

Urinary Incontinence and Cognitive Function on Fall Risk in Older Adults: A Cross-Sectional Study in Singapadu

Ni Made Ayu Ananda Pranata Dewi^{1*}, Anak Agung Gede Angga Puspa Negara², Ni Komang Ayu Juni Antari³, Anak Agung Gede Eka Septian Utama⁴

¹Undergraduate and Professional Physiotherapy Program, Faculty of Medicine, Udayana University

^{2,3,4}Department of Physiotherapy, Faculty of Medicine, Udayana University

*Correspondence author at: Jl. Raya Kampus Unud, Jimbaran, South Kuta, Badung Regency, Bali 80361, Indonesia

E-mail address: ayuanandapranatadewi27@gmail.com

Received 03 February 2025; Received in revised form 11 February 2025; Accepted 13 February 2025; Published 01 May 2025

© 2025 The Authors. Published by the Physiotherapy Study Program, Faculty of Medicine, Udayana University, in collaboration with the Indonesian Physiotherapy Association (Ikatan Fisioterapi Indonesia).

This is an open-access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

Abstract

Introduction: Falls can cause serious injuries and reduce the quality of life in older adults. While some studies suggest that urinary incontinence and cognitive impairment increase fall risk, others report no significant association. Urinary incontinence contributes to falls through urgency and mobility impairment, whereas cognitive function affects balance and reaction time. This study examines the impact of urinary incontinence and cognitive function on fall risk.

Methods: This cross-sectional study involved 77 older adults in Singapadu Tengah Village, Gianyar, using total sampling. Fall risk was assessed with the M-IFRAT, cognitive function with the MMSE, and urinary incontinence with the ICIQ-UI SF. Binary logistic regression was used to analyze the influence of the independent variables on fall risk.

Results: The regression model (Nagelkerke $R^2 = 0.534$) showed a significant association between urinary incontinence and fall risk ($p < 0.05$), while cognitive function was not. Older adults with moderate urinary incontinence had a 27.296 times higher fall risk (95% CI: 4.743–157.102, $p < 0.001$) than those with mild incontinence. Although cognitive impairment was not significantly related to falls, it increased fall risk by 3.053 times (95% CI: 0.829–11.243, $p = 0.093$).

Conclusion: Urinary incontinence is the most influential factor in fall risk among older adults. Fall prevention should focus on managing incontinence through balance training and pelvic floor muscle strengthening.

Keywords: older adults, urinary incontinence, cognitive function, fall risk.

Introduction

Global demographic changes indicate an increasing proportion of the elderly population across various countries. According to the World Health Organization (WHO), the number of older adults (aged ≥ 60 years) is expected to rise from 1 billion in 2020 to 1.4 billion and reach 2.1 billion by 2050.¹ This phenomenon presents various health challenges, one of which is the increased risk of falls, which can significantly impact the quality of life in older adults. WHO reports that falls rank as the second leading cause of unintentional injury-related deaths worldwide, following traffic accidents, with approximately 684,000 fall-related deaths annually.² A cross-sectional study in Indonesia by Susilowati (2022) involving 427 older adults found that 29% reported experiencing falls in the past year, with a higher prevalence in women (31%) compared to men (20%).³ Advancing age contributes to an increased risk of falls.⁴

Biological aging results from molecular and cellular damage over time, leading to decreased physical and mental capacity, as well as increased disease and mortality risk.¹ Aging affects the nervous system, which plays a crucial role in maintaining balance and stability, thereby increasing fall risk. Additionally, age-related declines in vision, muscle strength, and reaction speed can impair an individual's ability to maintain or restore balance when encountering environmental challenges such as uneven or slippery surfaces.⁵ Another consequence of aging is cognitive decline, which can affect daily activities and body balance, thus increasing fall risk.⁶

Cognitive function refers to the brain's ability to process information, including attention, memory, language, executive function, and visuospatial skills.⁶ Cognitive impairment affects balance through reduced visuospatial capacity, slower information processing, impaired judgment, and diminished executive function.⁷ A decline in cognitive function can lead to reduced neuromotor coordination, psychomotor abilities, and flexibility, increasing the likelihood of falls while walking.⁶ Additionally, executive function impairment decreases the ability to recruit compensatory mechanisms and adapt to changes in gait and balance, further elevating fall risk.⁶ Slower reaction times due to cognitive decline also impact balance in older adults, as neurological changes occur with aging.⁶

