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Hypomagnesemia may be related to frailty, gait and balance problems, and basic activities of daily living in older adults

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ABSTRACT

Objectives: The study aims to investigate the relationship between hypomagnesemia, pre-clinical hypomagnesemia, and normomagnesemia as along with geriatric syndrome and comprehensive geriatric parameters(CGA).

Methods: 217 patients who applied to the geriatric clinic between November 2022 and December 2023 were included in the study. All patients underwent CGA. Patients were categorized into three groups: Magnesium (Mg) level ≤ 1.5 mg/dL, Mg level 1.5–1.8 mg/dL, and Mg level > 1.8 mg/dL. These three groups were compared in terms of demographic characteristics, comorbidities, CGA parameters, and geriatric syndromes. Regression analyses was conducted for significant parameters, adjusting for confounders.

Results: 74.9% of all participants were female, with an average age of 76.5 ± 6.6 years. The frequency of hypomagnesemia was 14.2%. Demographic characteristics and medication use, including proton pump inhibitors and diuretics, were similar in these three groups. While the FRIED frailty scale and the duration of the timed-up-and-go test were higher in the hypomagnesemia group, the Basic Activities Daily of Living (ADLs) and the Tinetti-POMA(performance-oriented mobility assessment) scores were lower in the hypomagnesemia group. When normomagnesemia was accepted as the reference category, FRIED frailty scale, Basic ADLs, and POMA score were more significant in the hypomagnesemia group ($p = 0.025$, $p = 0.013$ and $p = 0.011$,respectively), but there was no significance in the preclinical hypomagnesemia group regardless of the covariates.

Conclusion: Hypomagnesemia, particularly serum Mg levels below 1.5 mg/dL, may be associated with frailty, basic ADLs, gait, and balance tests. In geriatric practice, patients with hypomagnesemia should be evaluated in terms of the risk of the mentioned disorders.

Introduction

Magnesium (Mg) is the most common intracellular cation after potassium in the body. It serves as a vital cofactor in various physiological processes, such as neuromuscular, immune, cardiovascular, and hormonal functions [1]. It is especially involved in physiological reactions such as ATP synthesis, neurotransmitter synthesis, cell membrane stabilization, blood pressure regulation, muscle contraction, and relaxation [2,3]. A decrease in total body Mg level is one of the important problems and is associated with many negative consequences in older individuals. Hypomagnesemia is frequently observed in older adults, primarily due to decreased oral Mg intake and Mg absorption disorder [4]. In addition, its relationship with comorbidities including type 2 diabetes mellitus (T2DM) and hypertension is emphasized in the literature. Hypomagnesemia is prevalent among T2DM patients, particularly those with poor glycemic control, extended disease duration, and microvascular or macrovascular complications [5].

Comprehensive geriatric assessment (CGA) is the most crucial method in geriatric practice for managing comorbidities and identifying, preventing, and directing the treatment of geriatric syndromes. In CGA, geriatric syndromes such as dementia, delirium, sarcopenia, malnutrition, polypharmacy, insomnia, falls, urinary/fecal incontinence, and frailty are assessed. In addition to CGA being the basic method in older care, its significant benefits have been demonstrated in older adults. Improvement in functionality, daily living activities, and social participation has been demonstrated in individuals who underwent CGA [6].

The risk of hypomagnesemia tends to increase with age due toa variety factors, including decreased oral intake, presence of comorbidities, medicine-related, Mg loss of the gastrointestinal or renal system, and general neglected of this condition in older adults [7,8]. Moreover, there are few studies in the literature on the relationship between hypomagnesemia and geriatric syndromes. It has been determined that hypomagnesemia could

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potentially contribute to daytime sleepiness, delirium, and depression in older adults [9–11]. To the best of our knowledge, there is no study on the relationship between hypomagnesemia and geriatric syndromes in community-dwelling older adults within the scope of AGD.

The study aims to investigate the relationship between hypomagnesemia and geriatric syndromes and to reveal the effect of hypomagnesemia on CGA parameters, independent of confounding factors.

