Original Research

Open Access

A cross-sectional analysis of fall risk among institutionalized older adults in Malaysia

Belitung Nursing Journal
Volume 11(4), 487-495

https://doi.org/10.33546/bnj.3899

Zahira Zohari[1]*, Azliza Rahim[2], Hazwan Mat Din[3], Nurfaizah Saibul[4], Asiah Jafri[2], Shafikah Rahim[2], Faizah Nasir[2], and Hakimah Mohammad Sallehuddin[1]

[1]Geriatric Unit, Medical Department, Faculty of Medical and Health Sciences, Universiti Putra Malaysia, Malaysia
[2]Nursing Unit, Hospital Sultan Abdul Aziz Shah, Universiti Putra Malaysia, Malaysia
[3]Malaysian Research Institute on Ageing (MyAgeing®), Universiti Putra Malaysia, Malaysia
[4]Clinical Research Unit (CRU), Hospital Sultan Abdul Aziz Shah, Universiti Putra Malaysia, Malaysia

Abstract

Background: Falls among older adults in institutional care are a significant concern due to their serious consequences and are further complicated by staffing constraints. Identification of key risk factors is essential for targeted prevention and closer monitoring.

Objective: To identify the fall risk factors among older adults in institutional care and evaluate their relationships with overall fall risk.

Methods: This retrospective cross-sectional study analyzed data from 184 residents of a public institutional care home in Selangor, Malaysia. Data were collected from January 2023 to October 2023 through fall risk assessments and medical records. A history of falls over the past 12 months was documented. Fall risk was assessed using the Downton Fall Risk Index (DFRI). Descriptive statistics were used to summarize participant characteristics and the prevalence of falls. Ordinal logistic regression was conducted to identify factors associated with higher fall risk scores.

Results: The study included 184 participants (60.3% male), with the majority aged 70–79 years (45.4%). Common comorbidities were hypertension (50.5%) and diabetes mellitus (28.8%), with sensory impairments such as visual (50.0%) and hearing (32.1%) deficits. Polypharmacy was reported in 23% of participants, and almost a quarter had a history of falls. A high fall risk was observed in 39.7% of cases. Ordinal logistic regression revealed significant predictors of higher fall risk: hypertension (OR 5.93, 95% CI 2.18–16.14), polypharmacy (OR 5.53, 95% CI 2.11–14.47), visual impairment (OR 16.28, 95% CI 3.38–78.41), hearing impairment (OR 17.64, 95% CI 3.50–88.85), cognitive impairment (OR 33.12, 95% CI 4.61–237.88), psychiatric illness (OR 4.76, 95% CI 1.23–18.44), and female sex (OR 2.61, 95% CI 1.19–5.74).

Conclusion: Regular fall risk assessments and tailored intervention plans that address these factors are crucial for reducing falls and improving the quality of life for this vulnerable population. These findings provide practical guidance for healthcare professionals, including nursing staff, in institutional care to prioritize high-risk residents and implement early preventive strategies.

Keywords

falls; fall risk; geriatric; long-term care; older adults; Malaysia

***Corresponding author:**
Dr. Zahira Zohari
Geriatric Unit, Medical Department, Faculty of Medical and Health Sciences, Universiti Putra Malaysia, 43400, Serdang, Selangor, Malaysia
Email: zahira.zohari@upm.edu.my

Article info:
Received: 6 March 2025
Revised: 11 April 2025
Accepted: 2 July 2025

E-ISSN: 2477-4073 | P-ISSN: 2528-181X

Background

The establishment of institutional care homes is on the rise, concurrent with the increasing number of older adults globally. By 2050, nearly 20% of the world's population will be over 60 years of age (WHO, 2024). Falls among the geriatric population are a significant public health concern worldwide, particularly in institutional care settings where the population is often frail and vulnerable (Damar et al., 2023).

A 'fall' is defined as an event in which a participant comes to rest inadvertently on the ground or at a lower level, not due to an intrinsic medical event (such as a stroke) or external force (such as being pushed) (WHO, 2021). Studies estimate that 30-40% of residents in care homes experience at least one fall each year, with many of these incidents leading to severe injuries such as fractures, head trauma, and even death (Imaginário et al., 2022; Kioh & Rashid, 2018). The consequences of falls are particularly severe in this population due to the prevalence of comorbidities, frailty, and diminished physiological reserve, which can complicate recovery and lead to long-term disability (de Vries et al., 2018; Shao et al., 2023).

In high-income countries, such as the United States, Canada, and European nations, falls in care homes have been extensively studied, and various preventive measures have been implemented (Boyce et al., 2022; Shao et al., 2023). These include standardized fall risk assessment tools, environmental modifications, and tailored interventions, such

as strength and balance training programs (Rand et al., 2021; Switalski et al., 2022).

In contrast, low- and middle-income countries face additional challenges. Limited resources, insufficient training for nursing care staff, and the absence of standardized protocols contribute to higher fall rates and poorer outcomes. For example, in many low- and middle-income countries, care homes are often underfunded and understaffed, which exacerbates the risk of falls and hinders the implementation of effective prevention programs (Mehta et al., 2024). Moreover, the lack of research specific to these settings means that many fall prevention strategies are adapted from high-resource environments, which may not be fully applicable or effective in these contexts.

In Malaysia, the number of older adults requiring institutional care is growing. However, the resources available to these institutions are often limited, and many operate without standardized protocols (Md Isa et al., 2022). The funding shortfall leads to limited resources, including staffing, general environment, and safety, which pose health and safety hazards to them (Switalski et al., 2022; Vellani et al., 2022). This incurs a substantial burden on the costs of injury, hospitalization, and staff (Sterke et al., 2018).

A significant knowledge gap exists regarding falls in institutionalized settings, particularly in Malaysia. Data on falls in institutional care homes is very scarce. To our knowledge, only two studies have been published concerning this topic (Ghazi et al., 2017; Kioh & Rashid, 2018). However, these studies were limited by small sample sizes and a narrow focus on specific risk factors, thereby limiting their generalizability and practical application in nursing care.

Therefore, this study addresses the key nursing research problem of inconsistent fall risk stratification in institutional care. It aims to identify the fall risk factors among older adults in these settings and evaluate their relationship with overall fall risk scores. Understanding fall risk factors can empower nurses and the staff to identify, monitor, and respond to high-risk residents.

