

Associations of Hyperuricaemia with Frailty, Probable Sarcopenia, and Sleep Quality in Older Adults

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Abstract

Background: This study investigated the associations of hyperuricaemia with subjective sleep quality, frailty, and probable sarcopenia in older adults. **Methods:** This retrospective cross-sectional study included geriatric outpatients aged ≥ 65 years who underwent comprehensive geriatric assessment. Hyperuricaemia was defined as serum uric acid >6 mg/dL in females and >7 mg/dL in males. Subjective sleep quality was assessed using the Insomnia Severity Index and Epworth Sleepiness Scale. Frailty was evaluated using the FRAIL scale, and probable sarcopenia was defined according to European Working Group on Sarcopenia in Older People 2 (EWGSOP2) criteria. Univariable and multivariable logistic regression analyses were performed. **Results:** The mean age was 75.6 ± 6.9 years, and 68.6% were female. Hyperuricaemia was more frequent in women and was associated with higher body mass index and lower estimated glomerular filtration rate (all $p < 0.001$). In univariable analyses, hyperuricaemia was associated with urinary incontinence, polypharmacy, lower grip strength, and higher FRAIL scores (all $p < 0.05$), whereas no significant associations were observed with sleep-related parameters. In multivariable analyses, body mass index (OR 1.07, 95% CI 1.02–1.11), lower estimated glomerular filtration rate (OR 0.95, 95% CI 0.94–0.97), and coronary heart disease (OR 1.86, 95% CI 1.07–3.23) remained independently associated with hyperuricaemia. **Conclusions:** Hyperuricaemia was associated with frailty and probable sarcopenia in unadjusted analyses, but these associations were not independent after adjustment for confounders. No significant association was found with subjective sleep quality. Hyperuricaemia appeared to be more closely related to cardiometabolic risk factors and impaired renal function than to geriatric syndromes themselves.

Keywords: hyperuricaemia; geriatric syndromes; subjective sleep quality; frailty; probable sarcopenia

1. Introduction

Uric acid is the end product of purine metabolism, and disruption of the balance between its production and excretion leads to hyperuricaemia, a common metabolic disorder in the adult population with an estimated global prevalence of approximately 20%¹. In addition to inflammatory processes related to urate crystal deposition, hyperuricaemia

may act as a pro-oxidant, enhancing oxidative stress and triggering molecular pathways associated with systemic inflammation, particularly within the vascular wall². Therefore, hyperuricaemia is not limited to gout but has been associated with obesity, diabetes mellitus, hypertension, metabolic syndrome, cardiovascular disease, and increased mortality. Serum uric acid levels tend to increase with advancing age due to age-related alterations in renal function, a higher burden of comorbidities, and increased medication use². Therefore, hyperuricaemia has increasingly been recognised as a clinically relevant condition in older adults and is thought to be associated with the development of various geriatric syndromes.

Frailty and sarcopenia are among the most prominent geriatric syndromes, reflecting age-related decline in physiological reserve and increased vulnerability to adverse health outcomes. Frailty is a multidimensional condition encompassing physical, psychological, and social domains, whereas sarcopenia, characterized by the progressive loss of skeletal muscle mass and strength, represents a key biological substrate contributing to physical frailty^{3,4}. Both conditions are strongly associated with functional decline, disability, hospitalization, and mortality in older adults. Importantly, their potentially reversible nature highlights the need to better understand the underlying biological mechanisms contributing to their development⁵.

Sleep disturbances are highly prevalent in older adults and are increasingly recognised as important components of geriatric vulnerability. Poor subjective sleep quality has been associated with frailty, sarcopenia, cognitive decline, and increased mortality. Epidemiological studies suggest that approximately 40–70% of older individuals experience impaired subjective sleep quality, which may be influenced by chronic diseases, psychiatric conditions, and social factors^{6–8}. In this context, subjective sleep quality may represent an additional and clinically relevant dimension of geriatric syndromes.

