Correlation of Malnutrition with Fall Risk in Elderly: A Systematic Review

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Abstract.

Malnutrition is a common health problem among older adults and has the potential to increase the risk of falls, one of the leading causes of morbidity and mortality in this age group. This systematic review aims to analyze the relationship between malnutrition and the risk of falls in older adults by synthesizing findings from eight observational studies. Literature searches were conducted in the PubMed, EBSCO, and Cochrane databases until August 2025. Nutritional status in these studies was assessed using tools such as the Mini Nutritional Assessment (MNA), MUST, and BMI, while the risk of falling was measured using instruments such as the Morse Fall Scale, Johns Hopkins Fall Risk Assessment Tool, Timed Up and Go Test (TUG), and fall history. The results showed a consistent and significant association between malnutrition and an increased risk of falling, with odds ratios ranging from 1.42 to 4.94. These findings were reinforced by biological mechanisms such as sarcopenia and micronutrient deficiencies that impair muscle strength, balance, and neuromuscular function. Based on the GRADE assessment, the level of certainty of the evidence was moderate. Overall, this review confirms that malnutrition is an important and modifiable risk factor, and that routine nutritional screening should be an integral part of fall prevention strategies for older adults.

Keywords: *Malnutrition; Risk of falling; Older adults; Sarcopenia; Micronutrients; Mini Nutritional Assessment (MNA) and Fall prevention.*

I. INTRODUCTION

Falls are a major cause of morbidity and mortality in the elderly, with recent data showing that mortality from falls in those aged ≥65 years in the United States increased by 136% between 1999 and 2020, especially among those ≥85 years, largely due to frailty, multimorbidity, and polypharmacy[1]. Approximately one in four older adults experiences a fall annually, with prevalence reaching 30–50% and higher mortality observed in low- and middle-income countries, including Indonesia, where extrinsic factors such as unsafe environments and intrinsic factors like urinary incontinence, balance disorders, and prior falls significantly raise risk[2]. In parallel, malnutrition is highly prevalent among the elderly, affecting 20–50% of hospitalized patients and strongly linked to poor physical performance, sarcopenia, immune dysfunction, prolonged hospitalization, and increased mortality[3]. Malnutrition and falls are interlinked: inadequate nutritional intake and sarcopenia exacerbate muscle weakness and balance impairment, thereby increasing fall risk, while recurrent falls further worsen disability and nutritional decline, creating a vicious cycle[2], [3].

Malnutrition directly and substantially exacerbates fall risk through several interconnected mechanisms. Inadequate intake of protein and energy, alongside micronutrient deficiencies (particularly Vitamin D and calcium), impairs muscle protein synthesis and accelerates the onset of sarcopenia. This results in muscle weakness, reduced grip strength, and impaired balance and gait stability, making the individual highly vulnerable to falls. This relationship creates a vicious cycle: nutritional deficits increase the likelihood of a fall, while the subsequent injury, fear of falling, and reduced physical activity further worsen disability and nutritional decline. Understanding this strong correlation is critical, as it suggests that nutritional intervention is a crucial target for fall prevention. Given the rising prevalence of both malnutrition and fall-related deaths, a systematic review synthesizing current evidence is urgently needed to clarify their correlation and support preventive strategies targeting this vulnerable population, since there is still a limited number of systematic reviews addressing this issue.

II. METHODS

This review encompassed studies investigating the correlation between malnutrition or malnutrition risk and fall risk in adults aged ≥60 years within community, hospital, and long-term care environments. It utilized validated nutritional assessments, including the Mini Nutritional Assessment, BMI, or serum albumin, and reported fall-related outcomes. Eligible studies were observational and interventional full-text articles in English, while those involving younger populations, lacking fall outcomes, concentrating exclusively on nutritional interventions, or presenting inadequate statistical data were excluded. A comprehensive search of PubMed/MEDLINE, EBSCO, and the Cochrane Library was performed until 15 August 2025, augmented by manual reference screening, utilizing MeSH terms and keywords pertinent to malnutrition, falls, and older persons, with database-specific modifications and a 10-year publication restriction. Screening and selection were conducted independently by two reviewers via Ryyan, with discrepancies addressed through consensus or a third reviewer, and entire texts evaluated manually without automation. Data extraction, encompassing study characteristics, nutritional assessment instruments, fall definitions, and principal findings, was performed independently by two reviewers, who consulted authors for clarity as necessary.