The findings can guide nursing staff and other healthcare professionals in prioritizing care, inform fall prevention strategies, and support decision-making in institutional care settings. These can potentially inform local practices and global strategies in similar resource-limited settings.

Methods

Study Design

This study used a retrospective, cross-sectional study in a public institutionalized care home in Selangor, Malaysia.

Sample/Participants

This study's population was selected from 289 residents in a public institutionalised care home in Selangor, Malaysia. Participants were chosen based on their medical records, ensuring they met the inclusion criteria. The inclusion criteria were delineated: participants had to be 60 years or older and residents of the care home. They needed to be able to ambulate independently, unaided, or with the assistance of a walking aid.

In contrast, the exclusion criteria included community-dwelling older adults not residing within the specified institution. Additionally, individuals who were bedbound, moribund, or otherwise immobilized, were excluded. This also extended to residents who were reliant on a wheelchair for their mobility. Participants with incomplete fall risk assessment data were excluded from the analysis. No imputation was conducted, and complete case analysis was used.

This study's sample size was determined using the recommendations from a simulation study for a multiple linear regression sample size by Knofczynski and Mundfrom (2008). With the estimated parameters of the current study, including a squared multiple correlation of 0.30, more than nine predictor variables, a significance level of 0.05, and a 95% confidence interval, a minimum sample size of 240 participants was required. In addition to the 20% expected non-response rate, a total of 288 participants were required for the study. Although the calculated sample size was 288, only 184 participants met the inclusion criteria due to incomplete or missing fall risk assessment data.

Instruments

Demographic information collected included age, gender, and race. Previous medical conditions and medications were also recorded. Timed-up and Go test (TUG) results were collected from the medical record. This test was done in the care home by their physiotherapist. A history of falls in the past 12 months was asked, and fall risk was assessed using the Downton Fall Risk Index (DFRI). The data were collected by a team of trained nurses and geriatric specialists who were actively involved in the "Knowledge Transfer Project" at the care home. This multidisciplinary team was responsible for conducting thorough assessments and ensuring the accuracy and reliability of the data collected.

Downton Fall Risk Index (DFRI)

The Downton Fall Risk Index (DFRI) is a validated assessment tool for assessing fall risk. It is endorsed for utilization in hospital settings, geriatric clinics, elderly care facilities, and primary care environments (Aranda-Gallardo et al., 2017; Rosendahl et al., 2003; Rutty, 1994). The validity and reliability of the tool have been supported through clinical practice and research in numerous studies. It comprises 11 risk elements, each attributed a point value of one. A cumulative score of 3 or above signifies a heightened risk of falls. The assessed risks encompass historical incidences of falls, medication types, sensory deficit occurrences, mental conditions, and gait attributes. DFRI was chosen because the characteristics tested were comprehensive and could be done quickly. This is important and suitable in situations where time is constrained.

Timed Up and Go Test

The Timed Up and Go (TUG) test is another widely used screening tool to assess fall risk (Klotzbier et al., 2021; Nordin et al., 2008; Rodrigues et al., 2023). The TUG involves timing a patient as they rise from an armchair, walk safely and comfortably to a line three meters away, turn around, walk back, and sit down again. If needed, the participant wears their usual footwear and may use a walking aid, such as a quadripod or walker. The timing is then recorded using a stopwatch. We evaluate completion times of less than 13.5 seconds as a threshold to identify those at higher risk of falls (Shumway-Cook et al., 2000). However, the literature reports a range of threshold values, varying from 10 to 33 seconds

(Ansai et al., 2018; Christopher et al., 2021; Makizako et al., 2017; Rodrigues et al., 2023; Steffen et al., 2002).

Data Collection

Data were collected from January 2023 to October 2023. This establishment falls under the jurisdiction of the Department of Social Welfare, which is part of the Ministry of Women, Family, and Community Development in Malaysia. This study utilized the data collected from fall risk assessments and medical records during a 'Knowledge Transfer Project' in the care home. The 12-month program included tailored health activities for older adults. It involved contributions from various specialists, including Geriatrics and Internal Medicine Experts, Psychiatrists, Physiotherapists, Dietitians, Clinical Nursing Specialists, Nurses, and Research Officers.

Data Analysis

The descriptive statistics of the study variables were reported as frequencies (percentages) and means (standard deviations) for categorical and numerical variables, respectively. The median (interquartile range) was reported whenever necessary for the numerical variables. We used an ordinal logistic regression model to determine the factors associated with higher fall risk scores. Variables for the ordinal logistic regression model were selected based on clinical relevance and findings from previous univariable and multivariable analyses. The proportional odds assumption was tested and met for all variables included in the analysis. Adjusted odds ratios (OR), 95% confidence intervals (CI), and *p*-values were reported. A significant level was set at $p < 0.05$. All statistical analyses were performed using the IBM SPSS v29.0 (SPSS Inc., Chicago, IL).

Ethical Consideration

This study had received ethics approval from The Ethics Committee for Research Involving Human Subjects at Universiti Putra Malaysia (Reference: JKEUPM-2023-695). All data were handled confidentially and anonymized to protect participant privacy. The requirement for obtaining participant consent was waived as this is a retrospective study, posing minimal risk to the individuals involved.

Results

Characteristics of the Participants

A detailed profile of 184 participants, representing 63.7% of the 289 residents, showed that the group was predominantly male (60.3%), with the largest proportion aged between 70 and 79 years (42.9%). The majority of participants were Malay (65.2%), followed by Indian (21.7%) and Chinese (13.0%). Common health conditions included hypertension (50.5%), diabetes mellitus (28.8%), ischemic heart disease (9.2%), hyperlipidemia (8.2%), and psychiatric illness (10.3%). A total of 67.4% of participants were taking at least one medication. Nearly half were on antihypertensives (45.1%), while smaller proportions used tranquilizers or sedatives (6.5%), diuretics (8.7%), antidepressants (6.0%), or antiparkinsonian drugs (3.3%). Various impairments were observed: 50.0% had visual impairments, 32.1% had hearing impairments, and 20.1% had limb impairments. Cognitive impairment was present in 11.4% of participants. Polypharmacy, defined as taking five or more medications, was reported in 23.4%, and 24.5% had a history of falls. Regarding mobility, 81.5% demonstrated a normal or safe gait when using walking aids. Based on the DFRI assessment, 39.7% were identified as being at high risk of falls. TUG test results were available for 37% of participants, of whom 20.1% were considered as high risk. The remaining 63.0% were unable to complete the TUG test due to limitations such as being bed-bound or medically unfit. Their results were excluded from the regression analysis but are presented descriptively for context (see **Table 1**).