Although several studies have examined the relationship between serum uric acid levels and individual geriatric syndromes such as frailty and sarcopenia, the findings remain inconsistent, with some studies suggesting a protective role due to the antioxidant properties of uric acid, whereas others have reported associations with oxidative stress, systemic inflammation, endothelial dysfunction, and adverse health outcomes^{9–11}. These mechanisms may also contribute to sleep disturbances by affecting sleep regulation. Furthermore, hyperuricaemia frequently coexists with obesity, metabolic syndrome, and cardiovascular disease, all of which are independently associated with impaired subjective sleep quality and sleep-disordered breathing. Together, these shared pathophysiological pathways provide a biological rationale for investigating the relationship between hyperuricaemia and subjective sleep quality in older adults^{1,2,12}.

In contrast, studies evaluating the association between hyperuricaemia and subjective sleep quality in older adults are limited. Moreover, comprehensive evaluations integrating these domains within a geriatric framework are scarce.

Therefore, this study aimed to investigate the association between serum uric acid levels and subjective sleep quality, frailty, and sarcopenia in older adults undergoing comprehensive geriatric assessment.

2. Materials and Methods

2.1. Study Design

This study was designed as a retrospective, cross-sectional, observational study analysing patients aged 65 years or older who presented to the geriatric outpatient clinic between November 2022 and January 2026. A total of 793 patients were included. Informed consent was waived due to the retrospective design of the study.

2.2. Inclusion Criteria

Patients aged 65 years or older who presented to the geriatric outpatient clinic for any reason and did not meet any exclusion criteria were eligible for inclusion.

2.3. Exclusion Criteria

Patients with active malignancy, severe anaemia (haemoglobin <7 g/dL), acute cardiac events (acute heart failure, acute coronary syndrome, or severe aortic stenosis), decompensated liver cirrhosis, sepsis, acute rheumatic or inflammatory diseases, alcohol and/or substance abuse, history of acute cerebrovascular accident, immobilisation, history of gout, dementia with a Clinical Dementia Rating score ≥ 2 , or Parkinson's disease at Hoehn and Yahr stage ≥ 3 were excluded from the study. Patients receiving urate-lowering therapy (e.g., allopurinol or febuxostat) were also excluded from the study. Immobilisation was defined as being bedridden or wheelchair-dependent and unable to walk independently.

2.4. Patient Characteristics

Demographic characteristics, including age, education level, and marital status, were recorded. Documented comorbidities included hypertension, diabetes mellitus, coronary artery disease, congestive heart failure, cerebrovascular disease, peripheral vascular disease, osteoporosis, atrial fibrillation, Parkinson's disease, and chronic lung disease. All medications used by the patients were recorded in detail.

Laboratory parameters included fasting plasma glucose, haemoglobin, platelet count, aspartate aminotransferase (AST), alanine aminotransferase (ALT), creatinine, uric acid, estimated glomerular filtration rate (eGFR), albumin, sodium, potassium, calcium, phosphate, ferritin, magnesium, vitamin D, vitamin B¹², folic acid, and blood urea nitrogen (BUN).

2.5. Comprehensive Geriatric Assessment

The comprehensive geriatric assessment (CGA) included evaluation of depressive symptoms using the Yesavage Geriatric Depression Scale¹³, daytime sleepiness using the Epworth Sleepiness Scale (ESS)¹⁴, insomnia severity using the Insomnia Severity Index (ISI)¹⁵, functional status using the Barthel Activities of Daily Living (ADL) Index¹⁶ and the Lawton–Brody Instrumental Activities of Daily Living (IADL) Scale¹⁷, nutritional status using the Mini Nutritional Assessment–Short Form¹⁸, and cognitive function using the standardised Mini-Mental State Examination (sMMSE)¹⁹.