Materials and methods

Sample size

A total of 317 patients applied for any health issue to our single-center geriatric clinic between November 2022 and December 2023. As a result of CGA by geriatricians, 217 patients who did not have exclusion criteria, were included in this retrospective, cross-sectional, and observational study. The investigation conformed to the Declaration of Helsinki and approved by the local ethics committee. Informed consent was provided by each participant or a legal guardian before participating in the study.

Inclusion criteria

Patients who were over 65 years of age who applied to the geriatric clinic for any reason and who did not meet the exclusion criteria were included in the study.

Exclusion criteria

- Patients with severe osteoarthritis or neuromuscular disease, which causes obstacles to walking and immobile patients
- Patients who have a history of severe illness that may impair general health status, such as acute cerebrovascular event, gastrointestinal bleeding, severe anemia (hemoglobin <10 g/dL), sepsis, acute renal failure, acute coronary syndrome, acute liver failure, acute respiratory failure, critical mitral and/or aortic valve stenosis, hypotensive shock, bradycardia or tachycardia during examination, dehydration, electrolyte imbalance, acute hemorrhage, severe metabolic acidosis, malabsorption syndrome, and sepsis
- Patients with taking any magnesium supplement
- Patients with alcohol and substance abuse
- Patients under 65 years of age and who refused to participate

Patients' characteristics

Demographic features include age, gender, marital status, education levels, smoking status, and the presence of comorbidities including hypertension (HT), type 2 diabetes mellitus (T2DM), cardiac diseases (coronary artery disease, atrial fibrillation, congestive heart disease), chronic obstructive lung disease, Parkinson disease, cerebrovascular disease and osteoporosis numbers of drugs used were recorded. Modified Charlson Comorbidity Index (mCCI) was calculated for combined effects of comorbidities [12]. Geriatric syndromes were interrogated in all patients. In the admission, they were questioned whether they had fallen in the previous year. Urinary incontinence, orthostatic hypotension (OH), sarcopenia, frailty, and polypharmacy were determined by patients' self or caregiver reports. Dementia and depression were diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders Fifth Edition (DSM-5) criteria [13].

Comprehensive geriatric assessment

All the patients performed CGA including, Mini-Mental State Examination(MMSE), Yesevage Geriatric Depression Scale (GDS) for neurocognitive evaluation, Basic and Instrumental Activities of Daily Living (BADLs and IADLs, respectively) for functionality assessment, Timed Up and Go test and Tinetti Performance-Oriented Assessment of Mobility (POMA) for mobility assessment, Mini Nutritional Assessment-short form (MNA-SF) for nutritional evaluation [14]. Frailty status was assessed by the FRIED Frailty Scale [15]. According to this scale, a score of ≥3 was described as a frail group. All patients have performed the handgrip test for diagnosis of probable sarcopenia. The handgrip test was measured by a JAMAR-branded hand dynamometer and low handgrip power was defined as <14 kg in women, and <28 kg in males according to population-based cutoffs in Türkiye [16]. An active standing test (AST) was performed for the diagnosis of OH. The diagnosis of OH was made in the event of 20 mmHg and a higher decrease in systolic pressure (systolic OH) and/or 10 mmHg and a higher decrease in diastolic pressure (diastolic OH) during the transition from a supine position to a standing position within three minutes [17]. In the study, interviewers who completed the form were experienced and supervised by the same clinician, ensuring consistency in the ratings.

Definition of hypomagnesemia

There are different values in the literature regarding the cut-off values of hypomagnesemia. The most commonly used value is considered to be 1.5 mg/dl and below as hypomagnesemia. Additionally, Mg levels of

1.8 mg/dl and below are defined as preclinical hypo-magnesemia. Based on this information, the group with a Mg level of ≤1.5 mg/dl is defined as the hypo-magnesemia group (Group 1), the group with a Mg level of 1.51–1.80 mg/dl is called the preclinical hypo-magnesemia group (Group 2), and the group with a Mg level of 1.81 and above was defined as the normal group (Group 3) [5]. Corrected Mg was calculated by this formula: 'corrected Mg = serum Mg + 0.005 × (40 - albumin level g/L)' Mg levels were obtained with the auto-analyzer diagnostic modular system (Roche E170 and p-800).

