1,808	154,270	1,172	1.478	1.371-1.595	<0.001
Hemiplegia	2,632	145,320	1,811	4,513	338,864	1,332	1.356	1.286-1.429	<0.001

PYs = Person-years; Adjusted HR = Adjusted Hazard Ratio: Adjusted for the variables listed in Table2; Rate=per 100,000 PYs; CI = confidence interval.

The comorbidities listed in the Table S1.

In Table S2, Model 1 shows that veterans had 1.252 times (P<0.001) the risk of falls of non-veterans after controlling for factors such as comorbidities/complications, and Model 2 shows that when the stratification was performed based on the dependent variable (cause of fall-related injury), veterans had 1.171 times (P<0.001) the risk of falls from a height of non-veterans, and 1.193 times (P<0.001) the risk of falls on the same level of non-veterans. Model 3 shows that when the stratification was performed based on the number of falls, veterans had 1.229 times (P<0.001) the risk of a single fall of non-veterans and 1.290 times (P<0.001) the risk of recurrent falls of non-veterans.

DISCUSSION

This study was Taiwan's first long-term follow-up study seeking to gain an understanding of falls in veterans, and the results showed that 35,454 veterans suffered falls (9.5%) during the research period, while 55,037 non-veterans suffered falls (7.4%) during the same period, indicating that veterans had 1.252 times (P<0.001) the risk of falls of non-veterans. In a 2015 cross-sectional study of injuries in 287,113 veterans and non-veterans receiving emergency care, veterans had a higher incidence of emergency care than non-veterans (5.1% vs. 4.0 %, P<0.001) [29], which was consistent with the findings of this study. Moreover, another study of falls in veteran's care centres found a 17.2% incidence of falls, [14] which was higher than the incidence in this study (9.5%). The study in question consisted solely of a self-completed questionnaire survey (concerning falls) of 940 veterans in eastern Taiwan, the sample was small, and the study only investigated output information. In contrast, the present study focused on patients who had been hospitalized with confirmed physician's diagnoses and constituted a large sample, which may account for the differences in findings with the prior study. Most past research on veterans has consisted of cross-sectional studies or questionnaire surveys with a short study length and small sample size. There have been few longitudinal studies of falls in veterans. The findings of this study help to make up for the shortcomings of the aforementioned research.

A stratified analysis by age revealed that veterans at all three age levels had a greater risk of falls than non-veterans, and veterans in the 75-84-year-old age group had 1.313 times the risk of falls of non-veterans. In contrast, a 2009 study of inpatient medical utilization by elderly fall patients over the age of 65 years indicated that the largest proportion of the patients were in the 75-84-year-old age group (46.5%) [30], but the study did not analyse veterans as a separate category. Furthermore, a 2016 paper concerning emergency care of injuries found that a higher percentage of male veterans receiving care for injuries were in the 75-84-year-old age group (51.7%, $P<0.001$) than the other age groups (65-74 years: 34.8%; ≥85 years: 13.5%) [29], which was similar to the finding of this study (54.5%); however, the previous study did investigate differences in risk of fall-related injuries between veterans and non-veterans. The present study discovered that veterans in the 75-84-year-old age group hospitalized for falls had a longer hospital stay than non-veterans (9.13 days vs. 8.75 days), had slightly higher average inpatient medical expenditures than non-veterans (NT$ 59,800 vs. NT$ 59,500), and was a high-risk group for recurrent falls. According to data from the Veterans Affairs Council, most veterans in the 75-84-year-old age group were senior veterans (born prior to 1934) and took part in the war of resistance against Japan; [3] it will be worthwhile to conduct a further longitudinal study determining whether the disabilities resulting from wartime service have caused these veterans to have a greater risk of falls than non-veterans.

The results of this study show that although veterans were older than nonveterans (80.1 vs 77.0 years old), their incidence of an ISS score of ≧16 was lower than that of nonveterans (0.3% vs 0.6%). A possible inferred cause is that veterans received complete military training while in service and hence could react more quickly and maintain a relatively ideal physical condition. (A re-analysis of the data showed that amongst the subjects who had fallen, the ratio of osteoporosis amongst the veterans and nonveterans was 4.8% vs 5.2%, respectively (P<0.001). (See the table S3 for a cross-analysis of the two groups and osteoporosis.) In addition, the living environment of the veterans could offer better protection (such as soft floors, amongst others) and related healthcare professionals for most of the veterans (veteran homes) [31] to offer immediate management and assistance in quickly sending them to the hospital for medical treatment as soon as they fall. This is why the incidence of veterans with more severe injuries (an ISS score of ≧16) was lower than that of nonveterans (0.3% vs 0.6%, as shown in the table below). Given the limitations of the secondary data, this type of correlation is worthy of further study.

The study results showed that urbanization is also a risk factor for falls amongst veterans. We further cross-analysed the extent of urbanization versus mental disorders, and the results showed that the ratio of mental disorders amongst veterans living in areas with a relatively low extent of urbanization was higher than that amongst veterans in highly urbanized areas (24.0% vs 14.6%; see table S4). This finding is similar to that of a study

amongst veterans in the US (the incidence of mental disorders amongst veterans living in agricultural areas and that amongst those in urban areas was 23.69% and 16.68%, respectively). The above study also indicated that fewer veterans in agricultural areas received psychotherapy than in urban areas. [32] Therefore, providing mental health care services to veterans in areas with a low extent of urbanization may be something that can be addressed by the Taiwan VAC for the current stage.

This study found that a significantly higher percentage of veterans suffered from mental illness than non-veterans (16.5% vs. 11.3%; P<0.001). A 2014 retrospective study of the psychological treatment of veterans using data from the US Veterans Health Administration (VHA) healthcare system discovered that the percentage of veterans receiving psychological treatment increased with age, and the frequency of psychological treatment also increased with time. [33] Our study found that veterans suffering from mental illness had 1.300 times the risk of falls of non-veterans. Past research has indicated that emotional disorders (such as depression and neurological disorders) may cause falls by affecting activities and the sense of balance. [16, 24, 25] This study's stratified analysis of the effect of mental illness further discovered that veterans with depression had 1.366 times the risk of falls of non-veterans (adjusted HR=1.366, 95% CI=1.283-1.454, P<0.001), while veterans with anxiety disorder had 1.317 times the risk of falls of non-veterans (adjusted HR=1.317, 95% CI=1.201-1.443; P<0.001) (Table S5). Furthermore, depression (adjusted

HR=1.938, P<0.001, 95% CI=1.793-2.094) (Table S6)was a predictor of recurrent falls in veterans; this result was somewhat similar to the findings of past research, which found that depression is a risk factor for falls in veterans and also for recurrent falls. [14]

A study of elderly persons in the community found that individuals with depression in conjunction with chronic diseases (cardiovascular disease, diabetes, arthritis) had a greater risk of falls than individuals who neither had depression nor suffered from chronic disease (3.95 times, 4.25 times, 9.66 times). [34] Further analysis in this study found that elderly individuals with depression together with HT or COPD or CD or RA had a greater risk of falls (2.262 times, 1.829 times, 1.867 times, 1.849 times) (Table S7)than those elderly individuals who neither had depression nor suffered from chronic disease.

The US Medical records of veterans reveal "that one in three patients was diagnosed with at least one mental health disorder- 41% were diagnosed with either a mental health or a behavioral adjustment disorder". [35] In addition, the research indicates that people with mental disorders (such as depression and anxiety) tend to develop negative sentiments and suffer from sleep disorders, amongst other symptoms. [36] The presence of sleep disorders (such as insomnia and fewer hours of sleep) leads to deteriorated physical coordination and reactivity and, hence, tends to increase the risk of falls. [37] Further data analysis in this study shows that the incidence of sleep disorders was higher amongst veterans than amongst nonveterans (0.9% vs 0.7%).

In addition, prior studies have pointed out that prescriptions for mental disorders (including anti-depressants, anti-psychotics, sedatives, or tranquillizers) also increase the risk of falls [38-41] However, medication amongst veterans was not explored in this study and will require clarification in subsequent studies.

In summary, apart from physiological (physical) issues, mental illness in veterans is a hidden problem that nevertheless should be taken seriously. This study infers that because veterans lose their social status after discharge, may have few interpersonal interactions, and may suffer from physiological stress due to the infirmity of old age, when veterans can no longer live independently, their unwillingness to leave their familiar environment and receive care in a veterans nursing home may be accompanied by mental illness such as depression and anxiety. The findings of this study support this phenomenon. In addition, the interaction of physiological and mental disorders will also increase the risk of falls. We therefore recommend that screening for mental illnesses such as depression be included when assessing risk of falls in the elderly. To summarize the abovementioned analyses, the Taiwan VAC can refer to the US VHA Measurement-based care (MBC) for related practices [42] and establish a complete monitoring system to precisely track the mental health, sleep problems, and medication use of veterans to protect against falls.

A health survey of the residents of veteran's care centers in Taiwan found that 73% of veterans had vision not exceeding 0.1, which implies that they would have difficulty reading

books and newspapers. [26] This study found that veterans with diseases of the eyes had a greater risk of falls than non-veterans, and among fall patients, significantly higher percentages of veterans had cataracts (12.7% vs. 4.7%; P<0.001) and glaucoma (2.3% vs. 1.1%, P<0.001) than non-veterans. Further analysis revealed that veterans with cataracts had 1.378 times the risk of falls of non-veterans with cataracts (adjusted HR=1.378, 95%CI=1.306-1.453, P<0.001). Similarly, veterans with glaucoma had 1.414 times the risk of falls of non-veterans with glaucoma (adjusted HR=1.414, 95%CI=1.259-1.588, P<0.001). While research has indicated that cataracts are an independent risk factor for falls in veterans, [14] this study found that cataracts (adjusted HR=1.322, P<0.001, 95%CI=1.237-1.412) are also a predictor of recurrent falls in veterans. Further research is needed to verify whether veterans' diseases of the eyes are a consequence of the long-term exposure of the lens to UV radiation while participating in field training or at other times during their period of service, or a result of poor control of chronic diseases, or are induced by the severity of their diseases.