2.6. Definitions of Probable Sarcopenia, Frailty, and Hyperuricaemia

Frailty was assessed using the FRAIL scale, and a score ≥ 3 was considered indicative of frailty²⁰; probable sarcopenia was defined according to the EWGSOP² criteria, and patients with low muscle strength (<14 kg for women and <28 kg for men) were considered to have probable sarcopenia^{7,21}; hyperuricaemia was defined as a serum uric acid level >6 mg/dL in females and >7 mg/dL in males²².

2.7. Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics (version 22; IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using the Shapiro–Wilk test. Continuous variables were expressed as mean (standard deviation) or median (interquartile range), as appropriate, and categorical variables as frequencies and percentages. Comparisons between the hyperuricaemia and normouricaemia groups were performed using the independent samples t-test or Mann–Whitney U test for continuous variables, and the chi-square test or Fisher's exact test for categorical variables, as appropriate. Associations between hyperuricaemia and geriatric syndromes, including frailty, sarcopenia, and sleep-related parameters (ISI and ESS), were initially evaluated using univariable logistic regression analyses. Variables with clinical relevance or a p-

value <0.10 in univariable analyses were included in multivariable logistic regression models. Sequential multivariable models were constructed: Model 1 was adjusted for age, sex, body mass index (BMI), and marital status; Model 2 was further adjusted for hypertension, coronary artery disease, congestive heart failure, and chronic obstructive pulmonary disease; and Model 3 additionally included C-reactive protein (CRP), eGFR, and lipid profile parameters. Results were reported as odds ratios (ORs) with 95% confidence intervals (CIs). A two-sided p -value <0.05 was considered statistically significant.

3. Results

Baseline demographic, clinical, medication, and laboratory characteristics of the study population according to hyperuricaemia status are presented in Table 1. Of the 793 participants, 257 (32.4%) had hyperuricaemia and 536 (67.6%) had normouricaemia. Patients with hyperuricaemia were more frequently female ($p < 0.001$) and less often married than those without hyperuricaemia ($p < 0.001$). BMI was significantly higher in the hyperuricaemia group ($p < 0.001$), whereas age and education level did not differ significantly between groups.

Regarding comorbidities, hypertension, coronary artery disease, congestive heart failure, and chronic obstructive pulmonary disease were more prevalent among patients with hyperuricaemia (all $p < 0.05$). Use of diuretics, renin–angiotensin–aldosterone system blockers, and beta-blockers was significantly more common in the hyperuricaemia group (all $p < 0.001$). In laboratory analyses, patients with hyperuricaemia had lower haemoglobin levels ($p = 0.026$), higher CRP levels ($p = 0.004$), higher triglyceride levels ($p = 0.003$), and lower HDL-cholesterol levels ($p = 0.002$). Renal function differed markedly between groups, with significantly lower eGFR values observed in the hyperuricaemia group ($p < 0.001$) (Table 1).

The distribution of geriatric syndromes and CGA parameters according to hyperuricaemia status is presented in Table 2. Compared with the normouricaemia group, patients with hyperuricaemia had a significantly higher prevalence of urinary incontinence ($p = 0.002$) and polypharmacy ($p = 0.015$). Regarding functional and physical performance measures, patients with hyperuricaemia demonstrated significantly lower grip strength ($p = 0.004$), higher FRAIL scores ($p = 0.001$), and lower basic activities of daily living scores ($p = 0.001$).

Table 1. Baseline demographic, clinical, and laboratory characteristics according to hyperuricaemia status

Variable	Hyperuricaemia n= 257	Normouricaemia n= 536	p value
Demographic features			
Age (years)	76.17 (6.43)	75.32 (7.07)	0.156
Female sex (%)	79.0	63.6	<0.001
Education (years)	5.42 (3.6)	5.82 (4.12)	0.326
Married (%)	44.7	59.1	<0.001
BMI (kg/m ²)	30.38 (6.06)	27.26 (5.49)	<0.001
Comorbidities (%)			
Hypertension	86.4	68.3	<0.001
Diabetes mellitus	43.6	38.8	0.200
Coronary artery disease	28.8	20.9	0.014
Peripheral artery disease	5.4	4.9	0.719
Congestive heart disease	20.6	9.0	<0.001
Chronic obstructive pulmonary disease	9.7	5.4	0.024
Osteoporosis	24.4	30.4	0.077