Table 1 Characteristics of the participants ($N = 184$)

Characteristics	*n*	%
Gender		
Male	111	60.3
Female	73	39.7
Age (years)		
60–69	59	33.9
70–79	79	45.4
80–89	33	19.0
90–99	3	1.7
Race		
Malay	120	65.2
Indian	40	21.7
Chinese	24	13.0
Presence of Illnesses		
Hypertension	93	50.5
Diabetes Mellitus	53	28.8
Ischaemic Heart Disease	17	9.2
Hyperlipidaemia	15	8.2
Psychiatric Illness	19	10.3
Medication Type		
Any Medication Use	124	67.4
Tranquilisers/Sedatives	12	6.5
Diuretics	16	8.7
Anti-Hypertensives	83	45.1
Antiparkinsonian Drugs	6	3.3
Anti-depressants	11	6.0
Impairments		
Visual Impairment	92	50.0
Hearing Impairment	59	32.1
Limb Impairment	37	20.1
Cognitive Impairment	21	11.4
Gait		
Normal/Safe with Walking Aids	150	81.5
Unsafe with or without Walking Aid	34	18.5
Polypharmacy (≥5 medications)		
Yes	43	23.4
No	141	76.6
History of Fall		
Yes	45	24.5
No	139	75.5
Risk of Falls (DFIR)		
Low Risk	111	60.3
High Risk	73	39.7
Risk of Falls (TUG Test)		
Low Risk	31	16.8
High Risk	37	20.1
Missing/Unfit	116	63.0

Note: Percentages do not total 100% as participants could report more than one condition

The Risk of Falls based on the Downton Falls Risk Index

Table 2 shows that 24.5% of participants had a history of falls, while the remaining 75.5% did not, based on the Downton Falls Risk Index assessment.

Table 2 Characteristics and frequencies of the participants based on the Downton Falls Risk Index (*N* = 184)

Characteristics	*n*	%
Known Previous Fall		
Yes	45	24.5
No	139	75.5
Medication Type		
Tranquilizers/Sedatives	12	6.5
Diuretics	16	8.7
Antihypertensives (Other Than Diuretics)	83	45.1
Antiparkinsonian Drugs	6	3.3
Antidepressants	11	6.0
Impairments		
Visual Impairment	92	50.0
Hearing Impairment	59	32.1
Limb Impairment	37	20.1
Cognitive Impairment	21	11.4
Gait		
Normal/Safe with Walking Aids	150	81.5
Unsafe with or without Walking Aid	34	18.5
Risk of Falls (DFRI Score)		
Low Risk (Score < 3)	111	60.3
High Risk (Score ≥ 3)	73	39.7

Several medications that may affect fall risk were notable. Antihypertensive medications (excluding diuretics) were used by 45.1% of participants. Additionally, 6.5% were on tranquilizers or sedatives, 8.7% on diuretics, 6.0% on antidepressants, and 3.3% on antiparkinsonian drugs.

Half of the participants had visual impairments, affecting balance and orientation. Hearing, limb, and cognitive impairments were found in 32.1%, 20.1%, and 11.4% of the participants, respectively. Clinically, 81.5% had a normal or safe gait with aids, while 18.5% had an unsafe gait. In terms of risk classification using the Downton Falls Risk Index, 60.3% of participants were categorized as low risk (score <3) and 39.7% as high risk (score ≥3).

Table 3 extends our understanding of fall risks by correlating various study variables with the Downtown Falls Risk Index scores. The overall median fall risk score across the study was 2.0 (IQR: 1.0-3.0), with a mean fall risk score of 2.17 (95% CI: 1.96-2.37). The data correlated with certain health factors and increased fall risk. Participants with a history of falls and those with visual, hearing, limb, or cognitive impairments exhibited higher median risk scores. Polypharmacy was also linked to increased risk, as was having an unsafe gait, which showed a notably higher median score.

Table 3 Fall risk score (Downton Fall Risk Index, range 0–11) in relation to study variables (*N* = 184)

Variable	*n (%)*	Fall Risk Median (IQR)	Fall Risk Mean (95% CI)
Overall	–	2.0 (1.0–3.0)	2.17 (1.96, 2.37)
Age (mean ± SD)	–	–	72.83 ± 7.34
Gender			
Male	111 (60.3%)	2.0 (1.0–3.0)	2.14 (1.88, 2.41)
Female	73 (39.7%)	2.0 (1.0–3.0)	2.21 (1.88, 2.53)
Diabetes Mellitus			
No	131 (71.2%)	2.0 (1.0–3.0)	2.07 (1.83, 2.31)
Yes	53 (28.8%)	2.0 (1.0–4.0)	2.42 (2.02, 2.81)
Hypertension			
No	91 (49.5%)	2.0 (1.0–3.0)	1.84 (1.54, 2.13)
Yes	93 (50.5%)	2.0 (1.0–3.0)	2.49 (2.22, 2.77)
Cardiovascular Disease			
No	167 (90.8%)	2.0 (1.0–3.0)	2.16 (1.94, 2.37)
Yes	17 (9.2%)	3.0 (1.0–3.5)	2.29 (1.49, 3.10)
Psychological Illness			
No	165 (89.7%)	2.0 (1.0–3.0)	2.17 (1.95, 2.39)
Yes	19 (10.3%)	3.0 (1.0–3.0)	2.16 (1.62, 2.70)
Known Previous Falls			
No	139 (75.5%)	2.0 (1.0–3.0)	1.80 (1.59, 2.01)
Yes	45 (24.5%)	4.0 (2.5–4.0)	3.31 (2.93, 3.69)
Polypharmacy			
No	141 (76.6%)	2.0 (1.0–3.0)	1.98 (1.75, 2.21)
Yes	43 (23.4%)	2.0 (2.0–4.0)	2.79 (2.38, 3.20)
Visual Impairment			
No	92 (50.0%)	1.0 (1.0–2.0)	1.39 (1.16, 1.62)
Yes	92 (50.0%)	3.0 (2.0–4.0)	2.95 (2.69, 3.20)
Hearing Impairment			
No	125 (67.9%)	1.0 (1.0–2.5)	1.68 (1.46, 1.90)
Yes	59 (32.1%)	3.0 (2.0–3.0)	3.20 (2.89, 3.52)
Limb Impairment			
No	147 (79.9%)	2.0 (1.0–3.0)	1.78 (1.58, 1.97)
Yes	37 (20.1%)	4.0 (3.0–4.0)	3.73 (3.36, 4.10)
Cognitive Impairment			
No	163 (88.6%)	2.0 (1.0–3.0)	2.10 (1.89, 2.32)
Yes	21 (11.4%)	3.0 (1.5–3.5)	2.67 (2.08, 3.25)
Unsafe Gait			
No	150 (81.5%)	2.0 (1.0–3.0)	1.84 (1.64, 2.04)
Yes	34 (18.5%)	4.0 (3.0–4.0)	3.62 (3.23, 4.00)