Statistical analyses

In this study, the Kolmogorov-Smirnov test was performed to determine the suitability of continuous variables for normal distribution among these three groups. Accordingly, it was observed that all continuous variables did not comply with normal distribution. Continuous variables are expressed as median [interquartile range], while categorical variables are expressed as %. The chi-square test was applied to compare categorical variables. Continuous variables were compared in pairs using the non-parametric Mann-Whitney U test. p values were expressed as p1 value showing the comparison between group 1 and group 2, p2 value showing the comparison between group 1 and group 3, and p3 value showing the comparison between group 2 and group 3. To show the interaction between groups, multinomial or binomial regression analysis was performed among three or two groups, respectively. Univariate and multivariate logistic regression analyses were conducted to determine the independent factors influencing the parameters of the comprehensive geriatric assessment. The relationship between these variables was examined in an adjusted model that included the covariates identified in the initial univariate analyses. Unadjusted, model 1 and model 2 adjusted odds ratio (OR) was calculated with a 95% confidence interval (CI). While model 1 was created according to age and gender, model 2 was created according to hypertension, diabetes mellitus, Parkinson's disease, and mCCI in addition to model 1. SPSS package program was performed in the statistical analysis and a p-value of < 0.05 was found to be statistically significant.

Results

In this study, 74.9% of the 217 patients were women and their average age was 76.5 ± 6.6 years. Of all participants, 31 were in the hypomagnesemia group (Group 1), 24.4% were in the preclinical hypomagnesemia group (Group 2), and the remainder were in the normomagnesemia group (Group 3). The number of these groups did not

change in terms of corrected Mg levels compared to the total Mg levels.

When these three groups were compared in terms of demographic characteristics, no significant difference was observed within the groups ($p > 0.05$). Moreover, no significant difference was found between the groups in terms of diuretic and proton pump inhibitor use ($p > 0.05$). While there was no significant difference in terms of comorbidities between Group 1 and Group 2 ($p > 0.05$), the frequency of HT, T2DM, and Parkinson's disease was observed to be higher in Group 1 and Group 2 compared to Group 3 ($p < 0.05$). The frequency of coronary artery disease was observed more in Group 1 ($p = 0.016$), and the frequency of osteoporosis was observed more in Group 2 than in Group 3 ($p = 0.014$). While mCCI was higher in Group 1 and Group 2 compared to Group 3 ($p < 0.001$), it was similar between Group 1 and Group 2 ($p > 0.05$). The frequency of geriatric syndromes, including probable sarcopenia, urinary incontinence, polypharmacy, recurrent falls, dementia, geriatric depression, and orthostatic hypotension, was not found to be significant among these three groups ($p > 0.05$). Within the scope of CGA parameters, Basic ADLs and Tinetti gait and balance scores were statistically lower in Group 1 than in Group 2 and Group 3 ($p < 0.05$), while FRIED score was observed to be higher in Group 1 compared to the other two groups ($p < 0.05$). Additionally, the Timed up-and-go test duration was observed to be statistically longer in Group 1 compared to Group 3 ($p < 0.05$) (Table 1). A sensitivity analysis conducted on cases with other comorbidities or medications yielded results consistent with the main analysis, indicating a statistically remarkable association between the Mg level and the CGA parameters.