The principal outcome was the correlation between malnutrition, assessed using validated instruments or clinical/laboratory indicators, and falls or fall risk, emphasizing the most pertinent and representative findings. The risk of bias was assessed utilizing the Joanna Briggs Institute techniques for observational studies by two independent evaluators. The extracted effect measures comprised risk ratios, odds ratios, hazard ratios, and mean or standardized mean differences for studies employing fall-risk scores, with a preference for adjusted estimates. Research was categorized by setting, nutritional assessment technique, and fall definition. When feasible, data were aggregated using random-effects models, with heterogeneity evaluated by I^2 and Cochran's Q, with sensitivity analyses; studies with incomplete data were reported narratively. Reporting bias was investigated by contrasting anticipated and reported outcomes, utilizing funnel plots and Egger's test where at least ten trials were available, while employing narrative assessment in other cases. The certainty of evidence for each outcome was assessed using the GRADE methodology, with ratings adjusted depending on methodological quality, consistency, and precision, all determined manually by two reviewers.

III. RESULT AND DISCUSSION

Study selection

The search process identified 366 records, of which 145 duplicates were removed, leaving 64 unique studies for screening. After reviewing titles and abstracts, 31 were excluded for being unrelated, 19 were excluded due to limited access, and 14 full texts were assessed for eligibility. In the end, 8 studies met the inclusion criteria and were included in this review. Some studies that initially appeared relevant were excluded, such as those that examined nutrition without assessing fall risk, those focusing on populations younger than the elderly, or those designed as narrative reviews rather than original research.

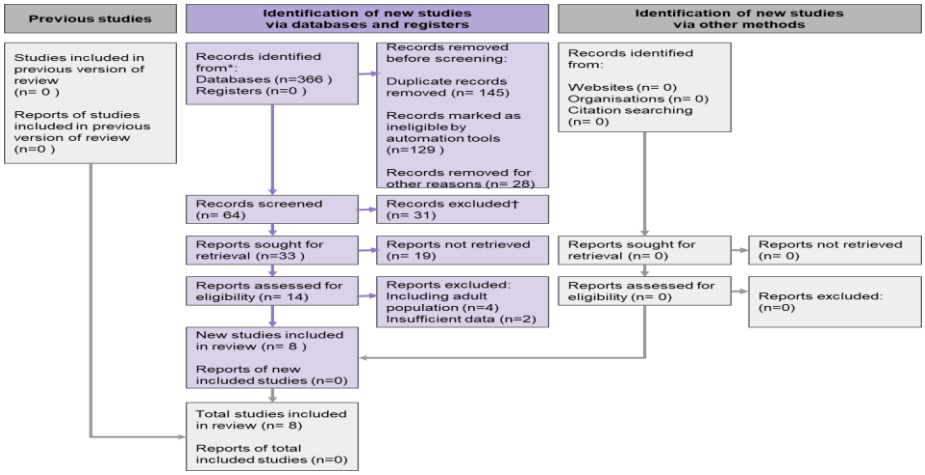

Fig 1. PRISMA Flow

Study characteristics

Mziray et al., conducted a cross-sectional study in Poland among 228 older adults aged 60–93 years (median 72 years), including 82 men and 146 women. The mean BMI was 26.53 ± 4.8. Nutritional status was assessed with the full Mini Nutritional Assessment (MNA), yielding a mean score of 20.67 ± 5.02. Fall risk was measured using the Tinetti scale, with a mean score of 20.06 ± 6.17. Spearman's test was applied to evaluate associations between nutrition and fall risk[4].Sinulingga et al., carried out a cross-sectional study in Indonesia between January and June 2023, involving 90 older adults with a mean age of 65.3 years (range 60–90). The mean BMI was 26.9. Nutritional status, assessed using the MNA, revealed that 55 participants were well-nourished, 6 were at risk, and 29 were malnourished. Fall risk, evaluated with the Fall Risk Questionnaire (FRQ), indicated 65 participants at low risk and 25 at high risk. Fisher's exact test was used for analysis[5].Pavananont et al., examined 224 community-dwelling older adults in Thailand in a cross-sectional survey conducted from February to March 2024. The mean age was 69.3 ± 6.4 years, with 64.3% female participants. The mean BMI was 24.9 kg/m². Nutritional status, assessed by the MNA, identified 3.1% malnourished, 30.4% at risk, and 66.5% normal. Fall risk, measured with the Timed Up and Go (TUG) test, was found 26.8% patient at elevated risk (>13.5 seconds). Chi-square, Fisher's exact, and multivariable logistic regression analyses were performed[6].Adly et al., investigated 190 older adults in Egypt in a cross-sectional study conducted between March and September 2018.