Beyond cognitive impairment, aging also weakens the pelvic floor muscles (PFM), which play a vital role in urinary continence.⁸ Urinary incontinence (UI) occurs due to weakened PFM, resulting in involuntary urine leakage.⁸ Studies indicate that UI prevalence ranges from 5% to 70%, with dominant figures between 25% and 45%.⁹ The weakening of PFM, which collaborates with core muscles to maintain body stability, leads to excessive reliance on leg muscles for balance, thereby increasing fall risk.¹⁰ UI can impair mobility due to an increased urgency to urinate, prompting older adults to rush to the restroom without considering balance and environmental conditions, heightening

the risk of falls.¹¹ Excessive urgency associated with UI can further restrict mobility, as individuals with UI may limit physical activity after a fall due to fear of recurrence or injury. This restriction leads to decreased balance and walking ability, increasing fall risk.¹¹

Although many studies have examined the relationship between UI, cognitive function, and fall risk in older adults, some research focuses solely on one risk factor without considering their combined effects. UI can increase fall risk through impaired mobility and excessive urgency, while cognitive impairment can affect balance and reaction time. However, the relationship between these factors and falls remains incompletely understood. Furthermore, limited studies have been conducted in Indonesia, particularly in Gianyar Regency, Bali, where the proportion of older adults is higher than the provincial average (14.27% vs. 12.37%).¹² Therefore, this study aims to explore the impact of UI and cognitive function on fall risk among older adults in Gianyar Regency.

This study aims to analyze the effects of UI and cognitive function on fall risk among older adults in Singapadu Tengah Village. Specifically, the objectives are: (1) to determine the impact of urinary incontinence on fall risk in older adults and (2) to assess the effect of cognitive function on fall risk in older adults. Based on studies indicating that older adults experiencing daily urgency UI are at high risk of falling and research suggesting that fall prevalence is twice as high in those with cognitive impairment, with an increased risk of fall-related injuries,^{11,13} the study hypothesizes that (1) UI significantly affects fall risk in older adults and (2) cognitive impairment increases fall risk in older adults. This research is expected to contribute to the healthcare field, particularly physiotherapy, and serve as a reference for both healthcare professionals and the general public in fall prevention efforts for older adults.

Methods

This study employed an analytical observational method with a cross-sectional approach and was conducted in Singapadu Tengah Village, Sukawati District, Gianyar Regency. Data collection took place from March to June 2024 while adhering to health protocols.

The study population consisted of all active older adults in Singapadu Tengah Village, totaling 210 individuals. However, only 77 older adults were present and participated in the study. A non-probability total sampling technique was applied to the available population ($n = 77$). To ensure a sufficient and representative sample size, the minimum sample calculation was performed using Slovin's formula, incorporating a population size (N) of 210 and a margin of error (e) of 0.1, resulting in a minimum required sample of 68 participants. With 77 respondents included, the study met the criteria for an adequate sample size.

The inclusion criteria were individuals aged 60 years or older, without neurological disorders, and willing to participate throughout the study by signing informed consent (IC). The exclusion criteria included individuals with severe hearing impairments or visual impairments (blindness or cataracts). After data collection from 77 participants, eligibility screening based on inclusion criteria resulted in the exclusion of five individuals under 60 years old, leaving a final sample of 72 participants for analysis.

First, participants signed the IC and underwent an interview regarding their name, age, gender, presence of neurological disorders, and any hearing or visual impairments (blindness or cataracts). Cognitive function was then assessed using the Mini-Mental State Examination (MMSE), which evaluates five cognitive domains: orientation, registration, attention and calculation, recall, and language. MMSE scores are interpreted as follows: 27–30 (normal cognitive function), 21–26 (mild cognitive impairment), 11–20 (moderate cognitive impairment), and 0–10 (severe cognitive impairment). The MMSE demonstrates high reliability (0.887) and validity (0.776), with a p -value of 0.001, confirming its suitability for cognitive function assessment.¹³

The interview continued with an assessment of urinary incontinence (UI) using the International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI SF). This questionnaire consists of four questions designed to measure urinary leakage frequency, assess leakage volume, evaluate the impact of UI on daily life, and provide a confirmation response.¹⁴ If any inconsistencies in responses were identified, the researcher directly clarified with the respondent to ensure data accuracy. The questionnaire is interpreted as follows: mild UI (score 1–5), moderate UI (6–12), severe UI (13–18), and very severe UI (19–21). The ICIQ-UI SF has an intraclass correlation coefficient (ICC) of 0.95, indicating high test-retest reliability.¹⁵

Next, fall risk assessment was conducted using the Modified Indonesian Fall Risk Assessment Tool (M-IFRAT), which has demonstrated good accuracy in assessing fall risk in Indonesian populations, with a ROC value of 76% and Cronbach's alpha reliability of 0.68.¹⁶ The M-IFRAT interpretation is as follows: total score ≥ 11 indicates high fall risk, while a score < 11 indicates low fall risk.¹⁶ This study received ethical clearance under approval number 0858/UN14.2.2.VII.14/LT/2024, dated March 15, 2024, from the Ethics Committee of the Faculty of Medicine, Udayana University/Sanglah General Hospital, Denpasar.