Regression Analysis of the Factors Associated with Falls

Table 4 presents the results of the ordinal logistic regression model examining the association between multiple predictors and fall risk scores. The model identified several significant predictors of higher fall risk levels, including female sex (OR 2.61, 95% CI 1.19–5.74, p = 0.017), hypertension (OR 5.93, 95% CI 2.18–16.14, p <0.001), psychiatric illness (OR 4.76, 95% CI 1.23–18.44, p = 0.024), polypharmacy (OR 5.53, 95% CI 2.11–14.47, p <0.001), visual impairment (OR 16.28, 95% CI 3.38–78.41, p <0.001), hearing impairment (OR 17.64, 95% CI 3.50–88.85, p <0.001), and cognitive impairment (OR 33.12, 95% CI 4.61–237.88, p <0.001). Age, diabetes mellitus, cardiovascular disease, prior falls, limb impairment, and unsafe gait were not significantly associated with fall risk in this model.

Table 4 Ordinal logistic regression results for Fall Risk (Downton Fall Risk Index)

Variable	β	SE	Wald χ^2	*p*-value	OR (Exp(β))	95% CI (Lower–Upper)
Age (continuous)	0.01	0.018	0.3	0.580	1.01	0.98–1.05
Female (vs Male)	0.96	0.402	5.7	0.017	2.61	1.19–5.74
Diabetes Mellitus (Yes)	0.20	0.321	0.4	0.533	1.22	0.65–2.29
Hypertension (Yes)	1.78	0.511	12.1	<0.001	5.93	2.18–16.14
Cardiovascular Disease (Yes)	0.21	0.362	0.3	0.562	1.23	0.61–2.51
Psychiatric Illness (Yes)	1.56	0.691	5.1	0.024	4.76	1.23–18.44
Known Previous Falls (Yes)	0.64	0.367	3.0	0.081	1.90	0.92–3.89
Polypharmacy (Yes)	1.71	0.491	12.1	<0.001	5.53	2.11–14.47
Visual Impairment (Yes)	2.79	0.802	12.1	<0.001	16.28	3.38–78.41
Hearing Impairment (Yes)	2.87	0.825	12.1	<0.001	17.64	3.50–88.85
Limb Impairment (Yes)	0.88	0.513	2.9	0.086	2.41	0.88–6.59
Cognitive Impairment (Yes)	3.50	1.006	12.1	<0.001	33.12	4.61–237.88
Unsafe Gait (Yes)	0.43	0.520	0.7	0.408	1.54	0.55–4.26

Discussion

Older adults in institutionalized care homes are at a heightened risk of falls. The fall prevalence in our study was approximately 24.5%. This means that nearly a quarter of the participants had a history of falls. This was slightly lower than the study conducted in Penang, which reported a 32.8% prevalence (Kioh & Rashid, 2018), and another smaller study, with a 30% prevalence in Kuala Lumpur (Ghazi et al., 2017). Although there was variability within the same country, it may be due to differences in specific institutional environments or practices. This may also be due to our small sample size in a single center.

A study in the United States found a comparable fall rate, with approximately one-quarter of participants experiencing falls (Marcum et al., 2022). In contrast, a lower prevalence of falls was reported among older adults in long-term care facilities in Shanghai (Jiang et al., 2020). However, higher fall rates have been observed in other regions, such as Portugal, where the prevalence was 43.4% (Imaginário et al., 2022), and Brazil, with a prevalence of 41.0% (Shao et al., 2023). These variations may be due to more comprehensive reporting or differences in the resident populations.

Risk of Falls based on DFRI

In analyzing the use of the Downton Falls Risk Index (DFRI) to classify the fall risk, 60.3% of participants were classified as low risk (score <3) and 39.7% as high risk (score ≥3), with a median fall risk score of 2.0 across the study. A study by Rosendahl et al. (2003) found that DFRI helps predict falls in older people living in residential care facilities, especially within the first three months of assessment. They found that within three months, the risk of falling was 36% higher in the high-risk group (DFRI score ≥3) compared to the low-risk group in a residential care facility.

A study in Penang found that 13.3% of older adults were at moderate to high risk of falling, as determined by the Fall Risk Assessment Tool (FRAT). Another study in India showed that 37.4% of older adults were at high risk of falls, based on the Long Term Care Fall Risk Assessment Form (Dhargave & Sendhilkumar, 2016). However, different fall risk assessment tools were used, which could explain the vast difference in the findings.

The minimal TUG test data identified approximately one-fifth of participants as being at risk. Limited data were available due to time constraints and staff shortages, as tests were conducted only during physiotherapy sessions, which not all residents attended. Literature widely reports that slower TUG test times correlate with an increased fall risk (Buisseret et al., 2020; Schoene et al., 2013; Shumway-Cook et al., 2000).

While we used recognized assessment tools like the DFRI, more sensitive instruments exist for identifying fall risk. Tools such as the TUG test focus on physical mobility and balance but may overlook other factors included in the DFRI, like medication use or cognitive impairment. The STRATIFY tool (Aranda-Gallardo et al., 2017), used in hospitals, primarily assesses clinical factors and does not cover DFRI's full range of risk factors.

Recent studies emphasize the need for sensitive, quantitative tools to assess fall risk. Wearable technology and advanced balance assessment systems (Leirós-Rodríguez et al., 2020) can more accurately predict falls and tailor interventions to residents' specific needs. However, global adoption of these technologies is uneven, with many developing countries facing financial and logistical challenges.

Risk Factors Associated with Falls

The ordinal logistic regression model used in this study stratified residents according to increasing fall risk, showing which clinical characteristics independently contributed to this outcome. Although a DFRI score of ≥3 is typically used in clinical settings to define high fall risk, our study retained the full ordinal range of scores in the regression analysis. This approach allowed us to capture the graded nature of fall risk.