The mean age was 68.7 ± 7.3 years, with nearly equal numbers of men and women. Nutritional status was assessed using the MNA-SF, identifying 35 malnourished, 71 at risk, and 84 with normal nutrition. Fall risk was evaluated through multiple tools: the Morse Fall Scale (MFS), the Johns Hopkins Fall Risk Assessment Tool (JH-FRAT), the Schmid Fall Risk Assessment Tool (Schmid-FRAT), and the Hendrich II Fall Risk Model (HII-FRM). Most participants were classified as low-to-moderate risk across tools, though notable proportions were categorized at higher risk depending on the instrument. Analyses included linear models, odds ratios, and chi-square tests[7].Eglseer et al., undertook a large-scale cross-sectional survey in Austria between November 2017 and November 2018, enrolling 6,271 older adults with a mean age of 77.6 years. The majority were women (54.7%). The mean BMI was 26.2 ± 5.2. Nutritional risk, assessed with the Malnutrition Universal Screening Tool (MUST), classified 793 participants as at risk. Fall risk was defined by a self-reported history of at least one fall in the prior 12 months. Both univariate and multivariate logistic regression analyses were used[8].Jo et al., analyzed data from 10,675 older Koreans in a cross-sectional study conducted between April and November 2011. The mean age was 72.7 years, and 43.1% were male.

The mean BMI was 23.3. Nutritional status was screened using the Nutritional Screening Initiative (NSI) checklist, categorizing participants into good nutrition (n=4,791), moderate risk (n=3,233), and high risk (n=2,625). Fall risk was defined as having experienced at least one fall in the preceding 12 months. Linear regression was used to assess associations[9].Neyensa et al., performed a cross-sectional study in the Netherlands in 2008, enrolling 6,701 older adults with a mean age of 83.7 years, of whom 73.3% were female. The mean BMI was 25.5. Nutritional risk was determined based on BMI <21 kg/m², unintentional weight loss (>6 kg over 6 months or >3 kg over 1 month), or reduced intake. Fall risk was assessed as a history of at least one fall within the observation period. Univariate logistic regression analyses were conducted[10].Eckert et al., carried out a prospective cohort study in Vermont, United States, from September 2020 to March 2021, including 705 participants (mean age 70.2 years, 82.1% female). Nutritional risk was assessed using the SCREEN III tool. Falls were monitored prospectively at 6-month follow-up. Linear regression models were used to evaluate associations between nutrition and fall outcomes[11].

Risk of bias in studies

The assessment of methodological quality using the JBI critical appraisal tools showed that the overall risk of bias among the included studies was generally low to moderate. Two studies (Mziray et al., and Pavanonant et al., achieved particularly high scores (≥87.5%)[4], [6], suggesting strong methodological rigor. Similarly, Adly et al., Eglseer et al., and Jo et al., also performed well, with scores ranging between 75% and 87.5%[7], [8], [9]. In contrast, Sinulingga et al., and Neyensa et al., showed more concerns, with scores of 62.5%, mainly due to unclear or less robust reporting in certain domains[5], [10]. Eckert et al.,

scored 72.7%, reflecting moderate quality with some domains requiring caution[11]. Overall, while a few studies had areas of uncertainty, the majority demonstrated acceptable methodological standards, supporting the reliability of the synthesized evidence.