Data analysis was conducted using SPSS version 27.0. Univariate analysis was used to describe the frequency distribution of age, gender, cognitive function, urinary incontinence, and fall risk variables. Multivariate analysis was performed using binary logistic regression with the Backward Likelihood (BL) method to determine the relationship between urinary incontinence, cognitive function, and fall risk.¹⁷ Prior to this, multicollinearity testing was conducted to ensure no excessively strong correlation among independent variables ($VIF < 10$, Tolerance > 0.1).¹⁸ Variables included in the logistic regression model were selected based on initial analysis results and subsequently eliminated stepwise until the final optimal model was achieved. A p -value < 0.05 indicated a significant relationship, whereas $p > 0.05$ indicated no significant association between variables.¹⁷ The odds ratio (Exp(B)) for independent variables was used to determine their influence on fall risk; higher values indicated a stronger tendency for the independent variable to increase fall risk.

Results

Data were collected and analyzed from a total of 72 respondents. The following figure and tables present the key findings of this study. Figure 1 illustrates the subject identification process used to determine the final sample. Table 1 provides the frequency distribution of subject characteristics. Tables 2 and 3 show the distribution of fall risk based on gender and age group, respectively. Table 4 presents the results of the multivariate analysis examining the combined effect of urinary incontinence and cognitive function on fall risk.

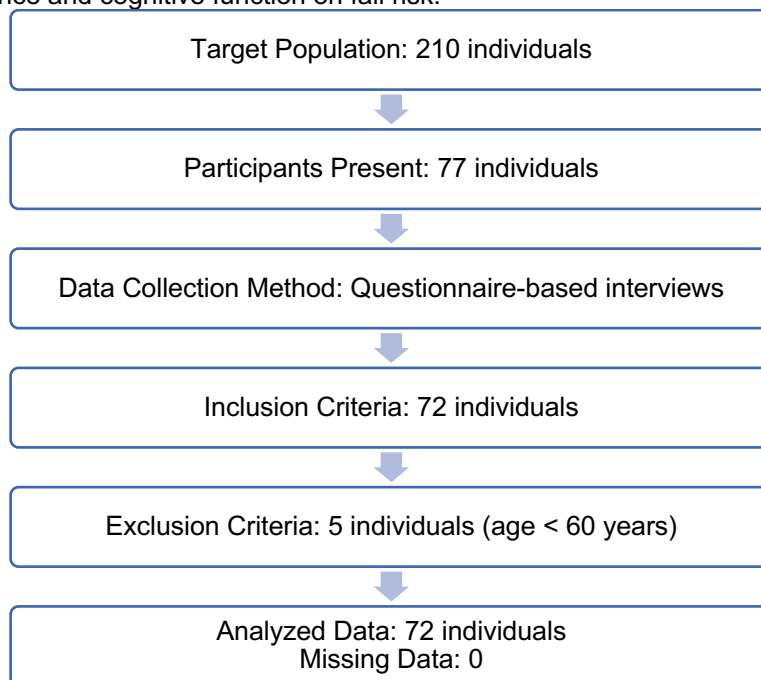


Figure 1. Subject Identification Process

Table 1. Frequency Distribution of Subject Characteristics (n=72)

Variable	Frequency	Percentage (%)
Gender		
Male	28	38.9%
Female	44	61.1%
Age		
60-69 years	37	51.4%
70-79 years	17	23.6%
≥ 80 years	18	25.0%
Cognitive Function		
Normal	32	44.4%
Impaired	40	55.6%
Urinary Incontinence		
Mild	35	48.6%
Moderate	17	23.6%
Severe	20	27.8%
Fall Risk		
Low	40	55.6%
High	32	44.4%

Table 1 shows that out of 72 respondents, the majority were female (n=44, 61.1%). The most prevalent age group was 60-69 years (n=37, 51.4%), based on the World Health Organization's (WHO) classification of elderly age groups. Cognitive function assessment revealed that 40 respondents (55.6%) had impaired cognitive function, while 32 respondents (44.4%) had normal cognitive function. Regarding urinary incontinence, 35 respondents (48.6%) were classified as having mild incontinence, while the fewest (n=17, 23.6%) fell into the moderate category. In terms of fall risk assessment, the majority of respondents (n=40, 55.6%) were categorized as having a low risk of falling.