The results of this study show that eye disease (including cataracts and glaucoma) is a risk factor for falls amongst veterans (Table S5), and cataracts is also a predictor of recurrent falls (Table S6).Meanwhile, the living environment (lighting equipment) may be a factor affecting falls as well. [43] Therefore, the Taiwan VAC should help veterans seek medical attention at a hospital ophthalmology department periodically [44] and should also focus

on improving the environment (indoor lighting equipment) to protect against falls. This study discovered that veterans had higher levels of all comorbidities/complications (including hypertension, cardiovascular disease, cerebrovascular disease, lung disease, arthritis, gastrointestinal disease, diabetes, liver disease, kidney disease, among others) than non-veterans. A 2013 cross-sectional study suggested that cerebrovascular disease and gouty arthritis are independent risk factors for falls in veterans, [14] which is consistent with this study. Foreign research has also indicated that veterans over the age of 65 years have more comorbidities/complications than veterans under the age of 65 years. [45] Our study findings indicate that among persons with comorbidities/complications, veterans have a greater risk of falls than non-veterans, which underscores the importance of chronic disease prevention and rehabilitation exercises as veterans age.

This study made the further discovery that among fall-related injuries, veterans had a greater incidence of both falls from a height and falls at the same level than non-veterans. Furthermore, veterans had 1.29 times ($P<0.001$) the risk of recurrent falls of non-veterans, and during the 2000-2013 period, each veteran had 4.07 falls, which was significantly greater than the falls of non-veterans (3.88 times). Moreover, the average hospital stay (9.13 days) and medical expenditures (NT$ 59,000) of veterans with falls were both higher than those of non-veterans (8.77 days and NT$ 58,000), and the percentage of veterans who died while hospitalized (3.7%) was also higher than that of non-veterans (2.8%) (Table S8). To

summarize the foregoing research findings, veterans constitute a high-risk group for falls among the general elderly population and have relatively high medical utilization after suffering falls.

The strengths of this study include a sufficiently large research sample and a tracking period of 14 years, as well as the ability to compare the risk of falls among veterans and non-veterans and confirm factors affecting falls in veterans. However, despite these strengths, this study also had the following limitations. First, this study was limited by the format of the data in the National Health Insurance Research Database and could not obtain other important information related to falls (such as the (widows or widowers), living environment (lighting equipment), patient weight, dietary intake, muscular endurance, and degree of disability). Second, this study analysed inpatient files in the National Health Insurance Research Database and was unable to estimate the percentages of individuals who did not receive care or who only received outpatient/emergency care; thus, this study may have underestimated the number of cases.

CONCLUSION

Veterans had 1.252 times the risk of falls and 1.290 times the risk of recurrent falls of non-veterans. In addition, veterans also had longer inpatient stays and higher medical expenditures and death rates than non-veterans. Age (especially the 75-84-year-old age group), urbanization, comorbidities/complications, mental illness, and diseases of the eyes

were risk factors for falls in veterans, and depression and cataracts were predictors of recurrent falls. Apart from implementing preventive measures targeting high-risk groups, the responsible authorities should also seek to reduce the risk of falls among veterans by resolving their psychological and physiological issues.

Declarations

Authors' Contributors

All authors (PHJ, YLC, CHC, Kao, and CWC) designed the study. Data analyses and interpretation were performed by PHJ, and CWC. Kao and CWC drafted and revised the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Patient Consent

Not required.

Ethics approval

The study protocol was approved by the approval institutional review board, Tri-Service General Hospital. (TSGHIRB No. 1-105-05-142).

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

No additional unpublished data from this study.

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Figure 1. The flowchart of study sample selection from National Health Insurance Research Database in Taiwan

Figure 2. Kaplan-Meier for cumulative risk of fall in 14-year tracking stratified by Veterans with log-rank test

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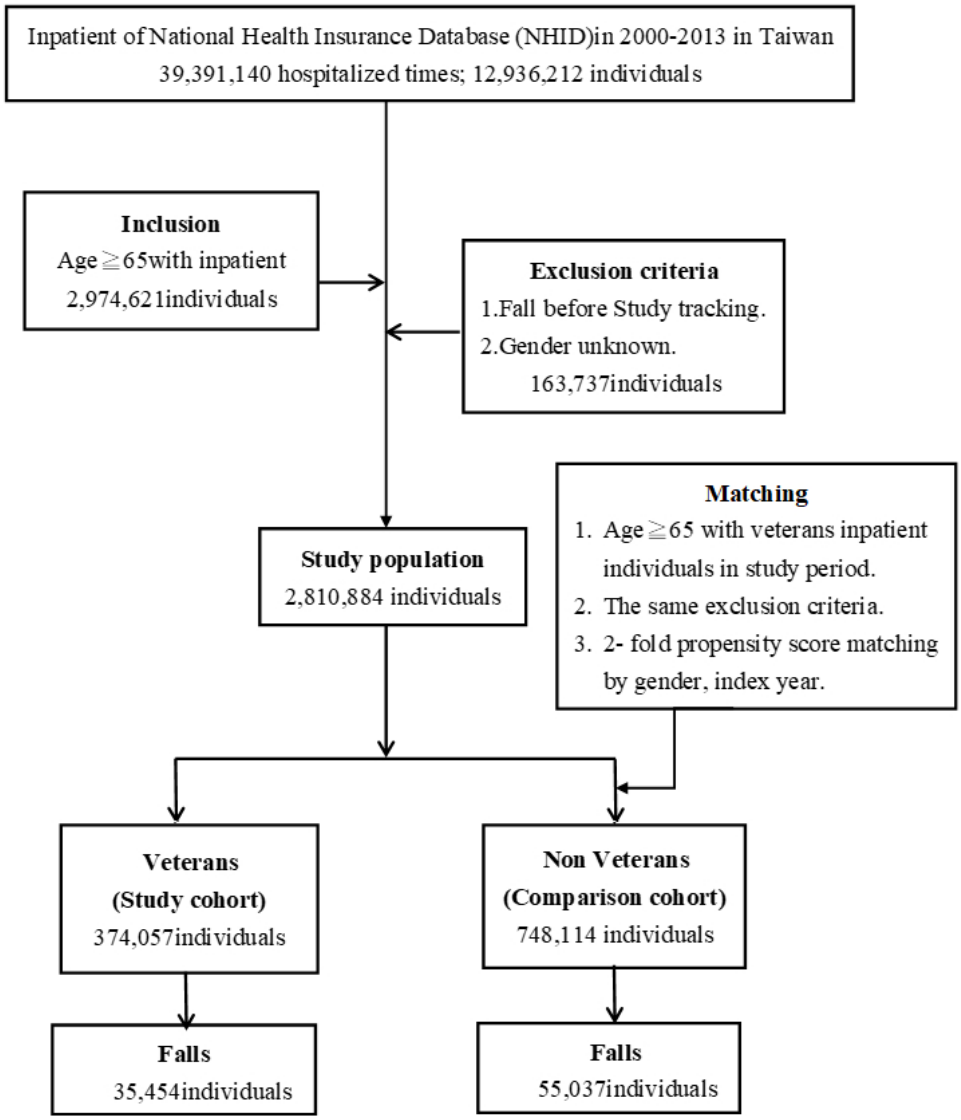

Figure1.The flowchart of study sample selection from National Health Insurance Research Database in Taiwan

131x149mm (144 x 144 DPI)

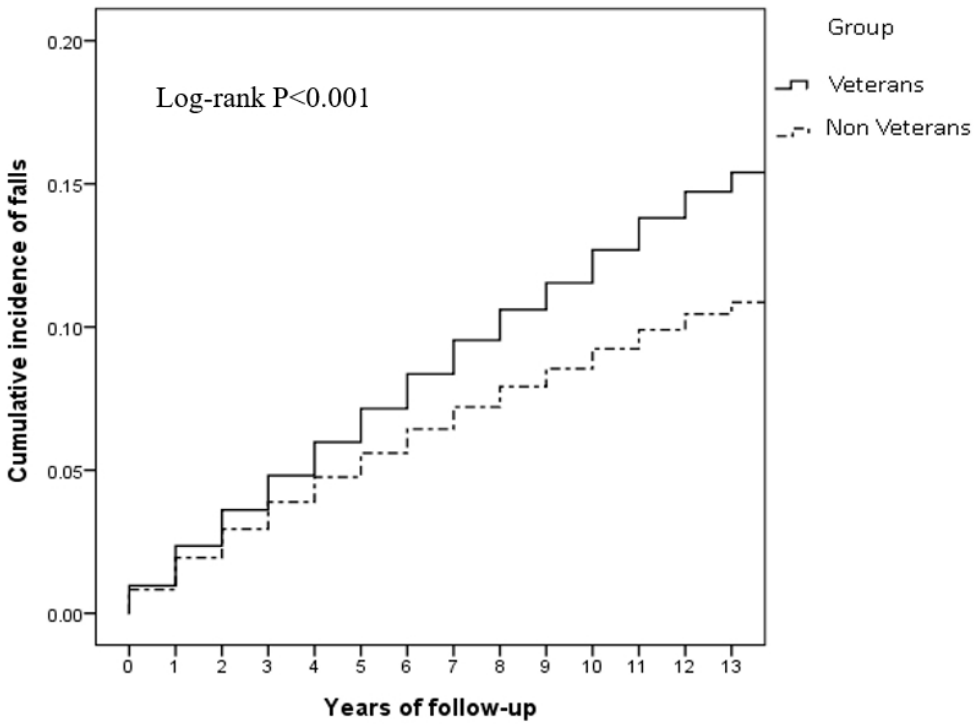

Figure2.Kaplan-Meier for cumulative risk of fall in 14-year tracking stratified by Veterans with log-rank test

