

Original Research



Characteristics of falls, contributory factors and injury-related outcomes in older people admitted to sentinel hospitals in Sri Lanka

Dilshan Wijeratne^{1*}, Shiromi Maduwage¹, Samitha Siritunga², Bhumini Karunarathna¹

¹Directorate Youth Elderly and Disabled Persons, Ministry of Health, Sri Lanka; ²Directorate of Non-Communicable Diseases, Ministry of Health, Sri Lanka

*Correspondence: dilshanain3@gmail.com

<https://orcid.org/0009-0004-1641-2672>

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Abstract

Introduction: Falls among older people are a major public health concern, particularly in ageing populations like Sri Lanka. Understanding falls epidemiology is crucial for falls prevention and promoting healthy ageing.

Objectives: To describe the epidemiological characteristics of falls, the contributory factors and the outcomes of related injuries among those aged ≥ 60 years, admitted to sentinel hospitals in Sri Lanka

Methods: This descriptive cross-sectional study utilised secondary data from the National Injury Surveillance System (NISS), Ministry of Health. Study population included individuals aged ≥ 60 years, admitted to hospitals nationwide due to falls between 2019-2022. Secondary data on falls, sociodemographic characteristics and injury outcomes were extracted from the NISS e-database. The proportion of falls among those ≥ 60 years was calculated by dividing the fall-related admissions by total injury admissions in the same age group. Age-specific death rates were calculated using Sri Lanka's 2012 census data.

Results: Falls accounted notably to injury-related hospitalisations among older people ($n=49,500$), showing an increasing trend from 2019-2022. The proportion was 32.6% (95% CI: 32.1, 33.1) in 2019, 34.4% (95% CI: 33.9, 34.9) in 2020, 34.7% (95% CI: 34.1, 35.3) in 2021, and rose to 39.4% (95% CI: 38.9, 39.9) in 2022. The highest number of falls in this population was reported in the Western province of Sri Lanka. The home is the primary location for falls, accounting for 65.7% ($n=32,504$), with most occurring during leisure (23.3%) or household (22.1%) activities. Among elderly fall admissions, 9.5% ($n=4,686$) developed disabilities. Young elders (60–69 years) accounted for 45.7% ($n=22,623$) of fall-related hospitalisations, while those ≥ 80 years had the highest age-specific death rate (36.9 per 100,000) in 2022.

Conclusions & Recommendations: Falls are a leading cause of hospitalisation and disability among older people, often occurring at home during household and leisure activities. Targeted falls prevention interventions are recommended, to ensure home safety, and age-friendly environments.

Key words: Accidents, Injury, Elderly falls, Falls-related injury

Introduction

Globally, falls are a major cause of morbidity and mortality among older people, with implications that reverberate on individual, societal and health system levels (1). Both local and international studies consistently report that approximately one-third of adults aged 65 years and above, experience a fall each year (2-3). The risk of falls and fall-related injuries increases further among those over 70 years of age and with advancing frailty (4-6). According to the World Health Organization (WHO), falls are the second leading cause of unintentional injury-related deaths worldwide, primarily affecting older people and compromising their healthy aging and well-being (2, 6). As populations continue to age, the burden of falls and their associated consequences on healthy ageing is expected to grow (7).

Sri Lankans, as one of the fastest ageing populations in the Southeast Asia region, faces a growing public health concern with falls among the elderly, along with their associated injuries and disabilities (3). Sri Lanka is experiencing a demographic shift towards an ageing population, driven by the increasing number of people aged 60 and above compared to other age groups, alongside declining birth rates. This shift, coupled with the country's ongoing economic crisis, and social transitions, presents a unique set of challenges (8).

Understanding and addressing the epidemiology of falls among older people is of paramount importance for several reasons. Firstly, falls and fall-related injuries can have devastating consequences for the affected individuals and their families. Older people who experience falls often suffer fall-related injuries, such as fractures, bruises, cuts, post-fall anxiety, etc. The resulting physical and emotional impact can lead to a decline in functional ability, limit daily activities and potentially cause long-term disability (1-2). Additionally, falls can have profound psychological repercussions, including loss of confidence, fear of fall again and heightened anxiety, which further restrict mobility and diminish quality of life (9-10).