Table 2. Distribution of Fall Risk by Gender

Gender	Fall Risk Level		Total	Sig.
	Low	High		
Male	15 (37.5%)	13 (40.6%)	28 (38.9%)	0.787
Female	25 (62.5%)	19 (59.4%)	44 (61.1%)	

Table 2 shows that the proportion of high fall risk was lower among males (40.6%) than females (59.4%). Statistical analysis revealed no significant difference in fall risk distribution between genders ($p = 0.787$), indicating that gender did not influence fall risk in this study. Consequently, gender was not included in further regression analysis.

Table 3. Distribution of Fall Risk by Age Group

Age Group	Fall Risk Level		Total	Sig.
	Low	High		
60-69 years	25 (62.5%)	12 (37.5%)	37 (51.4%)	0.004
70-79 years	11 (27.5%)	6 (18.8%)	17 (23.6%)	
≥ 80 years	4 (10.0%)	14 (43.8%)	18 (25.0%)	

Table 3 indicates that the highest proportion of high fall risk was observed in the ≥ 80 years age group (43.8%), while the lowest fall risk was predominantly in the 60-69 years age group (62.5%). A significant difference in fall risk distribution based on age was found ($p = 0.004$).

Table 4. Multivariate Analysis of the Effect of Urinary Incontinence and Cognitive Function on Fall Risk

Variable	Sig.	Exp(B)	95% C.I for Exp(B)
Age	0.013	1.110	1.022-1.206
Impaired Cognitive Function	0.093	3.053	0.829-11.243
Urinary Incontinence			
Mild	<0.001	-	-
Moderate	<0.001	27.296	4.743-157.102
Severe	0.016	6.016	1.406-25.735

Gender was excluded from the regression model because the initial analysis indicated that it was not significantly associated with fall risk ($p > 0.25$), following the backward likelihood elimination approach. The multivariate analysis results in Table 4 show that age was significantly associated with fall risk ($p = 0.013$). For every one-year increase in age, the fall risk increased by a factor of 1.110 ($\text{Exp}(B) = 1.110$). While age was a contributing factor to fall risk, its effect was relatively small compared to urinary incontinence. Although elderly individuals with impaired cognitive function were more likely to experience fall risk than those with normal cognitive function ($\text{Exp}(B) = 3.053$), the association was not statistically significant ($p = 0.093$). This may be influenced by other factors such as mobility compensation or the use of assistive devices.

Urinary incontinence, particularly in the moderate and severe categories, was highly significantly associated with fall risk ($p < 0.001$). Compared to those with mild incontinence, elderly individuals with moderate incontinence had a 27.296 times greater likelihood of falling, while those with severe incontinence had a 6.016 times greater likelihood ($p = 0.016$). These findings emphasize the importance of managing urinary incontinence as a key strategy in fall risk prevention among the elderly, particularly for individuals with moderate and severe incontinence, who have a significantly increased risk of falling.

Discussion

Characteristics of Research Respondents

The analysis results presented in Table 1 indicate that the majority of respondents in this study were female (61.1%). During the data collection process, the researchers observed that more elderly women participated in the study, coinciding with routine health check-ups conducted by the community health center (Puskesmas). This may be attributed to women being more active in social and health-related activities than men. These findings align with the 2021 SUSENAS data, which shows a higher proportion of elderly women in Indonesia, reflecting their greater life expectancy compared to men.¹⁹

The majority of subjects in this study were in the 60–69 age group. This finding is consistent with SUSENAS data, which indicates that this age group constitutes the largest elderly population in Indonesia, at 63.59%.¹⁹ Additionally, based on observations and interviews with healthcare workers and elderly care volunteers at the research site, individuals aged 60–69 years were more likely to access healthcare services than older age groups. This may be due to increased health awareness and better mobility in this age group, allowing them to independently participate in health check-up programs.