144x107mm (144 x 144 DPI)

Appendices: Supplementary materials

Perng et al., Fall and risk factors for veterans and nonveterans inpatients over the age of 65: 14 years of long-term data analysis

- Table S1.Abbreviation and ICD-9-CM / NHI order code
- Table S2. Factors of falls by using Cox proportional hazard regression in different model
- Table S3 Prevalence of osteoporosis in veterans and nonveterans who experienced falling
- Table S4. Analysis of veterans with mental disorders and urbanization
- Table S5. Risk factors of falls stratified by variables listed in the table based on the Cox regression analysis
- Table S6. Risk factors of recurrent falls by multivariable cox proportional hazard regression amongst veterans
- Table S7. Analysis between depression and chronic diseases
- TableS8. Comparison the medical utilization of falling between veterans and nonveterans

Table S1. Abbreviation and ICD-9-CM / NHI order code

Variables	Abbreviation	ICD-9-CM / NHI order code
Events		
Falls		880-888
From the different level		880-884
On the same level		885-886
Unspecified		887-888
Comorbidities		
Mental disorder		290-319
Eye disease		360-379
Hypertension	HTN	401–405
Hyperlipidemia		272
Atherosclerosis		440
Chronic obstructive pulmonary disease	COPD	490–496
Ischemic heart disease	IHD	410–414
Heart failure	HF	428
Cerebrovascular disease	CD	430-438
Rheumatism	RA	725-729
Peptic ulcer disease	PUD	533
Liver disease		571
Diabetes mellitus	DM	250
Hemiplegia		342-344
Chronic kidney disease	CKD	580-589
Cancer		140–239

Table S2. Factors of falls by using Cox proportional hazard regression in different model

Model	Variables	Adjusted HR	95% CI	*P-value*
Model 1	Falls	1.252	1.234-1.270	<0.001
Model 2	Falls			
	From the different level	1.171	1.122-1.222	<0.001
	On the same level	1.193	1.171-1.215	<0.001
	Unspecified	1.451	1.410-1.493	<0.001
Model 3	Single Fall	1.229	1.208-1.249	<0.001
	Recurrent Falls	1.290	1.250-1.331	<0.001

Abbreviations: HR=hazard ratio, CI=confidence interval, Adjusted HR: Adjusted for the variables listed in Table 2.

Table S3 Prevalence of osteoporosis in veterans and nonveterans who experienced falling

Osteoporosis	Group		Total	P-value
	Non veterans (%)	Veterans (%)		
Without	521,699 (4.8)	33,747 (95.2)	85,916 (94.9)	
With	2,868 (5.2)	1,707 (4.8)	4,575 (5.1)	<0.001
Total	55,037 (100)	35,454 (100)	90,491 (100)	

Table S4 Analysis of veterans with mental disorders and urbanization

Mental disorder	Urbanization			Total	P-value
	Low (%)	Midian (%)	High (%)		
Without	46,337 (76.0)	195,596 (84.8)	70,274 (85.4)	312,207 (83.5)	
With	14,660 (24.0)	35,195 (15.2)	11,995 (14.6)	61,850 (16.5)	<0.001
Total	60,997 (100.0)	230,791 (100.0)	82,269 (100)	374,057 (100)	

Table S5. Risk factors of falls stratified by variables listed in the table based on the Cox regression analysis

Group	Veterans			Non Veterans			Adjusted HR	95% CI	P-value
Stratified	Event	PYs	Rate	Event	PYs	Rate			
Mental disorder									
Depression	2,551	105,775	2,412	2,250	115,801	1,943	1.366	1.283-1.454	<0.001
Anxiety	1,110	52,259	2,124	1,051	64,946	1,618	1.317	1.201-1.443	<0.001
EYE disorder									
Cataract	4,502	307,007	1,466	2,573	212,489	1,211	1.378	1.306-1.453	<0.001
Glaucoma	820	51,179	1,602	606	50,345	1,204	1.414	1.259-1.588	<0.001

PYs = Person-years; Adjusted HR = Adjusted Hazard ratio: Adjusted for the variables listed in Table 2; Rate = per 100,000 PYs; CI = confidence interval.

Table S6. Risk factors of recurrent falls by multivariable cox proportional hazard regression amongst veterans

Variables	Adjusted HR	95 % CI	*P-value*
Depression	1.938	1.793-2.094	<0.001
Cataract	1.322	1.237-1.412	<0.001

HR = Hazard ratio CI = confidence interval, AHR: Adjusted Hazard ratio: Adjusted for the variables listed in Table 2; comorbidities are listed in Table S1.

Table S7. Analysis between depression and chronic diseases

Variables	Reference	Adjusted HR	95% CI	P-value
Depression + HT	No Depression + No HT	2.260	2.211-2.375	<0.001
Depression + COPD	No Depression + No COPD	1.829	1.745-1.898	<0.001
Depression + CD	No Depression + No CD	1.867	1.793-1.946	<0.001
Depression + RA	No Depression + No RA	1.849	1.708-1.985	<0.001

HR = Hazard ratio CI = confidence interval, Adjusted HR: Adjusted Hazard ratio: Adjusted for the variables listed in Table 2; comorbidities are listed in Table S1.

Table S8 Comparison the medical utilization of falling between veterans and nonveterans

variables	Total Mean ± SD	Veterans Mean ± SD	Nonveterans Mean ± SD	P-value
Length of day*	8.92 ± 8.72	9.13 ± 8.83	8.77 ± 8.65	<0.001
Medical cost(NT$)*	58,905 ± 77,292	58,997 ± 78,218	58,845 ± 76,690	<0.773
Death (%)	2,846 (3.25)	1,297 (3.7)	1,549 (2.8)	<0.001

Chi-square/Fisher exact test on category variables and *t-test on continue variables.

SD: standard deviation

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (*b*) For matched studies, give matching criteria and number of exposed and unexposed	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	8-9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (*b*) Describe any methods used to examine subgroups and interactions (*c*) Explain how missing data were addressed (*d*) If applicable, explain how loss to follow-up was addressed (*e*) Describe any sensitivity analyses	10
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	11
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	11-13
Outcome data	15*	Report numbers of outcome events or summary measures over time	14-15

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	15-16
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	17
Discussion			
Key results	18	Summarise key results with reference to study objectives	18-25
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	25-26
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	26
Generalisability	21	Discuss the generalisability (external validity) of the study results	26-27
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	28

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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Fall and risk factors for veterans and nonveterans inpatients over the age of 65: 14 years of long-term data analysis

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Fall and risk factors for veterans and nonveterans inpatients over the age of 65: 14 years of long-term data analysis

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ABSTRACT

Introduction: Falls are one of the most important causes of injuries and accidental deaths among this segment of over the age of 65 years.

The long-term follow-up study of fall-related injuries was conducted in elderly veterans over the age of 65 years, and the risk of falls in veterans and non-veterans was compared.

Methods: This study used the National Health Insurance Research Database for the period from 2000-2013 in Taiwan. this longitudinal study tracked falls in veterans over the age of 65 years, designated a control group (non-veterans), using 1:2 pairing on the basis of sex and time receiving medical care, and used Cox regression to analyze and compare the risk of falls among veterans and non-veterans.

Results: This study subjects consisted of 35,454 of the veterans had suffered falls (9.5%), as had 55,037 of the non-veterans (7.4%). After controlling for factors such as comorbidities/complications, the veterans had 1.252 times the risk of falls of the non-veterans, Furthermore, among persons in the 75-84-year-old age group, veterans had 1.313 times the risk of falls of non-veterans, and among persons with mental illnesses and diseases of the eyes, veterans had 1.300 and 1.362 times the risk of falls of non-veterans. In addition, each

veteran had an average of 4.07 falls during the 2000-2013 period, which was significantly higher than in the case of non-veterans (3.88 falls).

Conclusions: Veterans' risk of falls and recurrent falls were both higher than those of non-veterans, and age level, comorbidities/complications, and level of low urbanization were all important factors affecting veterans' falls. The responsible authorities should, therefore, use appropriate protective measures to reduce the risk of falls and medical expenses in high-risk groups.

Keywords：Veteran; Falls; National Health Insurance Research Database.

Strengths and limitations of this study

►► This is the first nationwide population-based cohort study to assess the falls injury associations between Veterans and nonveterans.

►►The strengths of this study include a sufficiently large research sample and a tracking period of 14 years, as well as the ability to compare the risk of falls among veterans and non-veterans and confirm factors affecting falls in veterans.

►► This study cohort is large enough to examine each risks of fall injury among subgroups.

►► The limitation of this study is the lack of information on the detailed patient characteristics and could not obtain other important information related to falls (such as the living environment, muscular endurance, and degree of disability).