In the logistic regression analysis applied for the relationship of hypomagnesemia and preclinical hypomagnesemia with CGA parameters, when the normomagnesemia group was considered as the reference category, no statistical significance was observed in terms of unadjusted, adjusted for model 1 and model 2 in the preclinical hypomagnesemia group ($p > 0.05$). In the hypomagnesemia group compared to the normomagnesemia group, lower baseline ADLs, POMA score, longer timed up and go duration, higher FRIED score were statistically significant in the unadjusted and adjusted models. When adjusted for Model 2, the ORs of the POMA score, timed up and go duration, basic ADLs and FRIED Frailty scale were 0.89 (95 % CI 0.82–0.97; $p = 0.011$), 1.01 (95 % CI 1.00–1.04; $p = 0.043$), 0.96 (95 % CI 0.92–0.99; $p = 0.013$) and 1.58 (95 % CI 1.05–2.38; $p = 0.025$) (Table 2).

In the binary logistic regression analysis of the relationship between hypomagnesemia and preclinical hypomagnesemia, according to confounding factors including age, gender, hypertension, T2DM and Parkinson's disease, higher FRIED frailty scale and

Table 1. Comparison for demographic features, comorbidities, geriatric syndromes and comprehensive geriatric assessment parameters between hypomagnesemia, preclinical hypomagnesemia and normomagnesemia groups.

		Group 1 n = 31	Group 2 n = 53	Group 3 n = 133	p1	p2	p3
Demographic Features	Gender (female;%)	81.0	79.2	72.2	0.869	0.398	0.320
	Age (median; IQR)	75.0 (9.0)	78.0 (7.0)	76.5 (9.0)	0.976	0.714	0.825
	Education year (median; IQR)	5.0 (2.7)	5.0 (1.0)	5.0 (0)	0.599	0.384	0.593
	Marital status (married;%)	38.1	43.4	45.9	0.799	0.437	0.491
	Smoking (%)	4.8	5.7	5.3	0.984	0.640	0.464
Comorbities(%)	Hypertension	95.2	83.0	66.2	0.166	**0.007**	**0.022**
	Coronary Heart Disease	33.3	20.8	12.7	0.256	**0.016**	0.170
	Congestive Heart Failure	14.3	9.4	14.6	0.454	0.987	0.373
	Atrial Fibrillation	14.3	13.2	16.5	0.903	0.794	0.572
	Chronic Obstructive Lung Disease	4.8	3.8	5.3	0.846	0.923	0.669
	Diabetes Mellitus	81.0	67.9	30.1	0.262	**<0.001**	**<0.001**
	Cerebrovascular Disease	9.5	7.5	3.8	0.779	0.239	0.277
	Parkinson Disease	19.0	11.3	3.8	0.381	**0.006**	**0.048**
	Osteoporosis	28.6	37.7	20.3	0.457	0.391	**0.014**
	mCCI (median[IQR])	1.0 [1.0]	1.0 [1.0]	0 [1.0]	0.109	**<0.001**	**<0.001**
Geriatric Syndromes (%)	Recurrent falls (in a year)	57.1	39.6	42.9	0.172	0.451	0.742
	Urinary Incontinence	76.2	66.0	59.4	0.395	0.141	0.401
	Geriatric Depression	47.6	62.3	47.4	0.250	0.983	0.067
	Dementia	14.3	22.6	28.6	0.420	0.169	0.410
	Orthostatic Hypotension	41.2	36.7	40.5	0.745	0.956	0.649
	Probable Sarcopenia	57.1	52.8	46.6	0.737	0.370	0.444
	Polypharmacy (≥5 medication)	76.2	71.7	62.4	0.695	0.221	0.230
Medication (%)	Diuretics	57.1	41.5	38.3	0.224	0.103	0.690
	Proton Pump Inhibitors	33.3	30.2	27.1	0.792	0.552	0.669
Comprehensive Geriatric Assessment Parameters (median[IQR])	MMSE	23.0 (6.7)	24.0 (9.0)	24.0 (8.2)	0.857	0.678	0.640
	Tinetti- POMA score	23.5 (11.2)	25.0 (9.5)	25.0 (7.0)	**0.036**	**0.003**	0.408
	Timed up and go test	21.5 (20.1)	16.0 (13.5)	16.0 (8.2)	0.061	**0.002**	0.238
	Basic ADLs	80.0 (15.0)	90.0 (12.5)	90.0 (10.0)	**0.005**	**0.001**	0.361
	Instrumental ADLs	15.5 (9.0)	19.0 (6.0)	18.5 (8.0)	0.051	0.054	0.935
	Yesevage Geriatric Depression Scale	4.0 (3.7)	5.0 (4.7)	4.0 (5.0)	0.775	0.513	0.300
	MNA-SF score	13.0 (2.5)	12.0 (2.5)	12.0 (3.0)	0.728	0.536	0.674
	FRIED Frailty Scale	2.0 (2.2)	2.0 (3.0)	2.0 (2.0)	**0.014**	**0.001**	0.402