Cognitive function among the elderly in this study was predominantly impaired, with 40 out of 72 participants (55.6%) exhibiting cognitive dysfunction. Although there were no specific data on cognitive function in this village before the study, this finding is consistent with previous research indicating that cognitive decline is common among the elderly. For example, a study by Pramadita et al. (2019) found that the prevalence of cognitive impairment among the elderly was 76%, compared to 24% in those with normal cognitive function.²⁰ Similarly, another study reported that cognitive impairment was more prevalent (52.5%) than good cognitive function (35.6%).⁶ According to information from local village officials, most elderly residents in this area had only completed elementary school education, which may contribute to the risk of cognitive decline. Previous studies have shown that lower education levels, particularly among those who never attended school, are associated with a higher likelihood of cognitive impairment compared to those who completed high school.²¹

This study found that the majority of elderly participants experienced mild urinary incontinence (UI). This finding aligns with previous research, which reported that the prevalence of mild UI (56%) was higher than moderate

(36%) and severe UI (8%) in elderly populations.²² The age distribution of respondents in this study also corresponds with these findings, as the 60–69 age group was more dominant than those aged >70 years. This may contribute to the higher prevalence of mild UI, as younger elderly individuals tend to have stronger pelvic floor muscles and better bladder control compared to older individuals. With advancing age, bladder capacity decreases while contractions become more irregular, leading to increased urinary retention, which can contribute to varying degrees of UI severity.²³

The study results indicate that most elderly respondents in this village had a low fall risk (55.6%). Table 2, which presents the distribution of fall risk by gender, shows that a higher proportion of high fall risk was observed in women (59.4%). Hormonal factors and physiological aging differences contribute to this disparity. A decline in estrogen levels in women leads to reduced osteoclastogenesis and decreased bone mass, affecting posture and increasing fall risk.²⁴ The distribution of fall risk by age (Table 3) shows that the highest proportion of high fall risk was among those aged ≥80 years (43.8%), while the lowest fall risk was dominant in the 60–69 age group (62.5%). This finding is consistent with a study by Noorratri et al. (2020), which demonstrated an age-related increase in fall risk, from 25% among those aged 70 years to 35% in individuals over 75 years. This is likely due to the decline in muscle function and strength associated with aging.²⁵

The Influence of Age on Fall Risk

Although age was not the primary focus of this study, the analysis revealed a significant relationship between age and fall risk ($p = 0.013$; $\text{Exp}(B) = 1.110$), indicating that each additional year of age increases the risk of falling by 1.110 times. This finding is consistent with a study by Novianti and Naufal (2023), which also reported a significant association between age and fall risk ($p = 0.038$), attributing it to aging-related degeneration and reduced ability to perform daily activities.²⁴ This decline affects body flexibility, ultimately increasing fall risk.²⁴

Other studies have found that elderly individuals' ability to perform activities such as climbing stairs and exercising is a situational factor contributing to falls.²⁶ One study showed that 52% of elderly individuals aged 60–74 years had a fall risk due to situational factors.²⁶ Most of this increased fall risk was due to impaired postural control, leading to reduced movement speed, balance disturbances, and decreased body coordination, increasing vulnerability to falls.²⁶ Conversely, a study by Agustiningrum (2023) found that older adults had a low fall risk due to good physical activity levels. Regular physical activity can enhance the vestibular system, somatosensory input, and central integration processes in the brain. This involves rapid adaptation mechanisms and the development of effective strategies to maintain balance, potentially preventing falls. The study concluded that lower physical activity levels among the elderly contributed to a higher fall risk.²⁷ Although aging significantly contributes to fall risk due to physiological changes such as reduced balance, coordination, and postural control, research suggests that this risk can be mitigated through regular physical activity.

The Influence of Cognitive Function on Fall Risk

Cognitive function in this study did not show a significant relationship with fall risk ($p = 0.093$). However, elderly individuals with impaired cognitive function were 3.053 times more likely to fall than those with normal cognitive function ($\text{Exp}(B) = 3.053$). This suggests that the relationship between cognitive function and fall risk may be influenced by age and UI. A systematic review analyzing 25 studies found that three studies did not establish a significant relationship between cognitive impairment and fall risk, indicating that the impact of cognitive dysfunction on fall risk may vary depending on population characteristics and controlled factors in the study.²⁸ In this study, cognitive function was likely related to fall risk, but its effect weakened in the multivariate model due to the stronger influence of age and UI.