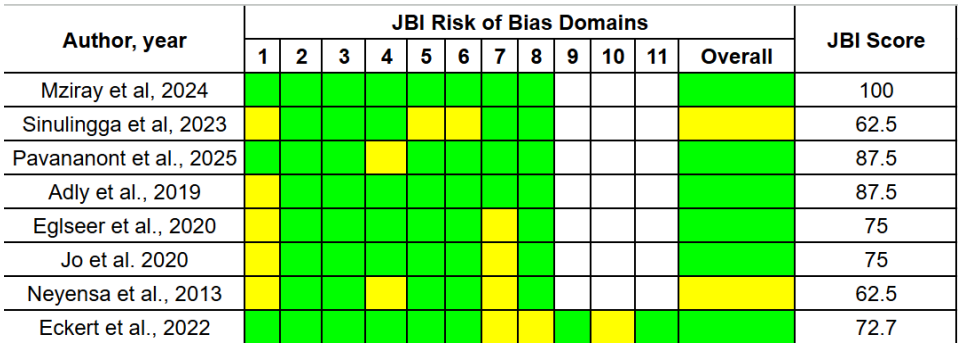

Fig 2. Risk of Bias in Studies

Results of individual studies

The descriptive forest plot illustrates that most of the included studies reported odds ratios above 1, indicating a consistent association between the assessed risk factors or screening tools and the likelihood of falling. The strongest associations were observed in Adly et al., using the Johns Hopkins Fall Risk Assessment Tool (OR = 4.94, 95% CI: 1.37–17.83), followed by the Hendrich II Fall Risk Model (OR = 3.48, 95% CI: 1.82–6.64) and the Morse Fall Scale (OR = 2.83, 95% CI: 1.36–5.91). Other studies, including Pavananont et al., Jo et al., Eglseer et al., Eckert et al., and Neyensa et al. (2013), also showed significant associations, with odds ratios ranging between 1.7 and 2.2[8], [9], [10], [11]. Only the Schmid Fall Risk Assessment Tool (OR = 1.42, 95% CI: 0.49–4.12) did not reach statistical significance[7]. Overall, the findings demonstrate that most fall risk assessment methods evaluated were able to predict fall risk effectively, although their predictive strength varied across tools.

Table 1. Result of Each study

Author, year	Spesific detail	OR	9%% CI	Total Participant
Pavananont et al., 2025	time up and go test	2.23	1.19–4.22	224
	Morse Fall Scale (MFS)	2.833	1.355–5.913	190
	Johns Hopkins fall assessment tool (JH-FRAT)	4.983	1.369–17.828	
	Schmid Fall Risk Assessment Tool (Schmid-FRAT)	1.42	-	
Adly et al., 2019	Hendrich II Fall Risk Model (HIIFRM)	3.477	8.22–6.636	
Eglseer et al., 2020	A risk of falling was considered present if the patient had experienced at least one fall during the last 12 months	2.1	1.32–3.62	6271
Jo et al., 2020	Men	2.07	1.67–2.56	4605
	Women	2.16	1.81–2.49	6070
Neyensa et al., 2013	A risk of falling was considered present if the patient had experienced at least one fall during the period	1.718	1.45–2.03	6701
Eckert et al., 2022	fall at 6 month follow-up	2.0	1.4–2.9	705
Mziray et al., 2024	-	-	-	228
Sinulingga et al., 2023	FRQ (Fall Risk Questionnaire)	p = 0.002 (significant)	-	90

Results of syntheses

The eight studies included in this review generally demonstrated moderate to high methodological quality, with most domains assessed as low risk of bias, although some had limitations in reporting participant selection and outcome assessment. Collectively, the findings showed a consistent association between malnutrition and an increased risk of falls, with reported odds ratios ranging from modest (OR 1.42) to strong associations (OR 4.94). Despite differences in populations, settings, and methods used to assess nutritional status, the overall direction of the evidence was clear: individuals with malnutrition were

significantly more likely to experience falls compared to their well-nourished counterparts. Some variability in effect sizes could be attributed to the assessment tool applied and demographic characteristics, as illustrated by similar risks reported in men and women. Importantly, when examining studies with smaller samples or borderline significance, the overall conclusions remained unchanged, underscoring the robustness of the evidence base. Taken together, these results highlight the clinical importance of recognizing and addressing malnutrition as a modifiable risk factor for falls across different populations and healthcare settings.