The Global Burden of Disease (GBD) study highlights that falls and falls-related injuries among older people substantially contribute to mortality and disability worldwide (11). According to the GBD 2019, falls among older people in Sri Lanka accounted for 3.11% (95% CI: 2.73, 3.5) of total years of healthy life lost due to disability (YLDs) (11). Furthermore, falls lead to substantial medical costs, including hospitalisations, rehabilitation and long-term care, placing a significant economic burden on healthcare systems (12). Beyond their impact on the victims' quality of life, falls also create emotional and financial distress for their families and caregivers (1).

Research on falls among older adults in Sri Lanka must carefully consider socioeconomic and environmental factors that contribute to falls and their outcomes. However, many local studies have given limited attention to these aspects. Additionally, existing local research often face limitations, such as small sample sizes, a narrow geographic focus or reliance on data from a single hospital setting (3, 5). These constraints restrict the generalizability of findings and hinder their impact on national-level decision-making.

The National Injury Surveillance System (NISS) of the Ministry of Health provides access to the largest dataset of fall-related cases among older people in Sri Lanka. Established in 2016, the NISS currently collects data from more than 120 base and higher-level hospitals across all provinces in Sri Lanka, with the highest proportion of reporting facilities located in the Western (23.1%), Eastern (15.7%) and Northern (12.4%) Provinces. The system includes four surveillance components, namely outpatient, inpatient, death and transfer data. Inpatient data is collected through the electronic Indoor Morbidity and Mortality Reporting (eIMMR) system, while the other components are captured via the DHIS2 platform. All injury data are classified according to the International Classification of Diseases (ICD)-10 classification.

Despite its comprehensive nature, the NISS database has received limited attention from researchers. This study utilised inpatient injury data to describe the epidemiological characteristics of falls, the contributory factors and the outcomes of related injuries among those aged ≥ 60 years, admitted to sentinel hospitals in Sri Lanka. The findings of this study will offer valuable insights into the distribution, patterns and outcomes of falls among older people, in order to inform the development of effective injury prevention strategies and policies, as well as promote the establishment of age-friendly environments that enhance the safety and well-being of older people across all settings.

Methods

This descriptive cross-sectional study utilised secondary data from the NISS central e-database of individuals aged ≥ 60 years who were admitted for falls or fall-related injuries to 121 base and higher-level hospitals across all nine provinces between 2019

and 2022. The data extraction process employed a filtering mechanism to identify eligible patient case records from the database, resulting in a study sample of 49,500 who received in-patient care following falls.

Two trained data collectors, with the assistance from directorate technical experts, used a pre-tested data extraction tool for data collection. Initially, data were extracted into Excel form for data cleaning, during which inconsistencies, duplicates and errors were identified and removed to ensure data quality. The cleaned data were then transferred to Statistical Package for the Social Sciences (SPSS) for statistical analysis. The extracted dataset was formatted and transformed to align with the study's objectives. Primary outcomes of this study included the percentage of falls out of all injuries that required inpatient care and age-specific mortality following falls. Falls-related injury outcomes were classified as disabilities, fractures, hospitalisation duration and fatalities.