The odds ratio for fall risk in this study ($\text{Exp}(B) = 3.053$) was lower than in a study by Hawako et al. (2022), which found that elderly individuals with cognitive impairment had a 7.563 times greater risk of falling than those with good cognitive function.²⁹ Differences in analysis methods may account for this discrepancy. Hawako et al. analyzed the relationship between cognitive function and physical activity with fall risk using bivariate analysis without controlling for other factors, potentially resulting in higher $\text{Exp}(B)$ values. The connection between cognitive function and fall risk can be explained by sensory response speed, decision-making time, and reflex movement. Elderly individuals with cognitive impairment have slower reflex responses than those with normal function.²⁹ Additionally, cognitive impairment can lead to postural instability. A study by Bagou et al. (2021) reported that elderly individuals with cognitive impairment were 5.46 times more likely to experience balance problems than those without impairment. Impaired sensory, neurological, and motor functions, along with delayed reaction times, can increase instability and fall risk.³⁰ Overall, although cognitive function was not a significant factor in the multivariate model, it still plays a role in fall risk among the elderly, especially in conditions requiring divided attention and good postural control.

The Impact of Urinary Incontinence on Fall Risk

Regression analysis (Table 4) indicates a significant relationship between urinary incontinence (UI) ($p < 0.001$) and fall risk. Older adults with moderate and severe UI have an increased risk of falling by 27.296 and 6.016 times, respectively, compared to those with mild UI. A study by Schluter et al. (2020) also found an increased risk of falling based on UI severity. Their findings showed that respondents with occasional UI and frequent UI had a 1.24-fold and 1.36-fold increased risk of falling, respectively, compared to those without UI.³¹

The difference between this study and the previous one lies in the probability values assigned to each category. In the prior study, the likelihood of falling was higher with increasing UI severity compared to those without UI.³¹ In contrast, the present study found that older adults with severe UI had a lower probability of increased fall risk (6.016 times) than those with moderate UI ($\text{Exp}(B) = 27.296$). This discrepancy may be attributed to several factors, one of which is the lack of control variables.³² One such factor is the fear of falling, which has been significantly associated with

UI in previous studies (OR = 1.62), particularly among older women.³³ Fear of falling often arises from the urgency to urinate, compelling individuals to rush to the restroom to prevent leakage.³³ In this study's context, older adults with moderate UI may experience urgency more frequently than those with severe UI, who are more likely to avoid certain activities due to physical or psychological limitations.

Additionally, a study by Jachan et al. (2019) found that older adults with severe UI tend to experience greater mobility limitations.³⁶ Their study reported that 71.1% of older adults with UI had reduced mobility, with those experiencing severe UI showing a greater impact on quality of life, including decreased physical activity.³⁴ Individuals with severe UI are more likely to limit their activities, reducing their exposure to fall-inducing factors. Conversely, those with moderate UI still maintain some mobility but experience frequent urgency, which may lead to rushing to the toilet.³⁵ This behavior increases fall risk due to loss of balance or slipping.

Furthermore, previous studies have shown that women with UI experience postural balance impairments, particularly in maintaining stability while standing. Older adults with UI tend to exhibit greater anterior-posterior body sway, indicating difficulty in maintaining balance compared to those without UI.¹⁰ This impairment increases fall risk, especially during daily activities requiring good postural control. One contributing factor to balance impairment in older adults with UI is pelvic floor muscle (PFM) weakness, which plays a crucial role in maintaining bodily stability. The PFM works in coordination with core muscles to support proper posture. When these muscles weaken, the body compensates with less effective strategies, such as over-relying on leg muscles for balance.¹⁰ Studies have shown that women with UI exhibit greater activation of the tibialis anterior and semitendinosus muscles, indicating compensatory efforts due to the inability to maintain balance through core muscles.¹⁰ Thus, although UI is often regarded as a bladder-related issue, these findings highlight its significant impact on balance and fall risk, underscoring the need to address UI in fall prevention strategies.

The implications of this study suggest that fall prevention efforts for older adults should consider UI as a primary risk factor. Given that UI directly affects balance and increases the likelihood of falls due to urgency-related rushing, interventions targeting balance training and pelvic floor muscle exercises (PFME) are crucial in fall risk prevention strategies.³⁵ Additionally, cognitive training should not be overlooked, particularly in improving gait control and dual-tasking. Multicomponent exercise programs, including aerobic, resistance, and balance training, can enhance attention, dual-tasking ability, and reduce fall risk, making them a viable strategy for preventing falls in older adults with cognitive impairments.³² Moreover, a multidisciplinary approach involving physiotherapists, pharmacists, and social workers can help manage other fall-related risk factors, such as medication effects and environmental modifications.³⁸ Fall prevention strategies should be holistic and tailored to individual needs.