Variable	Hyperuricaemia n= 257	Normouricaemia n= 536	p value
Cerebrovascular disease	5.4	5.0	0.807
Parkinson's disease	5.8	8.2	0.233
Dementia	18.6	20.0	0.638
Drug classes (%)			
Diuretic	60.7	29.3	<0.001
Renin-angiotensin-aldosterone system blockers	68.5	47.8	<0.001
Beta-blockers	46.3	31.5	<0.001
Calcium channel blocker	29.6	23.9	0.086
Alpha-blockers	8.2	11.8	0.125
Sodium-glucose cotransporter-2 inhibitors	8.9	10.3	0.562
Sleep medication	26.8	20.7	0.066
Laboratory findings			
Hemoglobin (g/dL)	12.61 (1.72)	12.95 (1.57)	0.026
C-reactive protein (mg/L)	10.83 (23.15)	9.61 (23.28)	0.004
Fasting blood glucose (mg/dL)	122.12 (49.42)	121.14 (51.04)	0.060
eGFR (mL/min/1.73 m ²)	56.46 (18.63)	71.71 (17.31)	<0.001
Total cholesterol (mg/dL)	201.72 (49.48)	207.09 (47.92)	0.161
Triglyceride (mg/dL)	147.92 (73.48)	132.04 (64.20)	0.003
LDL-cholesterol (mg/dL)	120.34 (40.41)	124.50 (38.59)	0.125
HDL-cholesterol (mg/dL)	52.55 (13.48)	56.29 (14.78)	0.002
Albumin (g/dL)	4.13 (0.40)	4.16 (0.36)	0.220
Uric acid (mg/dL)	7.62 (1.38)	4.77 (1.03)	<0.001

Values are presented as mean (SD) or percentage. BMI: body mass index; eGFR: estimated glomerular filtration rate; HDL: high-density lipoprotein; LDL: low-density lipoprotein; SD: standard deviation.

Table 2. Geriatric syndromes, CGA parameters, and sleep-related variables according to hyperuricaemia status

Variable	Total patients n=793	Hyperuricaemia n= 257	Normouricaemia n= 536	p value
Geriatric syndromes and CGA parameters				
Recurrent falls (>2/ year) (%)	42.9	44.0	42.4	0.667
Urinary incontinence (%)	60.5	68.5	56.7	0.002
Geriatric depression (%)	46.5	47.1	46.3	0.830
Orthostatic hypotension (%)	43.0	38.7	45.0	0.098
Polypharmacy (>5 medication) (%)	66.6	72.4	63.6	0.015
Mini Nutritional Assessment-Short Form score	11.92 (2.39)	11.96 (2.29)	11.91 (2.43)	0.909
Grip strength (kg)	18.23 (8.23)	17.12 (7.92)	18.77 (8.33)	0.004
Performance-Oriented Mobility Assessment score (0-28)	23.81 (5.75)	23.61 (5.74)	23.91 (5.77)	0.208
Timed Up and Go test (s)	20.72 (18.03)	20.69 (14.72)	20.73 (19.42)	0.199
FRAIL score [0-5]	1.67 (1.23)	1.87 (1.25)	1.57 (1.22)	0.001
Basic activities of daily living (0-100)	86.49 (15.20)	84.29 (16.70)	87.54 (14.32)	0.001
Instrumental activities of daily living (0-23)	17.19 (5.81)	17.05 (5.92)	17.25 (5.75)	0.578
sMMSE (0-30)	23.84 (5.73)	23.91 (5.47)	23.81 (5.85)	0.797
Yesavage Geriatric Depression Scale (0-15)	4.69 (3.44)	4.73 (3.38)	4.67 (3.46)	0.676