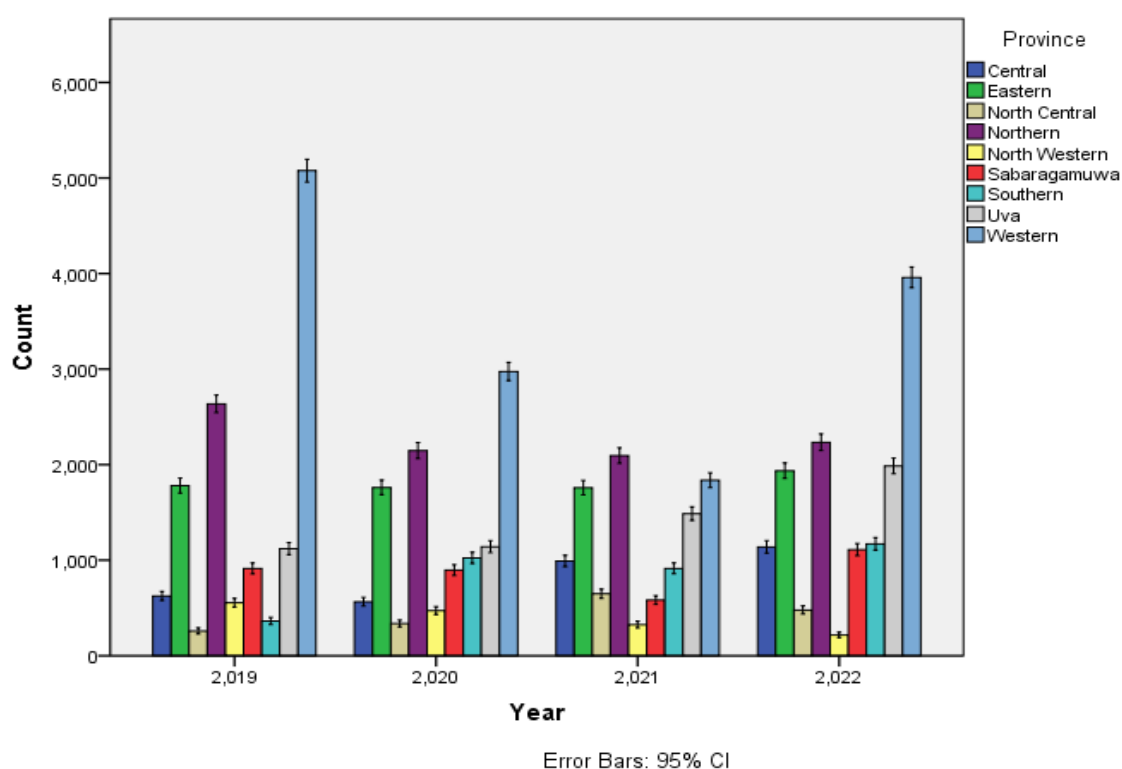


Figure 1: Geographical distribution of annual fall-related hospitalisations by province in elderly population