INTRODUCTION

Falls are the second leading cause of death among accidental injuries worldwide. According to 2018 WHO data, as many as 646,000 persons die from falls annually, and elderly persons over the age of 65 constitute the age group with the highest incidence of fall-related deaths.[1] In Taiwan, according to the 2017 annual report on the cause of death statistics issued by the Ministry of Health and Welfare, Executive Yuan, falls were the second leading cause of death among accidental injuries in 2017.[2] According to data from the Veterans Affairs Council, as of the end of 2017, veterans over the age of 65 years accounted for approximately 50% of all veterans and 6.14% of Taiwan's elderly population over the age of 65 years.[3] Furthermore, the health insurance participation of veterans over the age of 65 years accounts for 7.7% of that of all persons over the age of 65 years in Taiwan. [4] As a consequence, veterans constitute an important subgroup of elderly persons with relatively high healthcare needs.

According to research conducted in the United States, in 2012, 3.2 million people were injured in non-fatal falls (incurring medical expenses of US$ 30.3 billion), and 24,190 people died due to falls (incurring direct medical expenses of US$ 616.5 million); these figures increased to US$ 31.3 billion and US$ 637.5 million in 2015, and the incidence of falls and total medical expenses increased with age.[5] A research survey of elderly people in the US found that 78% of falls could be attributed to two or more risk factors, and the

greater the number of risk factors was, the greater the probability of a fall;[6] risk factors for falls include sex, age, socioeconomic status, environment, and physiological condition (poor vision, chronic illness, and poor balance). [7-9] According to the 2014 research of Clegg et al., risk factors for falls include a poor living environment, use of multiple medications, lack of vitamin D, comorbidities, sarcopenia or frailty, and impaired sensory system.[10] In addition, a 2017 cross-sectional study (Paliwal et al) of the relationship between chronic disease and falls among community seniors over the age of 65 years, involving the use of the Behavioural Risk Factor Surveillance System (BRFSS), found that the incidence of falls during the previous one-year period among people with such chronic diseases, such as stroke (adjusted OR=1.61), chronic kidney disease (adjusted OR=1.27), arthritis (adjusted OR=1.61), depression (adjusted OR=2.26), and diabetes (adjusted OR=1.32), was uniformly higher than in people without these diseases,[11] and whether assistive equipment was used was also a factor affecting falls.[12] In Taiwan, according to Chien et al., the 518,601 elderly persons hospitalized for injuries between 2005 and 2007 had an average age of 76.1, and 209,860 of these people (40.5) had fall-related injuries, making falls the chief cause of injuries.[13] Furthermore, in a study analysing factors associated with falls among 940 veterans at four veteran's care centres in eastern Taiwan during the 2009-2010 period, Ku et al. found that falls and recurrent falls had incidences of 17.2% and 6.9%, respectively; age, depression, stroke, gouty arthritis, and cataracts were

independent risk factors for falls, and depression was a risk factor for recurrent falls (adjusted OR=1.22).[14] In summary, a few large studies have examined veterans as subjects, and most of the research consisted of cross-sectional studies and questionnaire surveys. In contrast, we employed a long-term longitudinal study to analyse the risk of fall-related injuries, and we hope that this approach can help mitigate the shortcomings of the foregoing literature.

In Taiwan, after their discharge, veterans who spent their careers in the armed forces to contribute to their country face diseases of old age, and their fall-related injuries are also an issue of concern. Jobless veterans receive various benefits from the Veterans Affairs Council and enjoy exemption from health insurance co-payments. [3] While some literature has investigated issues such as chronic diseases acquired after discharge, [15] mental illness, [16] life satisfaction, [17] and medical utilization [18, 19] in some elderly veterans with wartime experience, there has been an absence of long-term follow-up studies of fall-related injuries in veterans. What is the risk of a fall among veterans? Does the risk of a fall among veterans differ from that among the general population? This study sought to investigate these questions. Accordingly, veterans over the age of 65 years during the 2000-2013 period were included as subjects in a long-term follow-up epidemiological study of fall-related injuries, and the risks of falls among veterans and non-veterans were compared.

METHODS

Data sources

Taiwan's National Health Insurance (NHI), which was introduced in 1995, records the medical data of all insured people, covering more than 99% of the 23 million people in Taiwan. As a result, the NHI data constitute an important resource for research concerning clinical medicine and public health.[20-21] Because the outpatient and emergency care files in the National Health Insurance Research Database (NHIRD) provide only injury diagnostic data, but not the causes of injuries, while hospitalization files provide information concerning the causes of injuries, this study accordingly performed string analysis of data in the NHIRD's "inpatient expenditures by admissions (DD)," "registry for contracted medical facilities (HOSB)," "major injury and illness (HV)," and "underwriting data details (ID)" files for the period from 2000 to 2013. This study was approved after a complete ethical review by the Institutional Review Board of National Defense Medical Center Tri-Service General Hospital and the informed consent was not necessary. (TSGHIRB No:1-105-05-142)

Patient and Public Involvement

Patient and public involvement Participants were not involved in the design or conduct of this study.

Study design and participants

This study included "jobless" veterans ("veterans") over the age of 65 years as the members of the case group. To ensure that the cases represented newly occurring falls, we excluded falls during the 1997-1999 period, and the study period was extended from January 1, 2000 to December 31, 2013 (tracking end point). We employed a matching control design in which 1:2 pairing was performed on the basis of the veterans' sex, age and time receiving medical care, and we selected non-veterans with the corresponding criteria to serve as the control group. To obtain a sufficient number of nonveteran subjects aged 65 and older, the tolerance was set at 0.25.

Event occurrence

All cases were tracked to a fall accident (ICD-9-CM E code 880-888), loss of case during the research period (loss to follow up), or to the research end point on December 31, 2013.

Standards and definitions

The ages of the subjects in this study were the ages when the event (fall) occurred. The three age groups in this study consisted of 65-74 years, 75-84 years, and over 85 years. The severity of falls was judged on the basis of a trauma severity greater than 16 points (Injury Severity Score(ISS > 16) in the major injury and illness category in the major injury and illness (HV) files. Injury Severity Score (ISS): This anatomic rating system divides the human body into six anatomic parts (Head/Neck, Face, Thorax, Abdomen, Extremity, and External). Each section is scored from 1 to 5 (a higher score indicates

greater severity), and the three parts that are the most severe are selected. The respective scores are squared and then added together; the result is the ISS score of the respective patient (0-75, in which an ISS score of > 16 represents severe injuries).[22] The ISS of the study can be obtained from the National Health Insurance Research Database.[23] Because comorbidities/complications [10, 11, 18], mental illness [11, 16, 24, 25] and diseases of the eyes [11, 14, 26] are also risk factors for falls in the elderly, to clarify the influence of illnesses on falls among veterans and non-veterans, this study included commonly seen comorbidities/complications of the elderly in its regression model and controlled for mental illness (ICD-9-CM 290-319) and diseases of the eyes (ICD-9-CM 360-379). In addition, among environmental variables, the level of urbanization was classified as high, moderate, and low, the urbanization level of residence was defined according to the population and various indicators of the level of development. High was defined as a population of >1,250,000 and a specific designation as a political, economic, cultural, and metropolitan development. Medium was defined as a population between 500,000 and 1,249,999 and as playing an important role in the political system, economy, and culture. Low was defined as a population <499,999.[27,28] the season was classified as spring (March-May), summer (June-August), fall (September-November), and winter (December-February), the grade of hospital where the subject received care was classified as a medical centre or a non-medical centre, and the hospital was classified as a veteran

hospital or a non-veteran hospital. In accordance with the external factor code (ICD-9-CM E-code (E880-888)), the causes of injuries were classified as three types: fall from a height (E800-884), fall on the same level (E885-886), and other falls (E887-888). Recurrent falls were defined as two or more falls occurring within the research period (from 2000 to the end of 2013).

Statistical analysis

This study included veterans over the age of 65 years as research subjects, tracked the cause of their falls during the 2000-2013 period and type of injury, and found factors affecting the occurrence of their falls. Data analysis was performed using SPSS 22 statistical software (SPSS, Inc., Chicago, IL, USA); the Chi-square test was employed to compare categorical variables and the t-test was used to compare continuous variables in the two groups. Factors affecting falls were analysed by Cox's regression, while hazard ratios (HRs), 95% confidence intervals (CIs), and Kaplan-Meier survival curves were used to extract differences between the veteran and non-veteran groups. A P-value<0.05 was considered the standard for the assessment of significance.

RESULTS

Fig. 1 shows the case selection (inclusion and exclusion) and a tracking result flowchart. During the 2000-2013 period, a total of 2,974,621 elderly people over the age of 65 years were hospitalized in Taiwan; after excluding 163,737 people who were hospitalized for falls

during the period from 1997-1999, a total of 2,810,884 persons remained, which included 374,057 veterans and 748,114 non-veterans over the age of 65 years.

Table 1 shows the basic characteristics of the entire sample of 1,122,171 people (374,057 veterans and 748,114 non-veterans) at the tracking end point. The reported ages of the subjects in this study (Table 1) were the ages when the event (fall) occurred: on average, these ages were 78.0 ± 7.2 years old (veterans: 80.1 ± 6.5; nonveterans: 77.0 ± 7.3). The mean follow-up duration amongst all subjects in this study (2000-2013) was 7.7 years. By age group, the mean follow-up was 8.1 years amongst those aged 65 to 74, 7.5 years amongst those aged 75 to 84, and 6.3 years amongst those aged 85 and above. The time to fall (the event) since observation amongst the subjects was 4.5 years on average. For the three age groups, the time to fall was 5.1, 4.1, and 2.7 years, respectively. On average, 1.7% of subjects experienced recurrent falls. For the three age groups, this proportion was 1.2%, 2.0%, and 2.1%, respectively. The abovementioned data show that the duration of follow-up was longer (8.1 years) in the younger population (65-74 years old), and the ratio of recurrent falls was relatively low in this population as well (1.2%). However, the duration of follow-up was relatively short (6.3 years) for the old population (≥85 years old), and the ratio of recurrent falls in this age group was relatively high (2.1%) (data not shown). The percentage of veterans who suffered falls was significantly higher than that of non-veterans (9.5% vs. 7.4%, P<0.001), and they also had a significantly higher probability (risk) of falls

during the first year than non-veterans (log-rank test, P<0.001) (Fig.2). In addition, a significantly higher percentage of veterans than non-veterans lived in areas with a moderate level of urbanization and received care at a medical centre or a veteran's hospital.