Variable	Total patients n=793	Hyperuricaemia n= 257	Normouricaemia n= 536	p value
Sleep-related parameters				
REM sleep behavior disorder (%)	20.4	21.8	18.8	0.510
Nocturia (>2/in a night) (%)	68.1	70.8	66.8	0.255
Restless legs syndrome (%)	11.7	12.5	11.4	0.661
Insomnia severity index score mean (SD)	8.40 (6.81)	8.69 (6.91)	8.26(6.76)	0.418
Epworth sleepiness scale score mean (SD)	4.38 (3.43)	4.47 (3.50)	4.34(3.40)	0.655

Values are presented as mean $\pm$ standard deviation or percentage. CGA: comprehensive geriatric assessment; sMMSE: standardized Mini-Mental State Examination; SD: standard deviation.

Sleep-related parameters showed no significant differences between the hyperuricaemia and normouricaemia groups. The prevalence of REM sleep behaviour disorder ($p=0.510$), nocturia ($p=0.255$), and restless legs syndrome ($p=0.661$) was comparable between groups. In addition, Insomnia Severity Index and Epworth Sleepiness Scale scores were similar between the two groups (both $p > 0.05$).

Table 3. Univariable and sequential multivariable logistic regression analyses of factors associated with hyperuricaemia

Model	Variable	Odds Ratio	95% CI	p value
Model 0	Urinary incontinence	1.65	1.21-2.26	0.002
	Polypharmacy	1.49	1.08-2.07	0.015
	Grip strength	0.97	0.95-0.99	0.009
	FRAIL score	1.22	1.08-1.37	0.001
Model 1	Urinary incontinence	1.10	0.71-1.71	0.649
	Polypharmacy	0.94	0.60-1.47	0.808
	Grip strength	0.98	0.95-1.02	0.524
	FRAIL score	1.16	0.98-1.38	0.075
Model 2	Urinary incontinence	1.10	0.70-1.73	0.660
	Polypharmacy	0.68	0.42-1.09	0.116
	Grip strength	0.98	0.94-1.02	0.449
	FRAIL score	1.09	0.91-1.31	0.317
Model 3	Urinary incontinence	1.21	0.72-2.04	0.451
	Polypharmacy	0.69	0.39-1.21	0.206
	Grip strength	0.96	0.92-1.01	0.168
	FRAIL score	0.94	0.76-1.17	0.619

OR: odds ratio; CI: confidence interval; BMI: body mass index; eGFR: estimated glomerular filtration rate.

Model 0: unadjusted model

Model 1: adjusted for age, sex, BMI, and marital status

Model 2: adjusted for Model 1 plus hypertension, coronary artery disease, congestive heart disease, and chronic obstructive pulmonary disease

Model 3: adjusted for Model 2 plus C-reactive protein, eGFR, and lipid profile

Univariable and sequential multivariable logistic regression analyses evaluating factors associated with hyperuricaemia are presented in Table 3. In the unadjusted model (Model 0), urinary incontinence ($p=0.002$), polypharmacy ($p=0.015$), lower grip strength ($p=0.009$), and higher FRAIL score ($p=0.001$) were significantly associated with hyperuricaemia. After adjustment for age, sex, BMI, and marital status (Model 1), none of these associations remained statistically significant, although the association with FRAIL score showed borderline significance ($p=0.075$). Further adjustment for comorbidities, including hypertension, coronary artery disease, congestive heart failure, and chronic

obstructive pulmonary disease (Model 2), attenuated the associations, with no variables reaching statistical significance. In the fully adjusted model (Model 3), which additionally included CRP, eGFR, and lipid profile parameters, no significant associations were observed between hyperuricaemia and urinary incontinence, polypharmacy, grip strength, or FRAIL score (all $p > 0.05$).