This study has certain limitations, including the lack of consideration for other potential factors influencing fall risk, such as previous fall history, comorbidities, or environmental factors, as well as the absence of sensitivity analysis. Additionally, the use of self-reported data may introduce recall bias or subjectivity in reporting fall incidents and UI severity.

Conclusion

The findings of this study indicate that urinary incontinence (UI) has a significant impact on fall risk among older adults, whereas cognitive function does not show a significant effect, despite indicating an increased risk. Furthermore, UI is the most influential risk factor for increased fall risk compared to age and cognitive function in older adults in Singapadu Tengah Village, Sukawati District, Gianyar Regency.

Therefore, fall prevention strategies for older adults should prioritize UI as a primary factor in interventions. These findings can serve as a reference for future research exploring the relationship between UI, cognitive function, and fall risk in older adults. Additionally, this study can assist physiotherapists in developing more effective prevention and intervention strategies to reduce fall risk, particularly among older adults with UI and cognitive function impairments.

Author Contribution

Ni Made Ayu Ananda Pranata Dewi: Conceptualization, methodology, data collection, data analysis, and manuscript drafting.

Anak Agung Gede Angga Puspa Negara: Supervision, guidance on research design, and critical review of the manuscript.

Ni Komang Ayu Juni Antari: Supervision, validation, and manuscript editing.

Anak Agung Gede Eka Septian Utama: Supervision, methodological consultation, and final manuscript review.

Acknowledgments

The authors would like to express their gratitude to the Faculty of Medicine, Universitas Udayana, for providing the academic support and facilities necessary for conducting this study.

Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

Funding Sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethics Statement

his study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Universitas Udayana (Approval No. 0858/UN14.2.2.VII.14/LT/2024). All participants provided informed consent prior to data collection.