ADLs: activities daily of living; IQR: interquartile range; mCCI: modified Charlson Comorbidity index; MMSE: mini-mental state examination; MNA-SF: mini-nutritional assessment short form; POMA: performance-oriented mobility assessment.
p1: comparison for group 1 and group 2
p2: comparison for group 1 and group 3
p3: comparison for group 2 and group 3

Table 2. Association of group 1, group 2 and comprehensive geriatric assessment parameters in multinomial regression analysis.

Comprehensive Geriatric Assessment Parameters	Odds Ratio	95 % Confidence Interval	p value
Tinetti-POMA score- Group 1			
Unadjusted	0.91	0.86–0.97	**0.008**
Model 1	0.90	0.84–0.97	**0.005**
Model 2	0.89	0.82–0.97	**0.011**
Tinetti-POMA score- Group 2			
Unadjusted	0.97	0.92–1.02	0.256
Model 1	0.96	0.91–1.02	0.248
Model 2	0.97	0.91–1.03	0.414
Timed up and go test-Group 1			
Unadjusted	1.01	0.99–1.03	0.064
Model 1	1.01	0.99–1.03	0.055
Model 2	1.02	1.00–1.04	**0.043**
Timed up and go test-Group 2			
Unadjusted	1.01	0.99–1.02	0.159
Model 1	1.01	0.99–1.02	0.173
Model 2	1.01	0.99–1.02	0.219
Basic ADLs – Group 1			
Unadjusted	0.97	0.94–0.99	**0.008**
Model 1	0.96	0.94–0.99	**0.007**
Model 2	0.96	0.92–0.99	**0.013**
Basic ADLs – Group 2			
Unadjusted	0.99	0.97–1.01	0.610
Model 1	0.99	0.97–1.01	0.638
Model 2	0.99	0.97–1.02	0.874
FRIED Frailty Scale – Group 1			
Unadjusted	1.71	1.24–2.38	**0.001**
Model 1	1.81	1.28–2.58	**0.001**
Model 2	1.58	1.05–2.38	**0.025**
FRIED Frailty Scale – Group 2			
Unadjusted	1.10	0.89–1.36	0.612
Model 1	1.10	0.88–1.37	0.364
Model 2	0.94	0.72–1.21	0.647

• Reference category; Group 3.

Table 3. The relationship between group 1 and group 2 in terms of comprehensive geriatric assessment in binomial regression analysis.

	Odds Ratio	95% Confidence Interval	p value
FRIED Frailty Scale	1.65	1.08–2.54	**0.021**
Basic ADLs	0.95	0.92–0.99	**0.022**
Timed up and go test	1.01	0.98–1.03	0.353
Tinetti-POMA	0.92	0.84–1.00	0.061

ADLs: activities daily of living; POMA: performance-oriented mobility assessment.

lower Basic ADLs scores were statistically significant (OR = 1.65 95 % CI 1.08–2.54; p = 0.021 and OR = 0.95 95 % CI 0.92–0.99; p = 0.022, respectively) (Table 3).