Table 1. Characteristics of study in the endpoint

Variables	Group Total 1,122,171(100) N (%)	 Veterans 374,057(33.3) N (%)	 Non veterans 748,114(66.7) N (%)	*P-value*
Falls				<0.001
Without	1,031,680(91.9)	338,603(90.5)	693,077(92.6)	
With	90,491(8.1)	35,454(9.5)	55,037(7.4)	
Gender				<0.001
Female	228,402(20.4)	73,298(19.6)	155,104(20.7)	
Male	893,769(79.6)	300,759(80.4)	593,010(79.3)	
Age	78.0 ± 7.2	80.1 ± 6.5	77.0 ±7.3	<0.001
Age group (years)				<0.001
65-74	408,190 (36.4)	84,862(22.7)	323,328(43.2)	
75-84	514,627 (45.9)	203,872(54.5)	310,755(41.5)	
≥85	199,354 (17.8)	85,323(22.8)	114,031(15.2)	
Season				0.147
Spring	380,246 (33.9)	126,741(33.9)	253,685(33.9)	
Summer	278,254 (24.8)	92,434(24.7)	185,820(24.8)	
Autumn	197,359 (17.6)	66,188(17.7)	131,171(17.5)	
Winter	266,132 (23.7)	88,694(23.7)	177,438(23.7)	
Urbanization				<0.001
High	310,836 (27.7)	82,269(22.0)	228,567(30.6)	
Medium	561495 (50.0)	230,791(61.7)	330,704(44.2)	
Low	249,840 (22.3)	60,997(16.3)	188,843(25.2)	
Level of care				<0.001
Non-Medical center	713,792 (63.6)	220,496(58.9)	493,296(65.9)	
Medical center	408,379 (36.4)	153,561(41.1)	254,818(34.1)	
Veterans Hospital				<0.001
Without	949,503 (84.6)	249,175(66.6)	700,328(93.6)	
With	172,668 (15.4)	124,882(33.4)	47,786(6.4)	
ISS≥16				<0.001
Without	1116,550(99.5)	372,822(99.7)	743,728(99.4)	
With	5,621(0.5)	1,235(0.3)	4,386(0.6)	
Comorbidities				
Mental disorder	146,081(13.0)	61,850(16.5)	84,231(11.3)	<0.001
Eye disease	124,737(11.1)	58,711(15.7)	66,026(8.8)	<0.001
HTN	618430(55.1)	226751(60.6)	391679(52.4)	<0.001
Hyperlipidemia	98,427(8.8)	32,259(8.6)	66,168(8.8)	<0.001
Atherosclerosis	27848(2.5)	10458(2.8)	17390(2.3)	<0.001
COPD	310,717(27.7)	114,072(30.5)	196,645(26.3)	<0.001
IHD	319,667(28.5)	120,945(32.3)	198,722(26.6)	<0.001
HF	178,935(15.9)	65,725(17.6)	113,210(15.1)	<0.001
CD	307,914(27.4)	103,809(27.8)	204,105(27.3)	<0.001
RA	49,639(4.4)	19,159(5.1)	30,480(4.1)	<0.001
PUD	62,556(5.6)	24,517(6.6)	38,039(5.1)	<0.001
Liver disease	107,109(9.5)	32,387(8.7)	34,722(10.0)	<0.001
DM	336,143(30.0)	112,864(30.2)	223,279(29.8)	<0.001
Hemiplegia	55,355(4.9)	17,852(4.8)	37,503(5.0)	<0.001

CKD	207,519(19.5)	68,396(18.3)	139,123(18.6)	<0.001
Cancer	300,719(26.8)	96,669(25.8)	204,050(27.3)	<0.001

Chi-square/Fisher exact test on category variables and t-test on continue variables.
The comorbidities listed in the Table S1.

Table 2 shows the results of the univariate and multivariate analysis for factors affecting falls. After controlling for factors such as comorbidities/complications, veterans' subsequent (14 years) risk of falls was 1.252 times (P<0.001)that of non-veterans; the subsequent risk of falls among those in the 75-84 and 85-year-old and over age groups were 1.081 times (P<0.001)and 1.057 times (P<0.001)that of people in the 65-74-year-old age group; and the subsequent risk of falls of people living in areas with moderate and low urbanization were 1.170 times (P<0.001) and 1.136 times (P<0.001)that of people living in areas with high urbanization. People with mental illness had a risk of falls 1.730 times (P<0.001) that of persons not suffering from mental illness. People suffering from diseases

Table 2. Factors of falls by using multivariable Cox proportional hazard regression model

Variables	Crude HR	95% CI	P-value	Adjusted HR	95% CI	P-value
Groups						
Non veterans	Reference			Reference		
Veterans	1.369	1.351-1.388	<0.001	1.252	1.234-1.270	<0.000
Gender						
Female	Reference			Reference		
Male	0.599	0.590-0.608	<0.001	0.577	0.568-0.586	<0.001
Age group (years)						
65-74	Reference			Reference		
75-84	1.366	1.344-1.388	<0.001	1.081	1.064-1.099	<0.001
≥85	1.520	1.491-1.549	<0.001	1.057	1.036-1.078	<0.001
Season						
Spring	Reference			Reference		

of the eyes had 1.225 times (P<0.001) the risk of falls of people not suffering from diseases of the eyes.

Summer	1.064	1.046-1.083	<0.001	1.075	1.056-1.093	<0.001
Autumn	1.052	1.032-1.073	<0.001	1.046	1.026-1.066	<0.001
Winter	1.082	1.064-1.101	<0.001	1.079	1.061-1.098	<0.001
Urbanization						
High	Reference			Reference		
Medium	1.250	1.231-1.273	<0.001	1.170	1.149-1.190	<0.001
Low	1.439	1.418-1.472	<0.001	1.136	1.113-1.160	<0.001
Level of Care						
Non-Medical center	Reference			Reference		
Medical center	0.608	0.598-0.617	<0.001	0.706	0.694-0.718	<0.001
Hospital Type *vs* Without (Ref)						
Veterans Hospital	0.917	0.899-0.934	<0.001	0.870	0.851-0.890	<0.001
ISS≥16 *vs* Without (Ref)	2.988	2.826-3.158	<0.001	3.076	2.884-3.225	<0.001
Comorbidities *vs* Without (Ref)						
Mental disorder	2.305	2.271-2.340	<0.001	1.730	1.703-1.757	<0.001
Eye disease	1.404	1.379-1.429	<0.001	1.225	1.203-1.247	<0.001
HTN	2.073	2.043-2.104	<0.001	1.560	1.535-1.585	<0.001
Hyperlipidemia	1.210	1.185-1.235	<0.001	0.890	0.871-0.909	<0.001
Atherosclerosis	1.337	1.291-1.385	<0.001	1.064	1.027-1.102	<0.001
COPD	1.572	1.551-1.593	<0.001	1.249	1.231-1.267	<0.001
IHD	1.550	1.529-1.571	<0.001	1.120	1.117-1.101	<0.001
HF	1.535	1.512-1.559	<0.001	1.096	1.078-1.114	<0.001
CD	1.735	1.712-1.758	<0.001	1.258	1.239-1.276	<0.001
RA	1.770	1.728-1.813	<0.001	1.371	1.338-1.405	<0.001
PUD	1.632	1.596-1.668	<0.001	1.139	1.113-1.165	<0.001
Liver Disease	1.305	1.280-1.331	<0.001	1.164	1.142-1.188	<0.001
DM	1.441	1.421-1.460	<0.001	1.109	1.093-1.124	<0.001
Hemiplegia	1.475	1.439-1.511	0.027	1.029	1.003-1.055	<0.001
CKD	1.416	1.395-1.438	<0.001	1.140	1.122-1.158	<0.001
Cancer	0.900	0.886-0.914	0.061	1.015	0.999-1.030	<0.001

HR = Hazard ratio; CI = Confidence interval; Adjusted HR: Adjusted hazard ratio: Adjusted for the variables listed in Table 2.The comorbidities listed in the Table S1.

Table 3 shows the results of a stratified analysis of the variables and reveals that, after controlling for factors such as comorbidities/complications, regardless of sex, age, season, level of urbanization, hospital grade, whether hospitalization occurred at a veteran's hospital, severity of the injury, whether the subject suffered from mental illness, or whether the subject suffered from diseases of the eyes, veterans had a higher risk of falls than non-veterans, and their risk was 1.155-1.478 times higher than that of non-veterans. In particular, in the male group, veterans had 1.299 times ($P<0.001$) the risk of falls of non-veterans; in the 75-84-year-old age group, veterans had 1.313 times ($P<0.001$) the risk of falls of non-veterans; among those with diseases of the eyes, veterans had 1.362 times ($P<0.001$) the risk of falls of non-veterans; and among those suffering from mental illness, veterans had 1.300 times ($P<0.001$) the risk of falls of non-veterans. Furthermore, among comorbidities/complications, in the atherosclerotic disease group, veterans had 1.478 times ($P<0.001$) the risk of falls of non-veterans; and in the group with paralysis of the limbs, veterans had 1.356 times ($P<0.001$) the risk of falls of non-veterans.