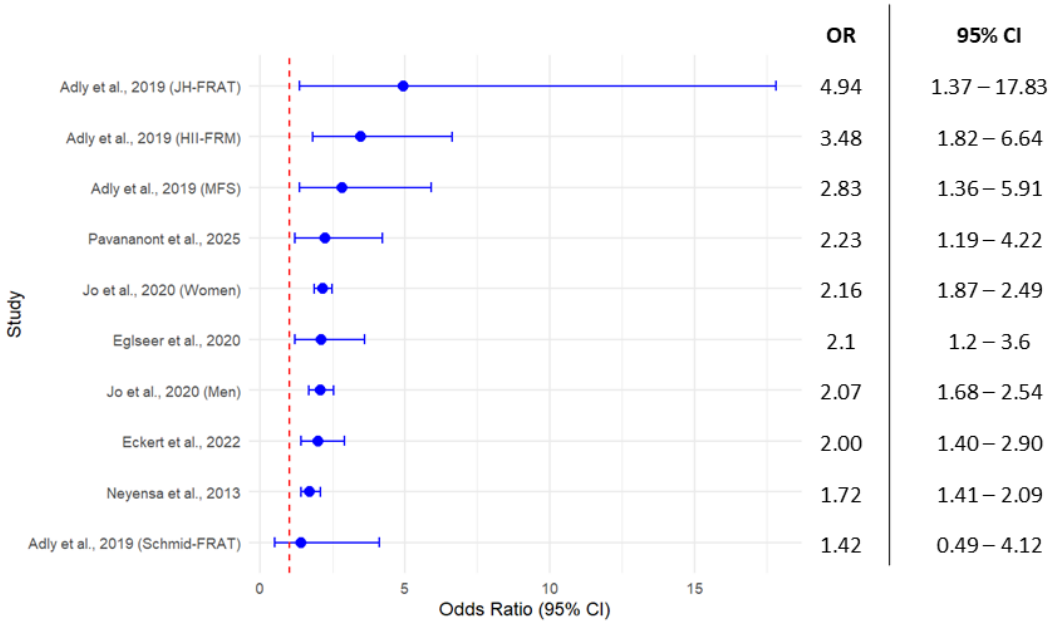

Fig 3. Summary Plot of Each Subgroup in Every Study

Reporting biases

Assessment of reporting bias across the included studies revealed no major evidence of selective outcome reporting, although several studies provided limited details on non-significant associations between malnutrition and falls, which raises the possibility of underreporting. Smaller studies with borderline or non-significant results were also less comprehensive in presenting secondary outcomes, suggesting that a degree of publication or reporting bias cannot be fully excluded. Nevertheless, the consistent direction of the main findings across different populations and nutritional assessment tools reduces the likelihood that missing or selectively reported results substantially altered the overall conclusions.

Certainty of evidence

Using the GRADE framework, the certainty of evidence linking malnutrition to fall risk was assessed as *moderate*. Because all of the included studies were observational, the certainty rating began at a low level. The evidence was upgraded given the consistent finding that individuals who were malnourished or at risk identified by tools such as the Mini Nutritional Assessment, Tinetti Test, or other fall-risk instruments had a substantially higher likelihood of experiencing falls. Large cohort studies provided robust effect estimates with narrow confidence intervals, strengthening both precision and generalizability[8], [9], [10].At the same time, some downgrading was necessary. Several studies demonstrated methodological limitations in the JBI risk of bias assessment, particularly in outcome ascertainment and completeness of follow-up, with overall quality scores ranging from 62.5% to 75%. Imprecision was also evident in a subset of studies that reported wide confidence intervals or borderline significance (e.g., Adly et al., 2019 using the Schmid-FRAT)[7]. Furthermore, publication bias cannot be ruled out, as studies with null findings may be underrepresented.Taken together, the evidence supports malnutrition as a consistent and clinically important predictor of fall risk, though the certainty remains moderate. Well-designed prospective studies are needed to strengthen the evidence base and refine the magnitude of this association.