By preserving the ordinal structure of the DFRI, we were able to examine how clinical factors contribute to varying degrees of fall risk, which would otherwise be lost in a dichotomous model. The final model identified female sex, hypertension, psychiatric illness, polypharmacy, sensory impairments, and cognitive impairment as significant predictors.

Being female was a significant independent predictor of higher fall risk (OR 2.61). This aligns with previous literature suggesting that older women are more vulnerable to falls due to a combination of factors, such as lower muscle mass, a higher prevalence of osteoporosis, greater life expectancy, and an increased likelihood of living alone (Özer et al., 2023). Additionally, older women are often more proactive in reporting symptoms, which may also influence the detection and scoring of fall risk.

Our study highlighted that residents with hypertension were at a higher risk of falls, with half taking at least one anti-hypertensive. While our research did not show a direct correlation, a local study examined fall factors in older adults with hypertension (Abu Bakar et al., 2021). It found that diuretic use, particularly with polypharmacy, significantly increased fall incidence in this group. A comprehensive review and meta-analysis by de Vries et al. (2018) analyzing 131 studies and confirmed that loop diuretics are significantly associated with increased fall risk.

Other studies noted that postural hypotension was significant among residents in care homes, potentially aggravating fall risk (McDonagh et al., 2021; Ooi et al., 2000). Antihypertensive medications, particularly those causing vasodilation or diuresis, can lead to postural hypotension, thus increasing fall risk. This underscores the need for careful management of antihypertensive therapy in this population, balancing blood pressure control with fall risk reduction.

We also found significant parallels in the impact of sensory impairments on the risk of falls among older adults. An Indian study revealed a high prevalence of falls among elderly individuals in residential care, with a notable link between low vision, specifically uncorrected refractive errors, and an increased fall risk (Marmamula et al., 2020). This aligns with our findings, emphasizing the importance of addressing visual impairments to reduce fall risks. Sensory impairments involving both vision and hearing are common problems experienced by older adults. Studies reported that the prevalence of visual and hearing impairments can be up to 50% of older adults aged 60 years and above, which worsens with increasing age. They are also known to have an impact on immobilization and dementia outcomes (Zhang et al., 2023). The strong association observed with cognitive impairment (OR 33.12) reflects the critical role that cognitive decline plays in mobility, balance, and hazard perception; however, the wide confidence interval suggests variability due to smaller subgroup sizes and warrants cautious interpretation.

Interestingly, although fall history is widely recognized as a major predictor of future falls, it was not statistically significant in our multivariable model (OR 1.90, 95% CI 0.92–3.89, p = 0.081). This contrasts with numerous prior studies, where fall history has consistently been a strong predictor of subsequent falls (Baixinho et al., 2022). Global findings underline the importance of fall history in predicting and preventing future falls in older adults (Chu et al., 2005; Hill et al., 2016; Lundin-Olsson et al., 2003; Sahril et al., 2020; Salari et al., 2022; Shao et al., 2023; Tan et al., 2019). The awareness of past falls often informs more individualized fall prevention strategies.

Age and diabetes mellitus have also been widely reported as fall risk factors in institutionalized older adults, but they were also not statistically significant in our multivariable model. This may be attributed to the more decisive influence of co-existing factors such as polypharmacy, cognitive impairment, and sensory deficits, which may have masked the independent contribution of age and diabetes. These findings highlight the complex, multifactorial nature of fall risk and the importance of examining combined effects rather than individual predictors in isolation.

These comparisons show that fall prevalence among institutionalized older adults varies across studies (Montero-Odasso et al., 2022; Shao et al., 2023). Institutional factors such as staffing ratios, supervision quality, and environmental safety (including lighting, flooring, and layout) significantly influence fall rates in long-term care settings. Facilities with structured policies, adequate staffing, and well-trained personnel typically report lower rates of falls. These differences may partly explain the variability in fall rates and associated risk factors in international studies (Baixinho et al., 2022; Kim et al., 2022). Although these factors were not directly measured in our study, they are important for interpreting fall risk in institutional care environments.

The overlapping and distinct factors contributing to falls among older adults in institutionalized care homes highlight the need for comprehensive, individualized approaches to managing fall risks in institutionalized settings. Our findings reinforce the clinical relevance of structured assessment tools, such as DFRI, which incorporate several significant predictors identified in this study, including polypharmacy, cognitive impairment, and sensory deficits. While not all components of the DFRI reached statistical significance in our analysis, their inclusion remains clinically justified based on prior evidence. Importantly, these results provide actionable insights for nursing practice by empowering nursing staff to incorporate regular fall risk assessments into routine care and prioritize closer monitoring of high-risk residents. Although this study was conducted in a single center with a limited number of residents, our findings can serve as a valuable empirical reference for revising patient safety policies and implementing measures that promote fall prevention in institutionalized care settings.

Limitations

While this study provides valuable insights into the situation in care homes, it is important to consider its limitations. The study's cross-sectional design hinders the establishment of a temporal relationship, and convenience sampling may introduce sample bias by overrepresenting the care home. The use of non-probability sampling and reliance on retrospective record review may introduce selection bias, as participants included were those with complete and accessible data. This could limit the representativeness of the findings and their generalizability to broader institutional care populations.

Moreover, there was a potential for recall bias, as participants were asked to recall falls that occurred within a year. Additionally, the involvement of different professionals in grading gait and mental status could introduce variability in the

assessments, which may affect the consistency and reliability of the findings. This study did not evaluate inter-rater reliability, and this variability could have influenced scoring consistency for these subjective domains.

The calculated sample size was 288, but only 184 participants were included due to incomplete fall risk assessments, resulting in fewer TUGs completed. This may have limited the statistical power to detect associations for variables with smaller effect sizes. Predictors like limb impairment and fall history showed elevated odds ratios but did not reach statistical significance. While the model had good internal consistency, it was not externally validated. Future studies with larger, independent samples are needed to test the robustness and generalizability of the identified predictors in various institutional care settings.