The results of the multivariable logistic regression analysis evaluating factors independently associated with hyperuricaemia are presented in Table 4. In the fully adjusted model, BMI was independently associated with hyperuricaemia ($p = 0.003$). Renal function was also independently associated with hyperuricaemia, with lower eGFR significantly increasing the likelihood of hyperuricaemia ($p < 0.001$). In addition, coronary heart disease was independently associated with hyperuricaemia ($p = 0.027$).

Table 4. Multivariable logistic regression analysis of factors independently associated with hyperuricaemia

Variable	OR	95% CI	p value
Age	0.96	0.92-1.00	0.113
Female sex	0.66	0.32-1.38	0.278
Married	1.29	0.86-1.93	0.212
BMI	1.07	1.02-1.11	0.003
Hypertension	1.86	0.96-3.61	0.065
Coronary heart disease	1.86	1.07-3.23	0.027
C-reactive protein	1.00	0.99-1.01	0.088
eGFR	0.95	0.94-0.97	<0.001
Triglyceride	1.00	0.99-1.00	0.517
Urinary incontinence	1.33	0.79-2.24	0.276
Polypharmacy	0.75	0.42-1.32	0.329
Grip strength	0.96	0.92-1.01	0.134
FRAIL score	0.98	0.79-1.22	0.908

OR: odds ratio; CI: confidence interval; BMI: body mass index; eGFR: estimated glomerular filtration rate.

4. Discussion

The present study demonstrated that hyperuricaemia was associated with frailty and probable sarcopenia in unadjusted analyses among older adults, whereas no significant relationship was observed between hyperuricaemia and subjective sleep quality. In addition, multivariable analyses identified BMI, renal function, and coronary heart disease as independent factors associated with hyperuricaemia. These findings suggest that although hyperuricaemia is associated with frailty and probable sarcopenia in unadjusted analyses, these relationships are likely influenced by underlying cardiometabolic and renal factors rather than representing independent associations.

In line with these findings, higher BMI and lower eGFR emerged as independent correlates of hyperuricaemia. These results are consistent with previous studies demonstrating a close relationship between serum uric acid levels and metabolic disturbances, including obesity and impaired renal function. Reduced eGFR may also partly mediate the relationship between hyperuricaemia and geriatric syndromes by impairing renal uric acid excretion, which may explain the attenuation of these associations after multivariable adjustment in our study^{23,24}. Uric acid, the final product of purine metabolism, exerts complex biological effects, including antioxidant and pro-oxidant activities as well as proinflammatory properties⁹. Although uric acid may act as an antioxidant under physiological conditions, excessive intracellular accumulation can promote oxidative stress through mechanisms such as activation of NADPH oxidase and increased production of reactive

oxygen species¹². These mechanisms may partly explain the metabolic alterations associated with hyperuricaemia in older adults.

Beyond metabolic factors, coronary heart disease was independently associated with hyperuricaemia after full adjustment. Uric acid has been implicated in key pathways related to atherosclerosis, including inflammation, oxidative stress, endothelial dysfunction, and activation of the renin–angiotensin–aldosterone system²⁵. Epidemiological evidence also supports an association between elevated serum uric acid levels and increased cardiovascular risk^{26,27}. However, given the cross-sectional design of our study, causal inference cannot be established. Overall, these findings suggest that elevated uric acid levels in older adults are more likely to reflect an adverse cardiometabolic profile rather than representing an independent pathogenic factor.

Hyperuricaemia was significantly associated with probable sarcopenia in unadjusted analyses. Several biological mechanisms may underlie this relationship, including the role of uric acid in systemic inflammation and oxidative stress, which have been implicated in muscle dysfunction and loss of muscle mass⁹. Alterations in vascular function and tissue perfusion may further contribute to impaired muscle strength and physical performance. However, this association did not remain significant after adjustment for confounding factors, suggesting that it may be mediated by underlying metabolic and renal alterations rather than representing an independent relationship. The relationship between serum uric acid levels and sarcopenia remains controversial. A recent meta-analysis reported heterogeneous findings across studies⁹. Similarly, Yoruk et al.¹⁰ found no significant association between serum uric acid levels and frailty or probable sarcopenia, although a negative association was observed with definite sarcopenia. These inconsistencies may reflect differences in study populations, definitions, and analytical approaches, as well as the predominantly cross-sectional design of existing studies.