Table 1: Distribution of sociodemographic and falls characteristics

	Year									
	2022		2021		2020		2019		2019-2022	
Total admissions with falls	15,800		9,061		11,313		13,326		49,500	
Characteristics	No.	%	No.	%	No.	%	No.	%	No.	%
Age (years)										
60- 64	3863	24.5	2440	26.9	2799	24.8	3285	24.7	12387	25.0
65- 69	3062	19.4	1880	20.8	2358	20.9	2936	22.0	10236	20.7
70- 74	3433	21.8	1926	21.3	2481	21.9	2870	21.5	10710	21.7
75- 79	2241	14.2	1201	13.3	1551	13.7	1732	13.0	6725	13.6
80 and above	3172	20.1	1609	17.8	2117	18.7	2500	18.8	9398	19.0
Not known*	29	0.2	5	<0.1	7	<0.1	3	<0.1	44	<0.1
Sex										
Male	6919	43.8	4298	47.4	5181	45.8	6150	46.2	22548	45.6
Female	8881	56.2	4763	52.6	6132	54.2	7176	53.8	26952	54.4
Location of fall										
Home setting	10993	69.6	6213	68.6	7587	67.1	7711	57.9	32504	65.7
Public administration setting	192	1.2	117	1.3	118	1.0	179	1.3	190	0.4
Road, street	1317	8.3	904	10.0	1149	10.2	1501	11.3	606	1.2
Occupational settings	163	1.0	99	1.1	121	1.1	140	1.1	146	0.3
Sports-exercise	52	0.3	21	0.2	32	0.3	41	0.3	576	1.2
Recreational/ leisure settings	183	1.2	166	1.8	103	0.9	124	0.9	4871	9.8
Educational settings	77	0.5	33	0.4	29	0.3	51	0.4	190	0.4
Other specified settings	2014	12.7	895	9.9	1415	12.5	2332	17.5	6656	13.4
Not known*	809	5.1	613	6.8	759	6.7	1247	9.4	3428	6.9
Cause of fall										
While engaging in Education	105	0.7	49	0.6	61	0.6	65	0.6	280	0.6
While sport activity	153	1.1	75	0.9	109	1.1	128	1.2	465	1.1
While in leisure activity	3461	24.6	1927	23.0	2246	22.5	2462	22.5	10096	23.3
While working for income	748	5.3	480	5.7	467	4.7	487	4.4	2182	5.0
While on Transportation	1505	10.7	1016	12.1	1131	11.3	1458	13.3	5110	11.8
While household activity	3245	23.1	1852	22.1	2352	23.6	2153	19.7	9602	22.1
While resting, eating, sleeping	2780	19.8	1521	18.1	2054	20.6	2142	19.6	8497	19.6
Other	470	3.3	403	4.8	371	3.7	391	3.6	1635	3.8
Not known*	1589	11.3	1058	12.6	1187	11.9	1661	15.2	5495	12.7
Evidence of alcohol use										
Yes	438	2.8	320	3.5	353	3.1	338	2.5	1449	2.9
No	12660	80.1	7576	83.6	8816	77.9	9221	69.2	38273	77.3
Not known*	2702	17.1	1165	12.9	2144	19.0	3767	28.3	9778	19.8
Evidence of substance use										
Yes	118	0.8	101	1.1	142	1.2	119	0.9	480	1.0
No	11952	75.6	7123	78.6	7994	70.7	8208	61.6	35277	71.2
Not known*	3730	23.6	1837	20.3	3177	28.1	4999	37.5	13743	27.8

*Not known indicate relevant data not available within the BHT or in the e-return

Data analysis

Descriptive statistics, including frequencies, percentages with 95% confidence intervals, were used to summarize the characteristics of falls. Age-specific death rates per 100,000 were calculated for different age groups, focusing on fall-related deaths, using the Sri Lanka's 2012 census population data. Data were presented both annually and cumulatively for the period 2019–2022. This approach helps determine whether the observed patterns are confined to a single year or persist over multiple years.

Results

As per the NISS database, a total of 139,992 older people aged 60 years and above, were admitted with injuries during 2019–2022, with annual admissions of 40,891, 32,896, 26,116 and 40,089, respectively. Of them, 49,500 were hospitalised for falls and falls-related injuries, with annual admissions of 13,326 in 2019, 11,313 in 2020, 9,061 in 2021 and 15,800 in 2022 (Table 1). Falls as a proportion of total admissions with injuries were 32.6% (95% CI: 32.1, 33.1) in 2019, 34.4% (95% CI: 33.9, 34.9) in 2020,

34.7% (95% CI: 34.1, 35.3) in 2021 and 39.4% (95% CI: 38.9, 39.9) in 2022.

Figure 1 illustrates the geographical distribution of annual fall-related hospitalisations by province during the period 2019–2022. Western Province reported the highest number of elderly falls, followed by the Northern and Eastern Provinces.

Table 1 presents the sociodemographic profile and the characteristics of falls of the study sample. The highest proportion receiving in-patient care ($n=12,387$; 25.0%) were within the 60–64-year age category. Nearly 45% ($n=22,623$) were classified as young older people aged 60–69 years. Throughout the study period, the proportion of female fall victims requiring in-patient care ranged from 52.6% to 56.2%. Home setting was the most common location for falls (65.7%). The highest proportion of falls took place while engaging in leisure (23.3%) or household activities (22.1%). Most hospitalised people were neither under the influence of alcohol (77.3%) nor engaged in illicit substance use (71.2%) at the time of their fall. Overall, these trends and injury patterns remained constant throughout the study period from 2019 to 2022.