Conclusion

This study has identified that female sex, hypertension, psychiatric illness, polypharmacy, sensory impairments (visual and hearing), and cognitive impairment are significant contributors to the increased risk of falls within this institution. By addressing these factors through proactive nursing interventions such as routine screenings, medication reviews, and individualized care plans, falls can be more effectively prevented. Future recommendations may include encouraging regular visits from geriatricians or geriatric nurses who are experts in the care of older adults, to facilitate comprehensive health assessments that detect fall risk factors. Collaborating with policymakers to strengthen regulations and care standards will further ensure that facilities are well-equipped to provide high-quality, preventive care. This integrated strategy not only improves resident safety but also elevates the overall standard of care in institutionalized environments.

Declaration of Conflicting Interest

No conflict of interest to declare.

Funding

This work was supported by the Knowledge Transfer Grant Scheme of Industry and Community Relations (JINM), Universiti Putra Malaysia (UPM) (UPM.UCTC.800-2/2/16(KTGS22). However, no funding was received for publication.

Acknowledgment

The authors thank the staff and residents of Rumah Seri Kenangan Cheras, Selangor, for their support and participation in this study. We also acknowledge the contributions of other project members of 'Program Pemerkasaan Perkhidmatan Penjagaan Kesihatan Warga Emas di Rumah Seri Kenangan Cheras, Selangor Melalui Kepakaran Penjagaan Geriatrik Hospital Sultan Abdul Aziz Shah (Hsaas), UPM': Sri Saliza Salleh, Haslina Hassan, Wan Rabiatul Adawiah Wan Rosdi, Norhazlinda Md Dali, Ngu Hee Hung, Salwana Ahmad, Nurul Iman Hafizah Adanan, and Norsidawati Abdul Gani.

Authors' Contributions

ZZ, AR, and HMS contributed to the conception and design of the study; HMD, AJ, SR, FN, SSS, and WRAWR performed and contributed to data collection and data arrangement; AR, HMD, and NS contributed to final data acquisition and initial data analysis; ZZ and HMD performed the final data analysis and data interpretation; ZZ drafted significant portions of the manuscript; ZZ and HMS contributed to the critical revision of the manuscript for important intellectual content. All authors reviewed and approved the final manuscript.

Authors' Biographies

Dr. Zahira Zohari, MD, MRCP (UK), is a Physician and Geriatric Fellow at the Geriatric Unit, Medical Department, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.

Azliza Rahim, RN, Master of Nursing (Orthopaedics & Traumatology), is a Clinical Nurse Specialist at the Nursing Unit, Hospital Sultan Abdul Aziz Shah, Universiti Putra Malaysia.

Hazwan Mat Din, MSc, B.MLT, a research officer, works at the Malaysian Research Institute on Ageing (MyAgeing), Universiti Putra Malaysia.

Nurfaizah Saibul, MSc Community Nutrition, a research officer, works at the Clinical Research Unit (CRU), Hospital Sultan Abdul Aziz Shah, Universiti Putra Malaysia.

Asiah Jafri, RN, BNurs (Hons), Advanced Diploma in Wound Care Nursing, is a Clinical Nurse Specialist at the Nursing Unit, Hospital Sultan Abdul Aziz Shah, Universiti Putra Malaysia.

Shafikah Rahim, RN, BNurs (Hons), Advanced Diploma in Nephrology Nursing, is a Clinical Nurse Specialist at the Nursing Unit, Hospital Sultan Abdul Aziz Shah, Universiti Putra Malaysia.

Faizah Nasir, RN, MPH, BNurs (Hons), Advanced Diploma in Midwifery, is a Clinical Nurse Specialist at the Nursing Unit, Hospital Sultan Abdul Aziz Shah, Universiti Putra Malaysia.

Dr. Hakimah Mohammad Sallehuddin, MBBS, MRCP (UK), is a Geriatrician at the Geriatric Unit, Medical Department, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.

Data Availability

The dataset generated during and analyzed during the current study is available from the corresponding author upon reasonable request.

Declaration of Use of AI in Scientific Writing

The authors utilized ChatGPT and Grammarly during the writing process to enhance readability and eliminate grammatical errors. However, they took full responsibility for the content.

References

Abu Bakar, A. A., Abdul Kadir, A., Idris, N. S., & Mohd Nawi, S. N. (2021). Older adults with hypertension: Prevalence of falls and their associated factors. *International Journal of Environmental Research and Public Health*, *18*(16), 8257. https://doi.org/10.3390/ijerph18168257

Ansai, J. H., Andrade, L. P. d., Nakagawa, T. H., & Rebelatto, J. R. (2018). Performances on the timed up and go test and subtasks between fallers and non-fallers in older adults with cognitive impairment. *Arquivos de Neuro-Psiquiatria*, *76*(6), 381-386. https://doi.org/10.1590/0004-282X20180055

Aranda-Gallardo, M., Enriquez de Luna-Rodriguez, M., Vazquez-Blanco, M. J., Canca-Sanchez, J. C., Moya-Suarez, A. B., & Morales-Asencio, J. M. (2017). Diagnostic validity of the STRATIFY and Downton instruments for evaluating the risk of falls by hospitalised acute-care patients: A multicentre longitudinal study. *BMC Health Services Research*, *17*, 277. https://doi.org/10.1186/s12913-017-2214-3

Baixinho, C. L., Madeira, C., Alves, S., Henriques, M. A., & Dixe, M. d. A. (2022). Falls and preventive practices among institutionalized older people. *International Journal of Environmental Research and Public Health*, *19*(13), 7577. https://doi.org/10.3390/ijerph19137577

Boyce, R. D., Kravchenko, O. V., Perera, S., Karp, J. F., Kane-Gill, S. L., Reynolds, C. F., Albert, S. M., & Handler, S. M. (2022). Falls prediction using the nursing home minimum dataset. *Journal of the American Medical Informatics Association*, *29*(9), 1497-1507. https://doi.org/10.1093/jamia/ocac111

Buisseret, F., Catinus, L., Grenard, R., Jojczyk, L., Fievez, D., Barvaux, V., & Dierick, F. (2020). Timed up and go and six-minute walking tests with wearable inertial sensor: One step further for the prediction of the risk of fall in elderly nursing home people. *Sensors*, *20*(11), 3207. https://doi.org/10.3390/s20113207

Christopher, A., Kraft, E., Olenick, H., Kiesling, R., & Doty, A. (2021). The reliability and validity of the Timed Up and Go as a clinical tool in individuals with and without disabilities across a lifespan: A systematic review: Psychometric properties of the Timed Up and Go. *Disability and Rehabilitation*, *43*(13), 1799-1813. https://doi.org/10.1080/09638288.2019.1682066

Chu, L.-W., Chi, I., & Chiu, A. Y. (2005). Incidence and predictors of falls in the Chinese elderly. *Annals of the Academy of Medicine, Singapore*, *34*(1), 60-72.