A similar pattern was observed for frailty, another key geriatric syndrome closely related to sarcopenia. Previous studies have reported a positive association between serum uric acid levels and frailty. For example, Kang et al.¹¹ demonstrated that higher uric acid levels were associated with increased frailty risk in older adults, while Wang et al.²⁸ reported a similar association in individuals with chronic kidney disease. These relationships have been attributed to mechanisms such as oxidative stress, systemic inflammation, and endothelial dysfunction. However, in the present analysis, the association between hyperuricaemia and frailty was attenuated after multivariable adjustment, suggesting that it may be confounded by shared underlying factors. Accordingly, the heterogeneity in the literature may be explained by differences in study populations and analytical approaches.

No significant association was observed between hyperuricaemia and subjective sleep quality in older adults. Although several studies have examined the relationship between serum uric acid levels and sleep disturbances, most have focused on sleep duration rather than sleep quality²⁹. In contrast to our findings, some studies conducted in younger populations have reported associations between uric acid levels and sleep duration or quality^{1,29}. However, these populations typically had a lower burden of comorbidities, which may limit the comparability of results. The lack of association observed in this study may be explained by the multifactorial nature of sleep regulation in older adults, as well as the influence of comorbid conditions and medications³⁰. In addition, the subjective nature of sleep assessment tools and the complex biological effects of uric acid may contribute to the heterogeneous findings reported in the literature. Subjective sleep questionnaires may also have limited the ability to detect subtle abnormalities in sleep architecture or sleep-disordered breathing, which could have contributed to the lack of a significant association. These findings suggest that sleep disturbances should be considered within a broader clinical context as part of comprehensive geriatric assessment.

This study has several limitations. First, due to its cross-sectional design, causal relationships cannot be established. Second, the single-centre design and inclusion of only geriatric outpatient clinic attendees may limit the generalisability of the findings to community-dwelling older adults or other clinical settings. In addition, muscle mass measurements were unavailable; therefore, probable sarcopenia was defined based on muscle strength according to the EWGSOP² criteria, reflecting primarily functional sarcopenia. Finally, subjective sleep quality was assessed using self-reported questionnaires without objective measurements, which may have introduced subjectivity and recall bias. Despite these limitations, this study contributes to the growing body of evidence on the relationship between serum uric acid levels and geriatric syndromes, including sleep-related parameters. In addition, frailty was assessed using the FRAIL scale rather than the Fried Frailty Phenotype, which may have resulted in a less objective assessment of frailty.

Further prospective and multicentre studies are needed to better elucidate the role of uric acid in the development of geriatric syndromes.

5. Conclusion

In conclusion, hyperuricaemia was associated with frailty and probable sarcopenia in unadjusted analyses; however, these associations were no longer significant after adjustment for potential confounding factors. No significant association was observed between hyperuricaemia and sleep quality. These findings suggest that the observed relationships may be largely explained by underlying metabolic and clinical factors rather than hyperuricaemia itself. Based on the fully adjusted analyses, hyperuricaemia should not currently be regarded as an independent marker of frailty or probable sarcopenia in older adults.

Ethical Considerations: This study was approved by the Balikesir University Health Research Ethics Committee (Approval No: 2025/9-9, Date: 04 November 2025). The study was conducted in accordance with the Declaration of Helsinki.

Consent to Participate: Due to the retrospective design of the study, the requirement for informed consent was waived by the ethics committee.

Consent for Publication: Not applicable.

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Data Availability: The data that support the findings of this study are available from the corresponding author upon reasonable request. Due to ethical and privacy restrictions, the data are not publicly available.

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