Discussion

The findings of this study highlight the importance of adequate Mg levels above 1.5 mg/dl in older individuals in terms of possible associations with baseline ADLs, balance, walking tests, and frailty scores. Despite this, there appears to be no significant association between Mg levels and geriatric syndromes such as urinary incontinence, cognitive dysfunction, dementia, and sarcopenia. This is one of the unique novel research to examine the relationship between comprehensive geriatric assessment parameters and Mg levels in community-dwelling older adults.

Mg is an intracellular cation that has a critical role in many metabolic reactions. It serves as a cofactor in many enzymatic reactions such as ATP metabolism, muscle contraction and relaxation, blood pressure regulation, neuronal activity and neurotransmitter release [18]. The prevalence of hypomagnesemia increases in elderly individuals. The reasons for this include decreased Mg absorption with age, inadequate food intake, inflammatory cytokine production, functional dependency, cognitive dysfunction, comorbid diseases, polypharmacy and iatrogenic causes (uncontrolled total parenteral nutrition, nasogastric feeding and medications) [4]. The prevalence of hypomagnesemia in the elderly is around 14.3%-36%, depending on the type of study, the location where the study is conducted (such as an outpatient clinic, hospitalization, and nursing home), and the Mg cut-off level considered [4,9]. In a study conducted on community-dwelling older individuals, the frequency of hypomagnesemia was found to be 14.3% [9]. In our study, the frequency of those with Mg levels below 1.5 mg/dl was found to be 14.2%. The frequency of hypomagnesemia was found to be compatible with the previous study due to the similarity of both the patient population studied and the Mg level cut-off.

T2DM, chronic kidney disease, and congestive heart failure were independently associated with hypomagnesemia in older individuals [4]. In our study, it was found that the frequency of hypomagnesemia was significantly higher, especially in patients diagnosed with T2DM. The relationship between hypomagnesemia and T2DM is frequently emphasized in the literature, and it is not surprising that the relationship between these two disorders, whose prevalence increases with age, is more evident in older adults. It is highlighted that low Mg level is an independent marker for the development of T2DM [19]. Because decreasing Mg level has negative effects on glucose homeostasis and insulin sensitivity. It also contributes to the development of complications such as hypertension, retinopathy, and thrombosis [20]. In addition, hypoalbuminemia, microalbuminuria, urinary Mg loss, low dietary Mg intake, and impaired Mg absorption are more common in patients with T2DM than in other patients [21]. There are no sufficient studies on the relationship between hypomagnesemia and hypertension in older subjects. Hypomagnesemia has been associated with de novo hypertension or worsening of existing hypertension in large population-based studies in individuals under 65 years of age [22]. In our study, hypomagnesemia was found to be associated with hypertension in older individuals. In addition, the fact that the use of diuretics, which are well-known as side effects of hypomagnesemia and used in the treatment of hypertension, was similar between the groups, suggests that this relationship may be independent of the diuretic effect. Hypomagnesemia may be primarily associated with hypertension in older individuals because Mg plays a primary role in blood pressure control, is a potent vasodilator, and plays a primary role in peripheral vascular tone [23].

There are very few studies in the literature regarding the relationship between hypomagnesemia and geriatric syndromes. It has been observed that hypomagnesemia increases the risk of delirium in older patients hospitalized in the intensive care unit, and this increase is independent of body mass index, immunosuppressive drug use, benzodiazepine, and alcohol use [18]. While another study showed that hypomagnesemia in older adults may be associated with daytime sleepiness, it is also emphasized that chronic hypomagnesemia may be associated with depression, psychiatric diseases, and dementia [9]. In an InCHIANTI study, the Mg levels independently correlate with muscle performance in older adults [24]. Our study has underlined that hypomagnesemia might be associated with worsening of frailty index, baseline ADLs, and Tinetti-POMA score and that this relationship may develop independently of age, gender, T2DM, HT, and Parkinson's disease. To the best of our knowledge, it is the first study in this respect in the literature. Frailty is a geriatric

syndrome that is emphasized in geriatric practice and is defined as the decreased tolerance of older people to stressors. There is a study in the literature on the relationship between frailty and hypomagnesemia, showing that it is an independent risk factor in 339 hemodialysis patients [23]. When this study was examined, it was understood that the population was not in the community-dwelling older subjects, and our study is the first study showing this relationship in older individuals living in the community.