Table 3. Factors of falls stratified by variables listed in the table by using Cox proportional hazard regression model

Falls (with vs. without)	Group						Adjusted		
	Veterans			Non Veterans					
Stratified	Event	PYs	Rate	Event	PYs	Rate	HR	95% CI	P-value
Total	35,454	2,765,101	1,282	55,037	5,917,965	930	1.252	1.234-1.270	<0.001
Gender									
Female	8,336	456,003	1,828	14,705	978,524	1,503	1.155	1.123-1.188	<0.001
Male	27,118	2,309,098	1,174	40,332	4,939,441	817	1.299	1.277-1.322	<0.001
Age group (years)									
65-74	6,134	562,055	1,091	17,155	2,241,756	765	1.279	1.240-1.320	<0.001
75-84	20,343	1,546,602	1,315	26,621	2,689,604	990	1.313	1.288-1.339	<0.001
≧85	8,977	656,444	1,368	11,261	986,605	1,141	1.197	1.161-1.234	<0.001
Season									
Spring	11,637	946,772	1,229	18,124	2,042,393	887	1.242	1.210-1.274	<0.001
Summer	8,970	680,735	1,318	13,782	1,458,123	945	1.279	1.242-1.316	<0.001
Autumn	6,153	490,355	1,255	9,637	1,006,877	957	1.227	1.1851.270	<0.001
Winter	8,694	647,239	1,343	13,494	1,410,573	957	1.260	1.224-1.298	<0.001
Urbanization									
High	7,599	593,925	1,279	12,570	1,773,595	709	1.399	1.358-1.440	<0.001
Medium	21,229	1,707,959	1,243	24,874	2,625,440	947	1.202	1.178-1.226	<0.001
Low	6,626	463,217	1,430	17,593	1,518,930	1,158	1.238	1.202-1.276	<0.001
Level of care	11,275	1,130,666	997	11,848	1,999,510	593	1.320	1.282-1.360	<0.001
Veterans Hospital	9,824	1,849,264	531	2,580	362,185	712	1.236	1.182-1.294	<0.001
ISS>16	323	8,403	3,844	940	32,190	2,920	1.170	1.022-1.339	<0.001
Mental disorder	10,949	480,604	2,278	13,006	699,930	1,858	1.300	1.264-1.336	<0.001
EYE disorder	7,953	511,495	1,555	7,083	578,155	1,225	1.362	1.314-1.411	<0.001
Atherosclerosis	1,468	85,603	1,715	1,808	154,270	1,172	1.478	1.371-1.595	<0.001
Hemiplegia	2,632	145,320	1,811	4,513	338,864	1,332	1.356	1.286-1.429	<0.001

PYs = Person-years; Adjusted HR = Adjusted Hazard Ratio: Adjusted for the variables listed in Table2; Rate=per 100,000 PYs; CI = confidence interval.

The comorbidities listed in the Table S1.

In Table S2, Model 1 shows that veterans had 1.252 times (P<0.001) the risk of falls of non-veterans after controlling for factors such as comorbidities/complications, and Model 2 shows that when the stratification was performed based on the dependent variable (cause of fall-related injury), veterans had 1.171 times (P<0.001) the risk of falls from a height of non-veterans, and 1.193 times (P<0.001) the risk of falls on the same level of non-veterans. Model 3 shows that when the stratification was performed based on the number of falls, veterans had 1.229 times (P<0.001) the risk of a single fall of non-veterans and 1.290 times (P<0.001) the risk of recurrent falls of non-veterans.

DISCUSSION

This study was Taiwan's first long-term follow-up study seeking to gain an understanding of falls in veterans, and the results showed that 35,454 veterans suffered falls (9.5%) during the research period, while 55,037 non-veterans suffered falls (7.4%) during the same period, indicating that veterans had 1.252 times (P<0.001) the risk of falls of non-veterans. In a 2015 cross-sectional study of injuries in 287,113 veterans and non-veterans receiving emergency care, veterans had a higher incidence of emergency care than non-veterans (5.1% vs. 4.0 %, P<0.001) [29], which was consistent with the findings of this study. Moreover, another study of falls in veteran's care centres found a 17.2% incidence of falls, [14] which was higher than the incidence in this study (9.5%). The study in question consisted solely of a self-completed questionnaire survey (concerning falls) of 940 veterans in eastern Taiwan, the sample was small, and the study only investigated output information. In contrast, the present study focused on patients who had been hospitalized with confirmed physician's diagnoses and constituted a large sample, which may account for the differences in findings with the prior study. Most past research on veterans has consisted of cross-sectional studies or questionnaire surveys with a short study length and small sample size. There have been few longitudinal studies of falls in veterans. The findings of this study help to make up for the shortcomings of the aforementioned research.

A stratified analysis by age revealed that veterans at all three age levels had a greater risk of falls than non-veterans, and veterans in the 75-84-year-old age group had 1.313 times the risk of falls of non-veterans. In contrast, a 2009 study of inpatient medical utilization by elderly fall patients over the age of 65 years indicated that the largest proportion of the patients were in the 75-84-year-old age group (46.5%) [30], but the study did not analyse veterans as a separate category. Furthermore, a 2016 paper concerning emergency care of injuries found that a higher percentage of male veterans receiving care for injuries were in the 75-84-year-old age group (51.7%, $P<0.001$) than the other age groups (65-74 years: 34.8%; ≥85 years: 13.5%) [29], which was similar to the finding of this study (54.5%); however, the previous study did investigate differences in risk of fall-related injuries between veterans and non-veterans. The present study discovered that veterans in the 75-84-year-old age group hospitalized for falls had a longer hospital stay than non-veterans (9.13 days vs. 8.75 days), had slightly higher average inpatient medical expenditures than non-veterans (NT$ 59,800 vs. NT$ 59,500), and was a high-risk group for recurrent falls. According to data from the Veterans Affairs Council, most veterans in the 75-84-year-old age group were senior veterans (born prior to 1934) and took part in the war of resistance against Japan; [3] it will be worthwhile to conduct a further longitudinal study determining whether the disabilities resulting from wartime service have caused these veterans to have a greater risk of falls than non-veterans.

The results of this study show that although veterans were older than nonveterans (80.1 vs 77.0 years old), their incidence of an ISS score of ≧16 was lower than that of nonveterans (0.3% vs 0.6%). A possible inferred cause is that veterans received complete military training while in service and hence could react more quickly and maintain a relatively ideal physical condition. (A re-analysis of the data showed that amongst the subjects who had fallen, the ratio of osteoporosis amongst the veterans and nonveterans was 4.8% vs 5.2%, respectively (P<0.001). (See the table S3 for a cross-analysis of the two groups and osteoporosis.) In addition, the living environment of the veterans could offer better protection (such as soft floors, amongst others) and related healthcare professionals for most of the veterans (veteran homes) [31] to offer immediate management and assistance in quickly sending them to the hospital for medical treatment as soon as they fall. This is why the incidence of veterans with more severe injuries (an ISS score of ≧16) was lower than that of nonveterans (0.3% vs 0.6%, as shown in the table 1). Given the limitations of the secondary data, this type of correlation is worthy of further study.

The study results showed that low urbanization is also a risk factor for falls amongst veterans. We further cross-analysed the extent of urbanization versus mental disorders, and the results showed that the ratio of mental disorders amongst veterans living in areas with a relatively low extent of urbanization was higher than that amongst veterans in highly urbanized areas (24.0% vs 14.6%; see table S4). This finding is similar to that of a study

amongst veterans in the US (the incidence of mental disorders amongst veterans living in agricultural areas and that amongst those in urban areas was 23.69% and 16.68%, respectively). The above study also indicated that fewer veterans in agricultural areas received psychotherapy than in urban areas. [32] Therefore, providing mental health care services to veterans in areas with a low extent of urbanization may be something that can be addressed by the Taiwan VAC for the current stage.

This study found that a significantly higher percentage of veterans suffered from mental illness than non-veterans (16.5% vs. 11.3%; P<0.001). A 2014 retrospective study of the psychological treatment of veterans using data from the US Veterans Health Administration (VHA) healthcare system discovered that the percentage of veterans receiving psychological treatment increased with age, and the frequency of psychological treatment also increased with time. [33] Our study found that veterans suffering from mental illness had 1.300 times the risk of falls of non-veterans. Past research has indicated that emotional disorders (such as depression and neurological disorders) may cause falls by affecting activities and the sense of balance. [16, 24, 25] This study's stratified analysis of the effect of mental illness further discovered that veterans with depression had 1.366 times the risk of falls of non-veterans (adjusted HR=1.366, 95% CI=1.283-1.454, P<0.001), while veterans with anxiety disorder had 1.317 times the risk of falls of non-veterans (adjusted HR=1.317, 95% CI=1.201-1.443; P<0.001)(TableS5). Furthermore, depression (adjusted

HR=1.938, P<0.001, 95% CI=1.793-2.094) (Table S6)was a predictor of recurrent falls in veterans; this result was somewhat similar to the findings of past research, which found that depression is a risk factor for falls in veterans and also for recurrent falls. [14]

A study of elderly persons in the community found that individuals with depression in conjunction with chronic diseases (cardiovascular disease, diabetes, arthritis) had a greater risk of falls than individuals who neither had depression nor suffered from chronic disease (3.95 times, 4.25 times, 9.66 times). [34] Further analysis in this study found that elderly individuals with depression together with HT or COPD or CD or RA had a greater risk of falls (2.262 times, 1.829 times, 1.867 times, 1.849 times) (Table S7)than those elderly individuals who neither had depression nor suffered from chronic disease.