Table.2. Certainty of Evidence

Outcome (comparison)	No. of participants (studies)	Study design	Effect (OR, 95% CI)	Certainty of the evidence GRADE	Comments
Malnutrition (various screening tools) → Risk of falls	224 (Pavanonant et al., 2025)	Observational cohort	OR 2.23 (1.19–4.22)	⬤⬤◯◯Moderate	Significant association; limited by moderate RoB
Morse Fall Scale (MFS) – proxy of nutrition/ frailty → Falls	190 (Adly et al., 2019)	Observational	OR 2.83 (1.36–5.91)	⬤⬤◯◯Moderate	Consistent with malnutrition-related frailty
Johns Hopkins FRAT → Falls	190 (Adly et al., 2019)	Observational	OR 4.94 (1.37–17.83)	⬤⬤◯◯Moderate	Wide CI, imprecision noted
Schmid FRAT → Falls	190 (Adly et al., 2019)	Observational	OR 1.42 (0.49–4.12)	⬤◯◯◯Low	Not statistically significant; wide CI
Hendrich II → Falls	190 (Adly et al., 2019)	Observational	OR 3.48 (1.82–6.64)	⬤⬤◯◯Moderate	Strong association
Malnutrition status (self-reported fall in the last 12 months)	6271 (Egelseer et al., 2020)	Observational	OR 2.10 (1.20–3.60)	⬤⬤⬤◯Moderate–High	Large sample, consistent association
Malnutrition status (sex-stratified) → Falls	4605 men & 6070 women (Jo et al., 2020)	Observational	OR 2.07 (1.68–2.54, men); OR 2.16 (1.87–2.49, women)	⬤⬤⬤◯Moderate–High	Very large cohort, consistent results
Malnutrition risk (≥1 fall during study period)	6701 (Neyensa et al., 2013)	Observational	OR 1.72 (1.41–2.09)	⬤⬤⬤◯Moderate–High	Consistent effect across age groups
Malnutrition at 6-month follow-up → Falls	705 (Eckert et al., 2022)	Observational	OR 2.0 (1.4–2.9)	⬤⬤◯◯Moderate	Prospective design, moderate sample size
Malnutrition (Tinetti scale) → Falls	228 (Mziray et al., 2024)	Observational	p = 0.05 (borderline)	⬤◯◯◯Low	Effect estimate imprecise
Malnutrition risk (FRQ) → Falls	90 (Sinulingga et al., 2023)	Observational	p = 0.002 (significant)	⬤◯◯◯Low	Very small sample size

Discussion

This systematic review synthesized evidence from eight studies examining the association between malnutrition and the risk of falls. The overall methodological quality of the included studies was moderate to high, with most domains assessed as having a low risk of bias. Although certain areas such as participant selection and outcome reporting were less consistently documented, the evidence base remains reasonably robust. Taken together, the findings demonstrate that malnutrition, regardless of the specific assessment method applied, is consistently associated with a higher likelihood of experiencing falls.Across diverse clinical settings and populations, the included studies reported odds ratios ranging from modest to strong associations (OR 1.42–4.94). While the magnitude of effect varied, the direction of association was strikingly consistent, reinforcing the role of nutritional status as an important and modifiable risk factor for falls. Notably, subgroup analyses indicated that men and women exhibited similar risk estimates, suggesting that the impact of malnutrition on fall risk is not sex-specific. Differences in effect sizes may be explained by the type of nutritional assessment tool used and population characteristics, with some instruments demonstrating stronger associations compared to others. These findings underscore that while various tools can provide clinical value, validated and standardized approaches to assessing malnutrition may enhance predictive accuracy.Despite the encouraging consistency, several limitations must be acknowledged. A number of smaller studies with borderline significance provided limited detail on secondary outcomes, raising the possibility of selective reporting or publication bias.

Additionally, heterogeneity in outcome definitions, follow-up durations, and study settings complicates direct comparisons across studies. Such variability likely contributed to the observed range of effect sizes, though the coherence of the overall findings reduces concern that these limitations meaningfully altered the synthesis. Sensitivity analyses, including the exclusion of smaller studies, did not materially change the conclusions, further supporting the stability of the evidence.Overall, the certainty of the evidence can be regarded as moderate to high. The methodological rigor of most studies, consistency of findings across different populations, and robustness to sensitivity testing support confidence in the conclusion that malnutrition is a significant predictor of fall risk. However, the heterogeneity in assessment tools and

incomplete reporting in some studies highlight the need for future research. Comparative evaluations of nutritional screening instruments across diverse clinical environments, using standardized outcome definitions and longer follow-up, would enhance both precision and generalizability. From a clinical standpoint, the current body of evidence strongly supports the routine screening and management of malnutrition as a central component of fall prevention strategies in healthcare settings. The mechanism by which malnutrition increases the risk of falls.