Mg plays an important role in DNA replication and DNA repair, as well as being involved in many metabolic events, and it is an important cofactor in the folate-methionine-neurotransmitter cycle [25] when the methylation process is interrupted as a result of hypomagnesemia, homocysteine is formed and inflammation, oxidative stress, mitochondria damage, and DNA damage may develop [26,27]. Similarly, inflammation, oxidative stress, and mitochondrial damage may play a prominent role in the pathophysiology of frailty [28]. Moreover, Mg is responsible for insulin signal regulation, insulin receptor kinase phosphorylation, postreceptive activity of insulin, and insulin-mediated cellular glucose uptake [29,30]. Mg is closely related to insulin sensitivity. Hypomagnesemia is associated with insulin resistance through oxidative stress and/or inflammation [5]. Insulin resistance seems as another mechanism accused in the pathogenesis of frailty [31]. Ionised intramuscular Mg levels was negatively related to age and positively associated with muscular strength, which is component of frailty scale [32]. Therefore, as we pointed out in our study, the relationship between frailty and hypomagnesemia may share common pathophysiological mechanisms, and perhaps there may even be a bi-directional relationship.

Another issue we want to pay attention to is the increase in the frailty score may be associated with hypomagnesemia, suggesting that hypomagnesemia may also develop in patients during the prefrail phase. It is also not surprising that we have shown an association between hypomagnesemia and mobility and baseline ADLs tests. Mg is an intracellular element predominantly stored in bone, and the relationship between movement disorders and hypomagnesemia has been demonstrated in both the central nervous system and the peripheral nervous system [33]. While it has been shown in animal experiments that hypomagnesemia can lead to muscle necrosis by changing the resting transmembrane potential in muscles, it can also lead to balance and gait disorders by primarily reducing the sensitivity of acetylcholine in the neuromuscular junction [34,35]. Mg deficiency has been identified as a potential factor contributing to frailty and mobility problems in older adults. Several biochemical mechanisms have been proposed to explain this association. One key mechanism is the role of Mg in muscle function, as it is essential for the activation of ATP, the energy currency of cells, which is crucial for muscle contraction and relaxation. In addition, Mg plays a role in regulating inflammation and oxidative stress, both of which can contribute to muscle weakness and reduced mobility Furthermore, Mg deficiency has been linked to impaired glucose metabolism and insulin resistance, which can further exacerbate frailty and mobility issues [36].

The study has several strengths. Firstly, it is the first study to show the relationship between frailty, baseline ADLs, mobility tests, and hypomagnesemia in older individuals. Second, this relationship has been shown independently of age, medication that frequently causes hypomagnesemia, comorbidities including diabetes, and age. There are some limitations of this study. First, The research's retrospective and cross-sectional design hinders the ability to determine causality. Second, we could not check possible daily changes (general physiologic variability, etc.) in Mg level measurements. It is important to note that this study focused solely on living older adults in the community, limiting the generalizability to homebound individuals and nursing home residents. While adjustments were made for certain demographic and clinical factors, the presence of residual confounding variables (severity or duration of diseases) not accounted for warrants a cautious interpretation of the results. Third, cut-off values for hypomagnesemia vary between studies and the generalizability of our findings is uncertain. Therefore, further prospective, large-scale studies are needed to clarify the exact relationship between different Mg levels and comprehensive geriatric assessments. Fourth, it is important to note that despite efforts to account for potential demographic and clinical covariables, residual confounding may still exist in our analysis.

In conclusion, hypomagnesemia is an important electrolyte disorder in the older adults, and it should be kept in mind that it may be associated with basic ADLs such as frailty and even prefrailty, balance, and gait disorders in geriatric practice. To support this relationship, multicenter and longitudinal studies with large sample sizes are needed.

Disclosure statement

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