Table 2: Distribution of characteristics of the injury and outcome

	Year									
	2022		2021		2020		2019		2019–2022	
Total admissions with falls	15,800		9,061		11,313		13,326		49,500	
Characteristics	No.	%	No.	%	No.	%	No.	%	No.	%
Nature of the fall										
Unintentional	14357	90.9	8130	89.7	9849	87.1	11025	82.7	43361	87.6
Intentional	513	3.2	300	3.3	331	2.9	312	2.3	1456	2.9
(violence by others)										
Deliberate self-harm	35	0.2	13	0.1	7	0.1	17	0.1	72	0.1
Not known*	895	5.7	618	6.8	1126	10.0	1972	14.8	4611	9.3
Type of the injury**										
Superficial injury	6824	43.2	3748	41.4	4549	40.2	4988	37.4	20109	40.6
Open wound	2394	15.2	1467	16.2	1494	13.2	1684	12.6	7039	14.2
Fracture	3869	24.5	2191	24.2	2405	21.3	2911	21.8	11376	23.0
Dislocation, sprain & strain	557	3.5	296	3.3	355	3.1	567	4.3	1775	3.6
Injury to nerves/spinal cord	29	0.2	26	0.3	31	0.3	26	0.2	112	0.2

Injury to blood vessels	68	0.4	45	0.5	35	0.3	43	0.3	191	0.4
Injury to muscle & tendons	114	0.7	71	0.8	77	0.7	73	0.5	335	0.7
Crushing injury	29	0.2	20	0.2	28	0.2	57	0.4	134	0.3
Traumatic amputations	30	0.2	10	0.1	11	0.1	7	0.1	58	0.1
Injury to internal organs	79	0.5	45	0.5	59	0.5	80	0.6	263	0.5
Other	395	2.5	411	4.5	695	6.1	626	4.7	2127	4.3
Not known*	1412	8.9	731	8.0	1574	14.0	2264	17.1	5981	12.1
Body region/s injured**										
Head	5063	32.0	2780	30.7	3193	28.2	3590	26.9	14626	29.5
Face	1050	6.6	614	6.8	757	6.7	795	6.0	3216	6.5
ENT	307	1.9	196	2.2	233	2.1	254	1.9	990	2.0
Eyes	172	1.3	159	1.4	92	1.0	173	1.1	596	1.2
Oro-maxillary region	121	0.8	49	0.5	60	0.5	110	0.8	340	0.7
Neck	140	0.9	98	1.1	116	1.0	121	0.9	475	1.0
Spine	366	2.3	240	2.6	251	2.2	246	1.8	1103	2.2
Chest	910	5.8	479	5.3	609	5.4	679	5.1	2677	5.4
Back of chest	357	2.3	182	2.0	199	1.8	268	2.0	1006	2.0
Abdomen	199	1.3	118	1.3	124	1.1	119	0.9	560	1.1
Genitalia	51	0.3	27	0.3	41	0.4	35	0.3	154	0.3
Upper limb including shoulder girdle, palm, fingers	4264	27.0	2440	26.9	2780	24.6	3205	24.1	12689	25.6
Lower limb including pelvic girdle, foot, toes	4494	28.4	2662	29.4	3244	28.7	3857	28.9	14257	28.8
Other	52	0.3	62	0.7	272	2.4	131	1.0	517	1.0
Duration of hospital stay (days)										
≤ 1	10254	64.9	5927	65.4	7816	69.1	9379	70.4	33376	67.4
2- 4	3939	24.9	2208	24.4	2619	23.2	2892	21.7	11658	23.6
5-9	978	6.2	567	6.3	541	4.8	631	4.7	2717	5.5
≥ 10	629	4.0	359	4.0	337	3.0	424	3.2	1749	3.5
Developed disability										
Yes	1771	11.2	767	8.5	912	8.1	1236	9.3	4686	9.5
No	11418	72.3	6870	75.8	7519	66.5	8009	60.1	33816	68.3
Unknown*	2611	16.5	1424	15.7	2882	25.5	4081	30.6	10998	22.2
Outcome of the falls										
Death before admission	166	1.1	144	1.6	241	2.1	296	2.2	847	1.7
Death after admission	234	1.5	96	1.1	166	1.5	175	1.3	671	1.4
Treated and sent home	10297	65.2	6077	67.1	5969	52.8	6698	50.3	29041	58.7
Left against medical advice	2002	12.7	1088	12.0	1818	16.1	2051	15.4	6959	14.1
Not known*	3101	19.5	1656	18.2	3119	27.5	4106	30.8	11982	24.1