References

1. World Health Organization. Ageing and health [Internet]. 2022 [cited 2023 Oct 8]. Available from: <https://www.who.int/news-room/fact-sheets/detail/ageing-and-health>
2. World Health Organization. Falls [Internet]. 2021 [cited 2023 Oct 8]. Available from: <https://www.who.int/news-room/fact-sheets/detail/falls#:~:text=An%20estimated%20684%20000%20fatal,for%2060%25%20of%20these%20deaths.>
3. Susilowati IH, Nugraha S, Sabarinah S, et al. Prevalence and risk factors associated with falls among community-dwelling and institutionalized older adults in Indonesia. *Malays Fam Physician*. 2020;15(1):30–8.
4. Hodgson G, Pace A, Carfagnini Q, et al. Risky business: factors that increase risk of falls among older adult inpatients. *Gerontol Geriatr Med*. 2023;9:1–10.
5. Vaishya R, Vaish A. Falls in older adults are serious. *Indian J Orthop*. 2020;54(1):69–74.
6. Wijaya TF, Putra IPYP, Kinandana GP, et al. Penurunan fungsi kognitif mempengaruhi terjadinya peningkatan risiko jatuh pada lansia di Desa Sumerta: studi cross-sectional. *Maj Ilm Fisioterapi Indones*. 2023;11(3):271.
7. Krismantara AY, Dewi NMK. Hubungan fungsi kognitif dengan keseimbangan postural pada lansia di PWRI Kota Denpasar. *J Kesehat Masyarakat*. 2022;6(3):1506–11.
8. Jorge JMN, Bustamante-Lopez LA. Pelvic floor anatomy. *Ann Laparosc Endosc Surg*. 2022;7:1–8.
9. Milsom I, Gyhagen M. The prevalence of urinary incontinence. *Climacteric*. 2019;22(3):217–22.
10. de Faria KC, Oliveira IM, Vaz LAJ, et al. Is there a difference in balance between continent and incontinent women? *Fisioter Mov*. 2023;36:1–8.
11. Moon S, Chung HS, Kim YJ, et al. The impact of urinary incontinence on falls: a systematic review and meta-analysis. *PLoS One*. 2021;16(5):e0252025.
12. Putrawan I, Ardana IMJ, Kusumawati NLPD, et al. Analisis profil penduduk Provinsi Bali. 2022.
13. Widia DK, Novitasari D, Sugiharti RK, et al. Mini-Mental State Examination untuk mengkaji fungsi kognitif lansia. *J Keperawatan Malang*. 2021;6(2):95–107.
14. Jensen LCG, Boie S, Axelsen S. International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form (ICIQ-UI SF): validation of its use in a Danish-speaking population of municipal employees. *PLoS One*. 2022;17(4):e0266358.
15. Lim R, Liong ML, Lau YK, et al. Validity, reliability, and responsiveness of the ICIQ-UI SF and ICIQ-LUTSqol in the Malaysian population. *Neurourol Urodyn*. 2017;36(2):438–42.
16. Susiana. M-IFRAT (Modification of Indonesian Fall Risk Assessment Tool) sebagai instrumen penilai risiko jatuh pada lanjut usia di masyarakat: studi di Jawa Barat tahun 2020–2021. 2022.
17. Faruk FM, Doven FS, Budyanra B. Penerapan metode regresi logistik biner untuk mengetahui determinan kesiapsiagaan rumah tangga dalam menghadapi bencana alam. *Semin Nas Off Stat*. 2020;2019(1):379–89.
18. Yaldi E, Pasaribu JPK, Suratno E, et al. Penerapan uji multikolinieritas dalam penelitian manajemen sumber daya manusia. *J Ilm Manaj Kewirausahaan (JUMANAGE)*. 2022;1(2):94–102.
19. Badan Pusat Statistik. Statistik penduduk lanjut usia 2023. Vol. 20. 2023.
20. Pramadita AP, Wati AP, Muhartomo H. Hubungan fungsi kognitif dengan gangguan keseimbangan postural pada lansia. 2019;8(2):626–41.
21. Riskiana NEPN, Mandagi AM. Tingkat pendidikan dengan fungsi kognitif pada lansia dalam periode aging population. *Prev J Kesehat Masyarakat*. 2021;12(2):256.
22. Wijaya DNH, Ramli R, Agus AI. Pengaruh senam Kegel terhadap inkontinensia urin pada lansia. *Window Nurs J*. 2024;5(1):32–9.
23. Regina K, Tamba E. Faktor risiko inkontinensia urin pada lansia. 2024;3(2):206–12.
24. Novianti IGASWN, Naufal J. Hubungan usia dan jenis kelamin dengan risiko jatuh pada lansia di Banjar Paang Tebel Peguyangan Kaja. *Indones J Physiother Res Educ*. 2023;4(2):41–6.
25. Noorratri ED, Mei Leni AS, Kardi IS. Deteksi dini risiko jatuh pada lansia di Posyandu Lansia Kentingan, Kecamatan Jebres, Surakarta. *GEMASSIKA J Pengabd Masyarak*. 2020;4(2):128.
26. Rohima V, Rusdi I, Karota E. Faktor risiko jatuh pada lansia di unit pelayanan primer Puskesmas Medan Johor. *J Persatuan Perawat Nasional Indones (JPPNI)*. 2020;4(2):108.
27. Agustiningrum R, Winarti A, Setianingsih S, et al. Aktivitas fisik berhubungan dengan risiko jatuh pada lansia. *J Keperawatan Jiwa (JKI)*. 2023;11(3):645–54.
28. Rosdiana I, Lestari CA. Hubungan antara keseimbangan tubuh dan kognisi terhadap risiko jatuh lanjut usia di Panti Wreda Pucang Gading. *Media Farm Indones*. 2020;15(2):1593–9.
29. Hawako HH, Sulung N, Utami RF, et al. Aktivitas fisik dan fungsi kognitif dengan risiko jatuh pada lansia. *Physio Move J*. 2022;44(2):44–54.
30. Bagou M, Febriona R, Damasyah H. Hubungan kemampuan kognitif dengan keseimbangan tubuh pada lansia di Desa Tenggela. *J Zaitun Jur Keperawatan*. 2021;1–10.
31. Schluter PJ, Askew DA, Jamieson HA, et al. Urinary and fecal incontinence are independently associated with falls risk among older women and men with complex needs: a national population study. *Neurourol Urodyn*. 2020;39(3):945–53.

32. Setyawan DA. Hipotesis dan variabel penelitian. Tahta Media Group. 2021. 72 p.
33. Bernardes RS, de Sousa Barros R, da Silva FS, et al. Urinary symptoms, falls, and fear of falling in older people with cognitive impairment. *Fisioter Mov.* 2024;37:1–8.
34. Jachan DE, Müller-Werdan U, Lahmann NA. Impaired mobility and urinary incontinence in nursing home residents: a multicenter study. *J Wound Ostomy Continence Nurs.* 2019;46(6):524–9.
35. Cho ST, Kim KH. Pelvic floor muscle exercise and training for coping with urinary incontinence. *J Exerc Rehabil.* 2021;17(6):379–87.