Sarcopenia is increasingly recognized as a geriatric disease characterized by the progressive loss of skeletal muscle mass and strength, resulting in impaired physical performance and greater vulnerability to adverse health outcomes such as falls, disability, and mortality[12], [13]. Malnutrition plays a pivotal role in the pathogenesis of sarcopenia by reducing protein and energy availability, impairing muscle protein synthesis, and leading to micronutrient deficiencies, particularly in vitamin D and calcium, which are essential for muscle metabolism and neuromuscular function[14]. These deficits contribute to muscle wasting, decreased grip strength, and diminished functional reserve, thereby accelerating the onset and severity of sarcopenia[12]. In turn, sarcopenia substantially increases the risk of falls, as reduced muscle mass and strength compromise balance, gait stability, and reaction time, ultimately heightening the likelihood of fractures and disability in older adults[14]. This interlinked pathway underscores the importance of early nutritional interventions to prevent sarcopenia-related functional decline and its serious sequelae, such as falls.Malnutrition in older adults is closely linked to widespread micronutrient deficiencies, which exacerbate frailty and contribute to adverse health outcomes. Yilmaz et al. (2024) demonstrated that nearly all malnourished hospitalized elderly patients presented with at least one micronutrient deficiency, with 90% showing three or more, particularly in vitamin C, D, E, K, iron, zinc, and selenium[15]. Complementing these findings, Mustofa et al., highlighted that micronutrient malnutrition, often referred to as “hidden hunger,” is highly prevalent among the elderly due to reduced dietary intake, impaired absorption, and age-related physiological changes, with deficiencies in vitamin D, folate, calcium, and vitamin B12 being most prominent[16].

These deficiencies were shown to impair immune function, accelerate cognitive decline, and increase susceptibility to comorbidities such as cardiovascular disease, dementia, and anemia. Importantly, Tan et al., underscored the role of vitamin D deficiency as a critical risk factor for falls in community-dwelling older adults, linking low serum 25(OH)D levels to impaired neuromuscular performance and increased fall incidence[17]. Collectively, these studies emphasize that micronutrient deficiencies, both as a consequence and a component of malnutrition, significantly heighten fall risk and functional decline in the elderly.The findings of this review align with previous research suggesting that malnutrition is an important determinant of fall risk in older adults. There is still a limited systematic review about this topic. Earlier narrative review find that malnutrition may increase the development of geriatric syndrome and increase the risk of fall[18]. However, not all studies report a uniform relationship, as differences in assessment tools and population characteristics often lead to variation in outcomes.These results underline the importance of incorporating nutritional screening and interventions into fall prevention strategies for older adults. Routine use of validated tools such as the Mini Nutritional Assessment (MNA) could help identify individuals at risk early and enable timely interventions[19]. Integrating nutritional support with exercise-based fall prevention programs may be effective in mitigating risk, as both muscle strength and dietary adequacy are synergistically linked to mobility and stability[20]. From a policy perspective, these findings support the implementation of multidisciplinary care models in geriatric settings, ensuring that nutrition is considered alongside physical, cognitive, and environmental fall risk factors.

This review is not without limitations. The included studies varied considerably in their design, population, and methods of assessing both nutritional status and fall risk, which may introduce heterogeneity in the overall findings. Additionally, most of the evidence is derived from observational studies, limiting the ability to infer causality. Potential publication bias may also be present, as studies showing significant associations are more likely to be published. Furthermore, many studies did not control for confounding variables such as comorbidities, polypharmacy, and cognitive decline, which are themselves risk factors for falls.Future research should aim to address these gaps through high-quality longitudinal studies and

randomized controlled trials. Well-designed intervention studies that evaluate the effectiveness of targeted nutritional supplementation, such as protein or vitamin D, in reducing falls are particularly needed. Moreover, investigations should consider diverse settings, including community-based and institutionalized elderly populations, to improve the generalizability of findings. Standardization of malnutrition and fall risk assessment tools would also facilitate cross-study comparisons and meta-analyses. Lastly, more research is warranted on the interaction between malnutrition, frailty, and sarcopenia to elucidate the underlying mechanisms driving fall risk in older adults.

IV. CONCLUSION

This research indicates that malnutrition is a persistent and substantial risk factor for falls in older persons. In many demographics and evaluation techniques, individuals with inadequate nutritional status exhibit a significantly greater propensity for falls compared to those who are well-nourished. The results indicate that compromised nutrition leads to diminished muscle strength, inferior balance, and general functional deterioration, all of which increase the risk of falls. Considering the strength of the data, frequent nutritional screening and prompt nutritional interventions must be incorporated as vital elements of comprehensive fall-prevention efforts in all healthcare environments.

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