Damar, H., Bilik, Ö., & Güler, A. (2023). Frailty and factors affecting it among older people living in nursing home: A cross-sectional study. *European Journal of Geriatrics and Gerontology*, *5*(3), 203-211. http://doi.org/10.4274/ejgg.galenos.2023.2022-11-1

de Vries, M., Seppala, L. J., Daams, J. G., van de Glind, E. M. M., Masud, T., van der Velde, N., Blain, H., Bousquet, J., Bucht, G., & Caballero-Mora, M. A. (2018). Fall-risk-increasing drugs: A systematic review and meta-analysis: I. Cardiovascular drugs. *Journal of the American Medical Directors Association*, *19*(4), 371.e371-371.e379. https://doi.org/10.1016/j.jamda.2017.12.013

Dhargave, P., & Sendhilkumar, R. (2016). Prevalence of risk factors for falls among elderly people living in long-term care homes. *Journal of Clinical Gerontology and Geriatrics*, *7*(3), 99-103. https://doi.org/10.1016/j.jcgg.2016.03.004

Ghazi, H. F., Elnajeh, M., Abdalqader, M. A., Baobaid, M. F., Rosli, N. S. R., & Syahiman, N. (2017). The prevalence of falls and its associated factors among elderly living in old folks home in Kuala Lumpur, Malaysia. *International Journal of Community Medicine and Public Health*, *4*(10), 3524-3529. http://dx.doi.org/10.18203/2394-6040.ijcmph20174214

Hill, K. D., Flicker, L., LoGiudice, D., Smith, K., Atkinson, D., Hyde, Z., Fenner, S., Skeaf, L., Malay, R., & Boyle, E. (2016). Falls risk assessment outcomes and factors associated with falls for older Indigenous Australians. *Australian and New Zealand Journal of Public Health*, *40*(6), 553-558. https://doi.org/10.1111/1753-6405.12569

Imaginário, C., Martins, T., Araújo, F., Rocha, M., & Machado, P. P. (2022). Risk factors associated with falls among nursing home residents: A case-control study. *Portuguese Journal of Public Health*, *39*(3), 120-130. https://doi.org/10.1159/000520491

Jiang, Y., Xia, Q., Zhou, P., Jiang, S., Diwan, V. K., & Xu, B. (2020). Falls and fall-related consequences among older people living in long-term care facilities in a megacity of China. *Gerontology*, *66*(6), 523-531. https://doi.org/10.1159/000510469

Kim, B., Do, K., & Yim, J. (2022). Environmental factors influencing the prevalence of falls in South Korea. *Physical Therapy Rehabilitation Science*, *11*(1), 66-77. https://doi.org/10.14474/ptrs.2022.11.1.66

Kioh, S. H., & Rashid, A. (2018). The prevalence and the risk of falls among institutionalised elderly in Penang, Malaysia. *Medical Journal of Malaysia*, *73*(4), 212-219.

Klotzbier, T. J., Korbus, H., Johnen, B., & Schott, N. (2021). Evaluation of the instrumented Timed Up and Go test as a tool to measure exercise intervention effects in nursing home residents: results from a PROCARE substudy. *German Journal of Exercise and Sport Research*, *51*, 430-442. https://doi.org/10.1007/s12662-021-00764-0

Knofczynski, G. T., & Mundfrom, D. (2008). Sample sizes when using multiple linear regression for prediction. *Educational and Psychological Measurement*, *68*(3), 431-442. https://doi.org/10.1177/0013164407310131

Leirós-Rodríguez, R., Romo-Pérez, V., García-Soidán, J. L., & Soto-Rodríguez, A. (2020). Identification of body balance deterioration of gait in women using accelerometers. *Sustainability*, *12*(3), 1222. https://doi.org/10.3390/su12031222

Lundin-Olsson, L., Jensen, J., Nyberg, L., & Gustafson, Y. (2003). Predicting falls in residential care by a risk assessment tool, staff judgement, and history of falls. *Aging Clinical and Experimental Research*, *15*, 51-59. https://doi.org/10.1007/BF03324480

Makizako, H., Shimada, H., Doi, T., Tsutsumimoto, K., Nakakubo, S., Hotta, R., & Suzuki, T. (2017). Predictive cutoff values of the five-times sit-to-stand test and the timed "up & go" test for disability incidence in older people dwelling in the community. *Physical Therapy*, *97*(4), 417-424. https://doi.org/10.2522/ptj.20150665

Marcum, Z. A., Dai, Z., & Tan, E. C. K. (2022). Prevalence and risk factors for falls and fall-related injuries in the 2018 National Post-acute and Long-term Care Study. *Journal of the American Geriatrics Society*, *71*(1), 276-279. https://doi.org/10.1111/jgs.18014

Marmamula, S., Barrenkala, N. R., Challa, R., Kumbham, T. R., Modepalli, S. B., Yellapragada, R., Bhakki, M., Friedman, D. S., & Khanna, R. C. (2020). Falls and visual impairment among elderly residents in 'homes for the aged' in India. *Scientific Reports*, *10*(1), 13389. https://doi.org/10.1038/s41598-020-70066-2

McDonagh, S. T. J., Mejzner, N., & Clark, C. E. (2021). Prevalence of postural hypotension in primary, community and institutional care: A systematic review and meta-analysis. *BMC Family Practice*, *22*, 1-23. https://doi.org/10.1186/s12875-020-01313-8

Md Isa, F., Noor, S., Wei Wei, G., Syed Hussain, S. D. B., Mohamad Ibrahim, H., & Ahmdon, M. A. S. (2022). Exploring the facet of elderly care centre in multiethnic Malaysia. *PSU Research Review*, *6*(1), 17-38. https://doi.org/10.1108/PRR-05-2020-0013

Mehta, V., Ajmera, P., Kalra, S., Miraj, M., Gallani, R., Shaik, R. A., Serhan, H. A., & Sah, R. (2024). Human resource shortage in India's health sector: A scoping review of the current landscape. *BMC Public Health*, *24*(1), 1368. https://doi.org/10.1186/s12889-024-18850-x