The US Medical records of veterans reveal "that one in three patients was diagnosed with at least one mental health disorder- 41% were diagnosed with either a mental health or a behavioral adjustment disorder". [35] In addition, the research indicates that people with mental disorders (such as depression and anxiety) tend to develop negative sentiments and suffer from sleep disorders, amongst other symptoms. [36] The presence of sleep disorders (such as insomnia and fewer hours of sleep) leads to deteriorated physical coordination and reactivity and, hence, tends to increase the risk of falls. [37] Further data analysis in this study shows that the incidence of sleep disorders was higher amongst veterans than amongst nonveterans (0.9% vs 0.7%).

In addition, prior studies have pointed out that prescriptions for mental disorders (including anti-depressants, anti-psychotics, sedatives, or tranquillizers) also increase the risk of falls [38-41] However, medication amongst veterans was not explored in this study and will require clarification in subsequent studies.

In summary, apart from physiological (physical) issues, mental illness in veterans is a hidden problem that nevertheless should be taken seriously. This study infers that because veterans lose their social status after discharge, may have few interpersonal interactions, and may suffer from physiological stress due to the infirmity of old age, when veterans can no longer live independently, their unwillingness to leave their familiar environment and receive care in a veterans nursing home may be accompanied by mental illness such as depression and anxiety. The findings of this study support this phenomenon. In addition, the interaction of physiological and mental disorders will also increase the risk of falls. We therefore recommend that screening for mental illnesses such as depression be included when assessing risk of falls in the elderly. To summarize the abovementioned analyses, the Taiwan VAC can refer to the US VHA Measurement-based care (MBC) for related practices [42] and establish a complete monitoring system to precisely track the mental health, sleep problems, and medication use of veterans to protect against falls.

A health survey of the residents of veteran's care centers in Taiwan found that 73% of veterans had vision not exceeding 0.1, which implies that they would have difficulty reading

books and newspapers. [26] This study found that veterans with diseases of the eyes had a greater risk of falls than non-veterans, and among fall patients, significantly higher percentages of veterans had cataracts (12.7% vs. 4.7%; P<0.001) and glaucoma (2.3% vs. 1.1%, P<0.001) than non-veterans. Further analysis revealed that veterans with cataracts had 1.378 times the risk of falls of non-veterans with cataracts (adjusted HR=1.378, 95%CI=1.306-1.453, P<0.001). Similarly, veterans with glaucoma had 1.414 times the risk of falls of non-veterans with glaucoma (adjusted HR=1.414, 95%CI=1.259-1.588, P<0.001). While research has indicated that cataracts are an independent risk factor for falls in veterans, [14] this study found that cataracts (adjusted HR=1.322, P<0.001, 95%CI=1.237-1.412) are also a predictor of recurrent falls in veterans. Further research is needed to verify whether veterans' diseases of the eyes are a consequence of the long-term exposure of the lens to UV radiation while participating in field training or at other times during their period of service, or a result of poor control of chronic diseases, or are induced by the severity of their diseases.

The results of this study show that eye disease (including cataracts and glaucoma) is a risk factor for falls amongst veterans (Table S5), and cataracts is also a predictor of recurrent falls (Table S6).Meanwhile, the living environment (lighting equipment) may be a factor affecting falls as well. [43] Therefore, the Taiwan VAC should help veterans seek medical attention at a hospital ophthalmology department periodically [44] and should also focus

on improving the environment (indoor lighting equipment) to protect against falls. This study discovered that veterans had higher levels of all comorbidities/complications (including hypertension, cardiovascular disease, cerebrovascular disease, lung disease, arthritis, gastrointestinal disease, diabetes, liver disease, kidney disease, among others) than non-veterans. A 2013 cross-sectional study suggested that cerebrovascular disease and gouty arthritis are independent risk factors for falls in veterans, [14] which is consistent with this study. Foreign research has also indicated that veterans over the age of 65 years have more comorbidities/complications than veterans under the age of 65 years. [45] Our study findings indicate that among persons with comorbidities/complications, veterans have a greater risk of falls than non-veterans, which underscores the importance of chronic disease prevention and rehabilitation exercises as veterans age.

This study made the further discovery that among fall-related injuries, veterans had a greater incidence of both falls from a height and falls at the same level than non-veterans. Furthermore, veterans had 1.29 times ($P<0.001$) the risk of recurrent falls of non-veterans, and during the 2000-2013 period, each veteran had 4.07 falls, which was significantly greater than the falls of non-veterans (3.88 times). Moreover, the average hospital stay (9.13 days) and medical expenditures (NT$ 59,000) of veterans with falls were both higher than those of non-veterans (8.77 days and NT$ 58,000), and the percentage of veterans who died while hospitalized (3.7%) was also higher than that of non-veterans (2.8%) (Table S8). To

summarize the foregoing research findings, veterans constitute a high-risk group for falls among the general elderly population and have relatively high medical utilization after suffering falls.

The strengths of this study include a sufficiently large research sample and a tracking period of 14 years, as well as the ability to compare the risk of falls among veterans and non-veterans and confirm factors affecting falls in veterans. However, despite these strengths, this study also had the following limitations. First, this study was limited by the format of the data in the National Health Insurance Research Database and could not obtain other important information related to falls (such as the (widows or widowers), living environment (lighting equipment), patient weight, dietary intake, muscular endurance, and degree of disability). Second, this study analysed inpatient files in the National Health Insurance Research Database and was unable to estimate the percentages of individuals who did not receive care or who only received outpatient/emergency care; thus, this study may have underestimated the number of cases.

CONCLUSION

Veterans had 1.252 times the risk of falls and 1.290 times the risk of recurrent falls of non-veterans. In addition, veterans also had longer inpatient stays and higher medical expenditures and death rates than non-veterans. Age (especially the 75-84-year-old age group), low urbanization, comorbidities/complications, mental illness, and diseases of the

eyes were risk factors for falls in veterans, and depression and cataracts were predictors of recurrent falls. Apart from implementing preventive measures targeting high-risk groups, the responsible authorities should also seek to reduce the risk of falls among veterans by resolving their psychological and physiological issues.

Declarations

Authors' Contributors

All authors (PHJ, YLC, CHC, Kao, and CWC) designed the study. Data analyses and interpretation were performed by PHJ, and CWC. Kao and CWC drafted and revised the manuscript. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

Patient Consent

Not required.

Ethics approval

The study protocol was approved by the approval institutional review board, Tri-Service General Hospital. (TSGHIRB No. 1-105-05-142).

Provenance and peer review

Not commissioned; externally peer reviewed.

Data sharing statement

No additional unpublished data from this study.

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Figure 1. The flowchart of study sample selection from National Health Insurance Research Database in Taiwan

Figure 2. Kaplan-Meier for cumulative risk of fall in 14-year tracking stratified by Veterans with log-rank test

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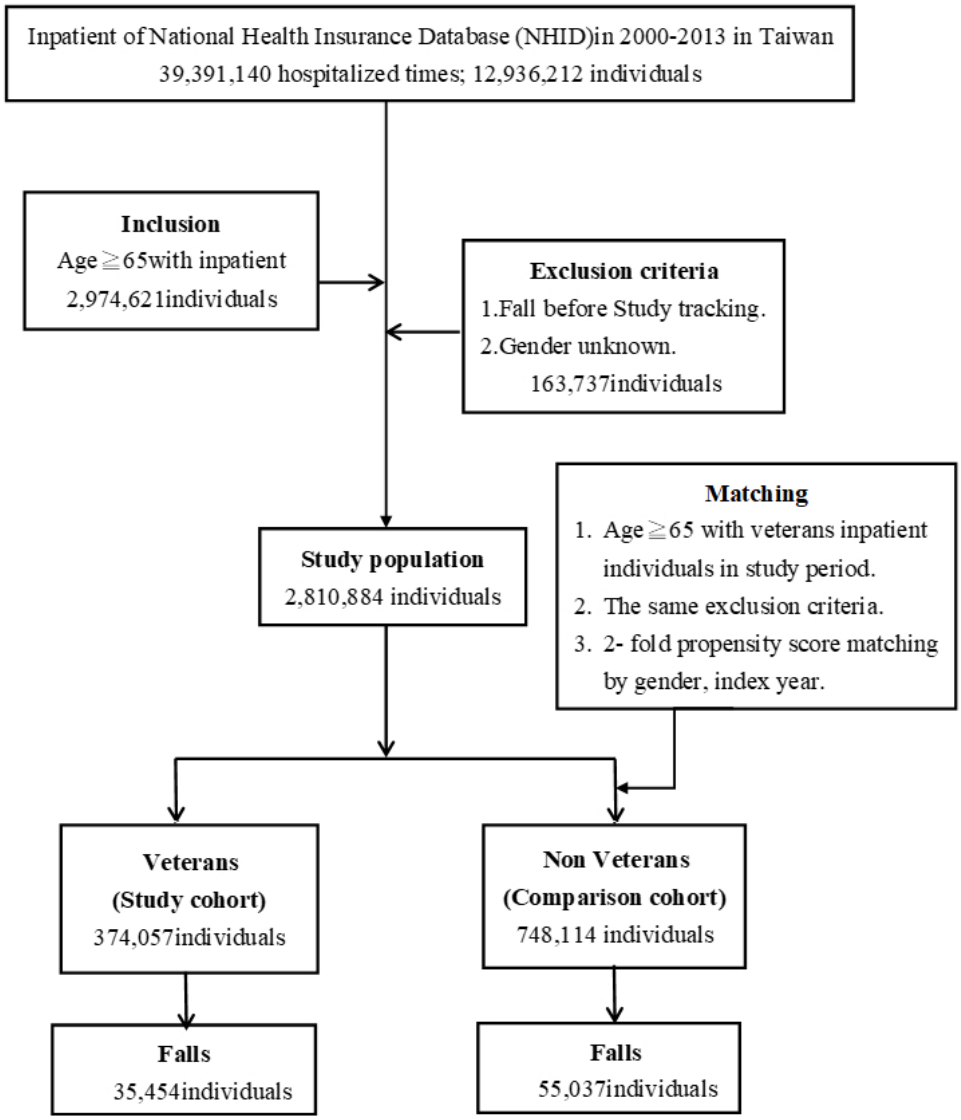