* Not known indicate relevant data not available within the BHT or in the e-return; **One people could have multiple types of injuries involving multiple body parts

Table 2 outlines the characteristics of falls, and their outcome. Unintentional falls consistently accounted for over 85% of cases ($n=43,361$), showing a gradual increase from 2019 to 2022. In contrast, intentional falls (ranging from 2.3% to 3.3%) and cases of deliberate self-harm (0.1% to 0.2%) remained stable over time, representing a smaller proportion of total cases. Superficial injuries were the most frequently reported injury type, accounting for 40.6% of all falls-related hospitalisations. Fractures ranked second occurring in nearly one-fifth. Head injuries accounted for the highest proportion (29.5%) of cases, followed by lower limb injuries (28.8%) and upper limb injuries (25.6%). Approximately one in ten older people admitted to hospitals due to falls had developed disabilities at the time of admission, with the highest proportion of 11.2% recorded in 2022.

Most fall-related hospitalisations were brief, with over 65% of cases discharged within one day. Meanwhile, 23.6% of patients had hospital stays ranging from 2 to 4 days. Longer hospital stays (5-9 days) showed a slight increasing trend from 2019 to

2022 raising from 5.5% to 6.2%. Regarding the fall outcomes, 1.7% of cases resulted in death before admission, while 1.4% died after hospital admission. Additionally, the proportion of patients leaving against medical advice remained stable, ranging from 12.7% to 16.1%, with an overall average of 14.1% across the study period.

Figure 2 shows the distribution of age-specific death rate following falls among older population. The overall age-specific mortality rate for those aged ≥ 60 years was 18.7, 16.1, 9.5 and 12.8 per 100,000 in 2019, 2020, 2021, and 2022, respectively. The age-specific death rate following falls consistently increased with age throughout the study period, with the highest rates observed in among individuals aged ≥ 80 years. In this age group, the age-specific death rate was 33.2, 27.8, 20.8, and 36.9 per 100,000 in 2019, 2020, 2021 and 2022, respectively. Across all age categories, there was a decline in age-specific death rate from 2019 to 2021, followed by an increase in 2022.