Montero-Odasso, M., Van Der Velde, N., Martin, F. C., Petrovic, M., Tan, M. P., Ryg, J., Aguilar-Navarro, S., Alexander, N. B., Becker, C., & Blain, H. (2022). World guidelines for falls prevention and management for older adults: A global initiative. *Age and Ageing*, *51*(9), afac205. https://doi.org/10.1093/ageing/afac205

Nordin, E., Lindelöf, N., Rosendahl, E., Jensen, J., & Lundin-Olsson, L. (2008). Prognostic validity of the Timed Up-and-Go test, a modified Get-Up-and-Go test, staff's global judgement and fall history in evaluating fall risk in residential care facilities. *Age and Ageing*, *37*(4), 442-448. https://doi.org/10.1093/ageing/afn101

Ooi, W. L., Hossain, M., & Lipsitz, L. A. (2000). The association between orthostatic hypotension and recurrent falls in nursing home residents. *The American Journal of Medicine*, *108*(2), 106-111. https://doi.org/10.1016/S0002-9343(99)00425-8

Özer, F., Akin, S., Soysal, T., Durmuş, N., & Gökçekuyu, B. (2023). Falls in older women and men: Associated factors and sarcopenia. *European Journal of Geriatrics and Gerontology*, *5*(2), 124-131. http://doi.org/10.4274/ejgg.galenos.2023.2023-1-1

Rand, S., Smith, N., Jones, K., Dargan, A., & Hogan, H. (2021). Measuring safety in older adult care homes: A scoping review of the international literature. *BMJ Open*, *11*(3), e043206. https://doi.org/10.1136/bmjopen-2020-043206

Rodrigues, F., Teixeira, J. E., & Forte, P. (2023). The reliability of the timed up and go test among Portuguese elderly. *Healthcare*, *11*(7), 928. https://doi.org/10.3390/healthcare11070928

Rosendahl, E., Lundin-Olsson, L., Kallin, K., Jensen, J., Gustafson, Y., & Nyberg, L. (2003). Prediction of falls among older people in residential care facilities by the Downton index. *Aging Clinical and Experimental Research*, *15*, 142-147. https://doi.org/10.1007/BF03324492

Rutty, E. (1994). Falls in the elderly. *Nursing Standard*, *8*(19), 54. https://doi.org/10.7748/ns.8.19.54.s62

Sahril, N., Shahein, N. A., Yoep, N., Mahmud, N. A., Sooryanarayana, R., Maw Pin, T., Muhamad, N. A., & Ismail, H. (2020). Prevalence and factors associated with falls among older persons in Malaysia. *Geriatrics & Gerontology International*, *20*, 33-37. https://doi.org/10.1111/ggi.13980

Salari, N., Darvishi, N., Ahmadipanah, M., Shohaimi, S., & Mohammadi, M. (2022). Global prevalence of falls in the older adults: A comprehensive systematic review and meta-analysis. *Journal of Orthopaedic Surgery and Research*, *17*(1), 334. https://doi.org/10.1186/s13018-022-03222-1

Schoene, D., Wu, S. M. S., Mikolaizak, A. S., Menant, J. C., Smith, S. T., Delbaere, K., & Lord, S. R. (2013). Discriminative ability and predictive validity of the timed Up and Go test in identifying older people who fall: Systematic review and meta-analysis. *Journal of the American Geriatrics Society*, *61*(2), 202-208. https://doi.org/10.1111/jgs.12106

Shao, L., Shi, Y., Xie, X.-Y., Wang, Z., Wang, Z.-A., & Zhang, J.-E. (2023). Incidence and risk factors of falls among older people in nursing homes: Systematic review and meta-analysis. *Journal of the American Medical Directors Association*, *24*(11), 1708-1717. https://doi.org/10.1016/j.jamda.2023.06.002

Shumway-Cook, A., Brauer, S., & Woollacott, M. (2000). Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. *Physical Therapy*, *80*(9), 896-903. https://doi.org/10.1093/ptj/80.9.896

Steffen, T. M., Hacker, T. A., & Mollinger, L. (2002). Age-and gender-related test performance in community-dwelling elderly people: Six-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and gait speeds. *Physical Therapy*, *82*(2), 128-137. https://doi.org/10.1093/ptj/82.2.128

Sterke, C. S., Panneman, M. J., Erasmus, V., Polinder, S., & Van Beeck, E. F. (2018). Increased care demand and medical costs after falls in nursing homes: A Delphi study. *Journal of Clinical Nursing*, *27*(13-14), 2896-2903. https://doi.org/10.1111/jocn.14488

Switalski, J., Wnuk, K., Tatara, T., Miazga, W., Wiśniewska, E., Banaś, T., Partyka, O., Karakiewicz-Krawczyk, K., Jurczak, J., & Kaczmarski, M. (2022). Interventions to increase patient safety in long-term care facilities—Umbrella review. *International Journal of Environmental Research and Public Health*, *19*(22), 15354. https://doi.org/10.3390/ijerph192215354

Tan, M. P., Mat, S., Alex, D., & Kamaruzzaman, S. B. (2019). 150 Falls in Malaysia: Magnitude, risk, disparities, and solutions. *Age and Ageing*, *48*(Supplement_4), iv34-iv39. https://doi.org/10.1093/ageing/afz164.150

Vellani, S., Zuniga, F., Spilsbury, K., Backman, A., Kusmaul, N., Scales, K., Chu, C. H., Mateos, J. T., Wang, J., & Fagertun, A. (2022). Who's in the house? Staffing in long-term care homes before and during COVID-19 pandemic. *Gerontology and Geriatric Medicine*, *8*, 23337214221090803. https://doi.org/10.1177/23337214221090803

WHO. (2021). *Falls*. https://www.who.int/news-room/fact-sheets/detail/falls

WHO. (2024). *Ageing and health*. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health

Zhang, W., Roberts, T. V., Poulos, C. J., & Stanaway, F. F. (2023). Prevalence of visual impairment in older people living with dementia and its impact: A scoping review. *BMC Geriatrics*, *23*(1), 63. https://doi.org/10.1186/s12877-022-03581-8

Cite this article as: Zohari, Z., Rahim, A., Mat Din, H., Saibul, N., Jafri, A., Rahim, S., Nasir, F., & Mohammad Sallehuddin, H. (2025). A cross-sectional analysis of fall risk among institutionalized older adults in Malaysia. *Belitung Nursing Journal, 11*(4), 487-495. https://doi.org/10.33546/bnj.3899