Figure1.The flowchart of study sample selection from National Health Insurance Research Database in Taiwan

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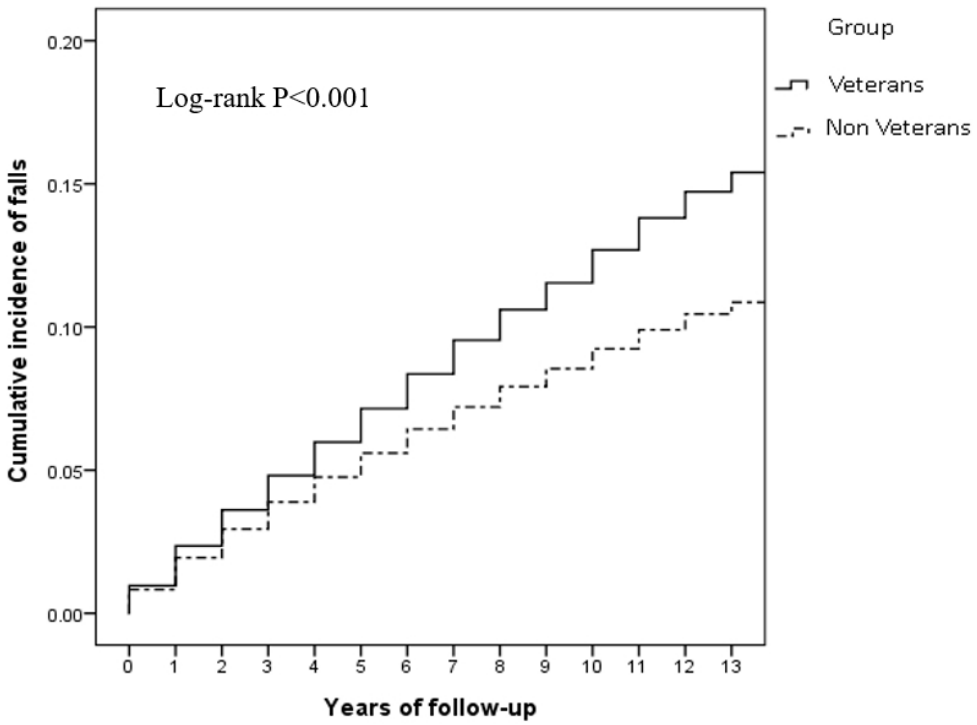

Figure2.Kaplan-Meier for cumulative risk of fall in 14-year tracking stratified by Veterans with log-rank test

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Appendices: Supplementary materials

Perng et al., Fall and risk factors for veterans and nonveterans inpatients over the age of 65: 14 years of long-term data analysis

- Table S1.Abbreviation and ICD-9-CM / NHI order code
- Table S2. Factors of falls by using Cox proportional hazard regression in different model
- Table S3 Prevalence of osteoporosis in veterans and nonveterans who experienced falling
- Table S4. Analysis of veterans with mental disorders and urbanization
- Table S5. Risk factors of falls stratified by variables listed in the table based on the Cox regression analysis
- Table S6. Risk factors of recurrent falls by multivariable cox proportional hazard regression amongst veterans
- Table S7. Analysis between depression and chronic diseases
- TableS8. Comparison the medical utilization of falling between veterans and nonveterans

Table S1. Abbreviation and ICD-9-CM / NHI order code

Variables	Abbreviation	ICD-9-CM / NHI order code
Events		
Falls		880-888
From the different level		880-884
On the same level		885-886
Unspecified		887-888
Comorbidities		
Mental disorder		290-319
Eye disease		360-379
Hypertension	HTN	401–405
Hyperlipidemia		272
Atherosclerosis		440
Chronic obstructive pulmonary disease	COPD	490–496
Ischemic heart disease	IHD	410–414
Heart failure	HF	428
Cerebrovascular disease	CD	430-438
Rheumatism	RA	725-729
Peptic ulcer disease	PUD	533
Liver disease		571
Diabetes mellitus	DM	250
Hemiplegia		342-344
Chronic kidney disease	CKD	580-589
Cancer		140–239

Table S2. Factors of falls by using Cox proportional hazard regression in different model

Model	Variables	Adjusted HR	95% CI	*P-value*
Model 1	Falls	1.252	1.234-1.270	<0.001
Model 2	Falls			
	From the different level	1.171	1.122-1.222	<0.001
	On the same level	1.193	1.171-1.215	<0.001
	Unspecified	1.451	1.410-1.493	<0.001
Model 3	Single Fall	1.229	1.208-1.249	<0.001
	Recurrent Falls	1.290	1.250-1.331	<0.001

Abbreviations: HR=hazard ratio, CI=confidence interval, Adjusted HR: Adjusted for the variables listed in Table 2.

Table S3 Prevalence of osteoporosis in veterans and nonveterans who experienced falling

Osteoporosis	Group		Total	P-value
	Non veterans (%)	Veterans (%)		
Without	521,699 (4.8)	33,747 (95.2)	85,916 (94.9)	
With	2,868 (5.2)	1,707 (4.8)	4,575 (5.1)	<0.001
Total	55,037 (100)	35,454 (100)	90,491 (100)	

Table S4 Analysis of veterans with mental disorders and urbanization

Mental disorder	Urbanization			Total	P-value
	Low (%)	Midian (%)	High (%)		
Without	46,337 (76.0)	195,596 (84.8)	70,274 (85.4)	312,207 (83.5)	
With	14,660 (24.0)	35,195 (15.2)	11,995 (14.6)	61,850 (16.5)	<0.001
Total	60,997 (100.0)	230,791 (100.0)	82,269 (100)	374,057 (100)	

Table S5. Risk factors of falls stratified by variables listed in the table based on the Cox regression analysis

Group	Veterans			Non Veterans			Adjusted HR	95% CI	P-value
Stratified	Event	PYs	Rate	Event	PYs	Rate			
Mental disorder									
Depression	2,551	105,775	2,412	2,250	115,801	1,943	1.366	1.283-1.454	<0.001
Anxiety	1,110	52,259	2,124	1,051	64,946	1,618	1.317	1.201-1.443	<0.001
EYE disorder									
Cataract	4,502	307,007	1,466	2,573	212,489	1,211	1.378	1.306-1.453	<0.001
Glaucoma	820	51,179	1,602	606	50,345	1,204	1.414	1.259-1.588	<0.001

PYs = Person-years; Adjusted HR = Adjusted Hazard ratio: Adjusted for the variables listed in Table 2; Rate = per 100,000 PYs; CI = confidence interval.

Table S6. Risk factors of recurrent falls by multivariable cox proportional hazard regression amongst veterans

Variables	Adjusted HR	95 % CI	*P-value*
Depression	1.938	1.793-2.094	<0.001
Cataract	1.322	1.237-1.412	<0.001

HR = Hazard ratio CI = confidence interval, AHR: Adjusted Hazard ratio: Adjusted for the variables listed in Table 2; comorbidities are listed in Table S1.

Table S7. Analysis between depression and chronic diseases

Variables	Reference	Adjusted HR	95% CI	P-value
Depression + HT	No Depression + No HT	2.260	2.211-2.375	<0.001
Depression + COPD	No Depression + No COPD	1.829	1.745-1.898	<0.001
Depression + CD	No Depression + No CD	1.867	1.793-1.946	<0.001
Depression + RA	No Depression + No RA	1.849	1.708-1.985	<0.001

HR = Hazard ratio CI = confidence interval, Adjusted HR: Adjusted Hazard ratio: Adjusted for the variables listed in Table 2; comorbidities are listed in Table S1.

Table S8 Comparison the medical utilization of falling between veterans and nonveterans

variables	Total Mean ± SD	Veterans Mean ± SD	Nonveterans Mean ± SD	P-value
Length of day*	8.92 ± 8.72	9.13 ± 8.83	8.77 ± 8.65	<0.001
Medical cost(NT$)*	58,905 ± 77,292	58,997 ± 78,218	58,845 ± 76,690	<0.773
Death (%)	2,846 (3.25)	1,297 (3.7)	1,549 (2.8)	<0.001

Chi-square/Fisher exact test on category variables and *t-test on continue variables.

SD: standard deviation

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (*b*) For matched studies, give matching criteria and number of exposed and unexposed	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	8-9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding (*b*) Describe any methods used to examine subgroups and interactions (*c*) Explain how missing data were addressed (*d*) If applicable, explain how loss to follow-up was addressed (*e*) Describe any sensitivity analyses	10
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	11
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount)	11-13
Outcome data	15*	Report numbers of outcome events or summary measures over time	14-15

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (*b*) Report category boundaries when continuous variables were categorized (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	15-16
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	17
Discussion			
Key results	18	Summarise key results with reference to study objectives	18-25
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	25-26
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	26
Generalisability	21	Discuss the generalisability (external validity) of the study results	26-27
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	28

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.