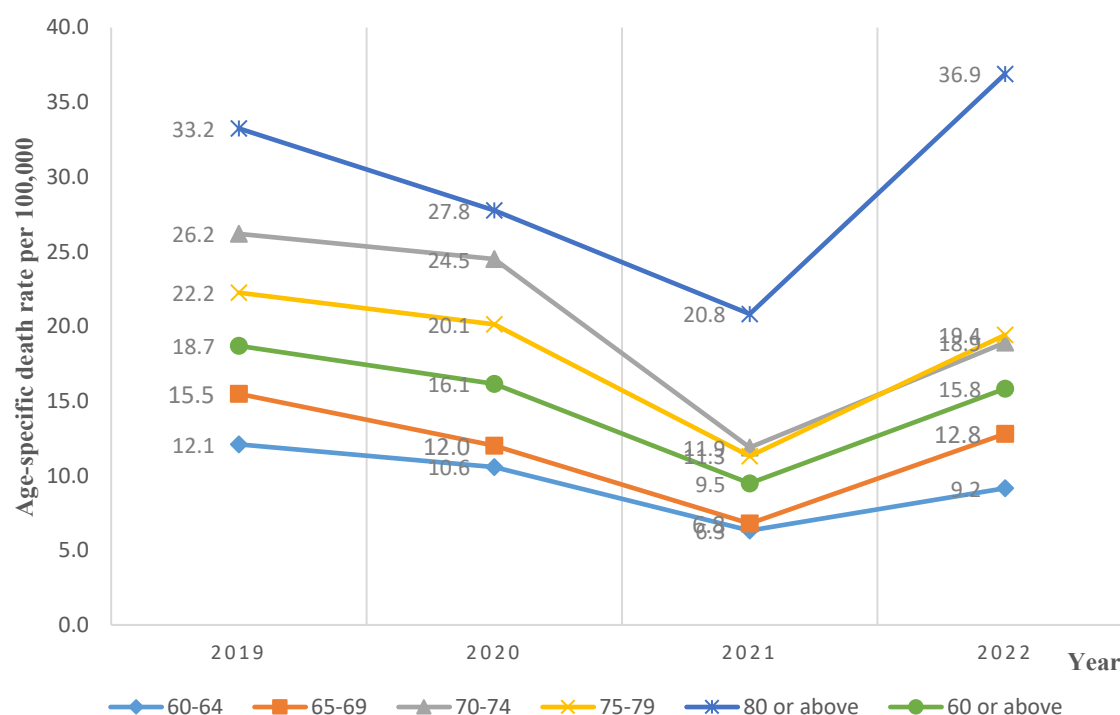


Figure 2: Age-specific death rate following falls among elderly population

Discussion

Between 2019 and 2022, a total of 139,992 older people (≥ 60 years) were hospitalised with injuries in Sri Lanka, with falls accounting for 49,500 cases (35.3%). The proportion of falls-related hospitalisations increased over time, reaching its highest proportion of 39.4% in 2022. Falls predominantly occurred at home, were more frequent among females and the younger elderly (60-69 years). Superficial injuries and fractures were the most common fall-related injury outcomes. Although most hospital stays were brief, both disability and mortality rates showed an upward trend, particularly among those aged ≥ 80 years.

The study highlights that falls accounted for a substantial proportion (32.6%–39.4%) of total injury-related hospitalisations among older people over the four-year period. This finding broadly aligns with the existing literature, which identifies falls as one of the most common reasons older people seek hospital care (2-3). Moreover, the upward trend in fall-related hospitalisations suggests a growing burden of falls in Sri Lanka. While the exact causes remain uncertain, the potential contributing factors may include lifestyle changes driven by the economic crisis, which have led people to greater reliance on government healthcare services as well as increased health-seeking behaviours following the easing of COVID-19 travel restrictions (13-14). Additionally, the proportion of falls out of all injuries in this study was much higher than the findings of a previous hospital-based study conducted among older people in Colombo, Sri Lanka (5). This highlights the importance of recognizing elderly falls as a major public health concern and a contributor to injury-related healthcare utilization.

The Western Province of Sri Lanka stood out with the highest count of elderly falls, emphasizing the need for targeted falls prevention interventions in this region. Given that this province has the highest proportion of older people in Sri Lanka (15-16), this finding aligns with demographic distribution this

older people. Previous community-based studies in the Southern and Western Provinces have similarly identified a higher prevalence of falls among older people in the Western Province (3-4). Furthermore, a comparison of fall-related hospitalisations with the distribution of hospitals linked to the NISS suggests that provinces with a higher number of NISS-linked hospitals also reported more fall-related hospital admissions.

Sociodemographic characteristics revealed that young-older individuals aged 60-69 years group accounted for the highest proportion of fall victims, with the 60-64 category being the most affected. This group typically consist of active, mobile older people who are adjusting to retirement lifestyle changes, increased free time and evolving social interactions, which may contribute to a higher risk of falls. Additionally, census data indicate that young-old subgroup forms the largest proportion of the older population aged ≥ 60 years (15), partly explain reason for the higher crude number of falls observed in this age group. The study highlights the vulnerability of the 'young older people' to falls, emphasizing that falls preventive strategies and healthy ageing should start early through a life course approach (1, 17).

The home setting remained the most common location for elderly falls, accounting for over 65% of cases each year. This finding is consistent with existing literature, which suggests that most falls among older people occur inside house or home garden areas (18-19). This highlights the importance of modifying indoor environments and implementing home safety measures as targeted interventions to prevent falls and create age-friendly living spaces for older people (1, 17). Present study findings provide valuable insights for the ongoing development of a home-safety checklist by the Directorate of NCD, reinforcing the necessity of integrating elderly safety measures into home settings. Furthermore, the fact that most falls occurred during household or leisure activities, points to the need for targeted health educational programs and awareness campaigns to

promote falls prevention and safe behaviours during daily activities within the home.

International literature suggests that falls contribute to a notable portion of disability among older people and second commonest cause for unintentional injury-related mortality (20). The present study findings align with this evidence, revealing that nearly 10% of the older people admitted to hospitals with falls developed disabilities with varying degrees of functional impairments. Similar findings have been reported in other Asian countries, where 6-8% of older people sustain fractures following falls, further exacerbating disability, and contributing to long-term functional impairments (21). These findings have several implications for public health interventions and healthcare planning for older populations in Sri Lanka. Specifically, targeted injury prevention interventions are recommended to aim at transforming home environments to become age friendly. Further health promotional initiatives are recommended to promote safe behaviours during routine household and leisure activities.

This study utilised secondary data from the NISS, which was constrained by the limitations of the available dataset. As a result, certain valuable information not collected by NISS, such as detailed socio-demographic characteristics, pre-existing health conditions, mobility limitations, or

environmental factors contributing to falls, and characteristics and nature of disabilities, could not be captured. Additionally, since NISS records patient information at a single point in time and does not include follow-up data, it limits the ability to assess long-term outcomes or estimate disability-adjusted life years (DALYs) associated with falls among older people.

Conclusions & Recommendations

This study provides a comprehensive overview of the epidemiology of falls among older people in Sri Lanka highlighting characteristics related to distribution, key patterns and outcomes of falls and falls-related injuries. The findings emphasize the need for targeted falls prevention strategies, especially in home settings and during household or leisure activities. To address this, it is recommended to develop community-driven fall prevention programs, raise awareness among older people and caregivers and integrate fall risk assessment into routine healthcare services. Furthermore, advocating for policies that support age-friendly environments and infrastructure, as well as encouraging further research on fall-related risks in different subgroups, are recommended to reduce the burden of falls and improving the quality of life for older people in Sri Lanka.

Public Health Implications

- Falls and fall-related injuries are a major cause of hospitalization, disability, and fatalities among older people aged ≥ 60 years in Sri Lanka. Since most elderly falls occur at home during household and leisure activities, injury prevention stakeholders and caregivers can use this insight to create safer living environments and reduce fall risks among older people.
- Policy interventions and caregiver education are essential to enhance fall prevention efforts. Strengthening community awareness and integrating fall prevention into public health programs can improve older peoples' well-being and reduce the strain on families and caregivers.

Author Declarations

Competing interests: The authors declare that they have no competing interests.

Ethics approval and consent to participate: This study utilised secondary data from the National Injury Surveillance System with permission from the Injury Prevention and Control Unit of the Ministry of Health Sri Lanka. Study investigators ensured the confidentiality and integrity of the dataset excluded personal contact details to ensure anonymity. Ethical clearance was obtained from the Ethics Review Committee at the National Institute of Health Science (NIHS/ERC/24/20).

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Author contributions: DW led the development of the research proposal, performed data extraction and analysis, contributed to data interpretation, and drafted the manuscript; SM contributed to the development of the research proposal, participated in manuscript writing, and provided critical review and revisions; SS was involved in data extraction, data cleaning, and reviewing and improving the manuscript; BK contributed to the research

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