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The Association Between the Primitive Reflexes and Falls in Older Adults Without Neurodegenerative Disease

Mehmet Selman Ontan[1], Fatma Sena Dost[2], Ahmet Turan Işık[2]

[1]University of Health Sciences Türkiye, İzmir Tepecik Training and Research Hospital, Clinic of Geriatric Medicine, İzmir, Türkiye
[2]Dokuz Eylul University Faculty of Medicine, Department of Geriatric Medicine, İzmir, Türkiye

Abstract

Objective: Falls, a major public health concern, may lead to morbidity and mortality among older adults. While the re-emergence of primitive reflexes (PRs) reflects a loss of cortical inhibition and is generally associated with neurodegenerative conditions, the relationship between PRs and falls in older adults without neurodegenerative disease has yet to be investigated in detail. This study aimed to evaluate the association between PRs and falls in older adults without neurodegenerative disease.

Materials and Methods: A retrospective cross-sectional study was conducted involving 668 older adults without neurodegenerative disease. Demographics, comorbidities, medications, and laboratory parameters were obtained from patients' medical records. The presence of specific PRs (palmomental, snout, glabellar, and grasp) and a history of falls in the last 12 months were evaluated in such patients.

Results: Of the 668 participants, 241 (36.1%) reported a history of falls. Each of the palmomental, snout, and glabellar reflexes was more prevalent in the fallers group compared with non-fallers ($p < 0.001$, $p = 0.020$, $p = 0.020$, respectively). In logistic regression, the association between falls and both the palmomental reflex and the glabellar reflex remained significant. [Odds ratio (OR): 1.877, 95% confidence interval (CI): 1.162-3.033, $p = 0.010$ and OR: 2.363, 95% CI: 1.130-4.943, $p = 0.022$].

Conclusion: The palmomental and glabellar reflexes are associated with falls in older adults. Eliciting these simple, non-invasive clinical signs may significantly aid in early fall risk stratification and preventive care.

Keywords: Palmomental reflex, glabellar reflex, snout reflex, grasp reflex, risk factors

Introduction

Falls represent a major public health concern, as well as a geriatric syndrome, with incidence increasing significantly with advancing age (1). Approximately one-third of older adults experience at least one fall per year (2). Falls may not only lead to fractures, prolonged hospital stays, increased healthcare costs, a marked decline in functional independence, and a reduced quality of life (3,4) but are also associated with mortality in the geriatric population (1). Given these life-threatening complications, identifying conditions associated with fall risk is crucial for implementing effective preventive and therapeutic strategies in geriatric care.

Falls among older adults are associated with numerous physiological, behavioral, and environmental factors, as well as age-related changes. Furthermore, a multitude of risk factors are detected for falls, such as a previous history of falls, sarcopenia, balance/gait impairment, polypharmacy, vision impairment, and dementia (5). Additionally, primitive reflexes (PRs), which were inhibited during the first year of life as the cerebral cortex matures and takes control of postural reactions, may re-emerge with advancing age (6,7). The re-emergence of PRs generally suggests a loss of cortical inhibition (7). While isolated reflexes, such as the palmomental reflex (PMR), may occasionally be observed in healthy individuals as a sign of physiological aging, the presence of numerous or strong reflexes—particularly the

Address for Correspondence: Mehmet Selman Ontan, MD, University of Health Sciences Türkiye, İzmir Tepecik Training and Research Hospital, Clinic of Geriatric Medicine, İzmir, Türkiye
E-mail: selmanontan@gmail.com **ORCID:** orcid.org/0000-0003-4360-4114
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grasp reflex—is significantly associated with advanced dementia and brain pathology (7-11). The re-emergence of these reflexes in conditions of impaired cortical integrity may be suggestive of a decline in the ability to process environmental hazards or maintain balance during complex movements (12), which, in turn, raises the question of whether PRs could be related to falls.

Consequently, this study aimed to investigate the relationship between specific PRs—the palmomental, snout, glabellar, and grasp reflexes—and falls among older adults.

Materials and Methods

Study Design and Participants

This retrospective cross-sectional study was conducted at the geriatrics outpatient clinic. The inclusion criteria were age ≥60 years and availability of complete medical records. Patients with a pre-existing diagnosis of dementia (major neurocognitive disorder according to the diagnostic and statistical manual of mental disorders (13) were excluded. Patients with Parkinson's disease, Parkinson-plus syndromes, a history of stroke, malignancy, or acute illness (e.g., acute cerebrovascular events, sepsis, acute coronary syndrome, or organ failure) were also excluded. The final study population consisted of 668 older adult patients who met these criteria. Ethical approval was obtained from the Dokuz Eylül University Non-Interventional Research Ethics Committee (approval no: 2025/45-09, date: 29.12.2025). Written informed consent was waived due to the study's retrospective design.

Data Collection

Demographic, clinical, and laboratory data were extracted from patients' medical records. Recorded demographic and clinical variables included age, sex, number of medications, and the presence of specific clinical conditions such as urinary incontinence. Comorbidity burden was quantified using the Charlson Comorbidity Index (CCI) (14). Medication history was reviewed specifically for use of antihypertensives, antidiabetics, antidepressants, and antipsychotics. Routine laboratory parameters, including hemoglobin, vitamin B12, thyroid-stimulating hormone, 25-hydroxyvitamin D levels, and estimated glomerular filtration rate (eGFR), were extracted from the patients' files. A patient was categorized into the "fallers" group if they had a documented history of at least one fall, an individual coming to rest at a level lower than their current position without the application of any external force, within the past 12 months (15).

Assessment of Primitive Reflexes

Stimulation of the thenar eminence was utilized to elicit the PMR, with a positive reaction indicated by the twitching of the ipsilateral mentalis muscle (16). The snout reflex was assessed by tapping the closed lips at the midline; lip puckering or protrusion was considered positive (17). The glabellar reflex was tested by repetitive tapping of the glabella; persistent, non-habituating blinking was accepted as positive (18). The grasp reflex was provoked by stroking the palm, and involuntary finger flexion was recorded as a positive response (17). All primitive reflex examinations were performed by a single senior clinician.

Statistical Analysis

Data analysis was performed using Statistical Package for Social Sciences version 25.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Kolmogorov-Smirnov test. Descriptive statistics are presented as mean ± standard deviation for continuous variables and as percentages (%) for categorical variables. Group comparisons (fallers vs. non-fallers) were conducted using the Independent Samples t-test or the Mann-Whitney U test for continuous variables, depending on their distribution. Categorical variables were compared using the chi-square test. Variables that differed significantly between non-fallers and fallers (age, sex, years of education, CCI, number of medications, hemoglobin, eGFR, antidiabetic and antidepressant use, urinary incontinence, and each of PMR, snout reflex, and glabellar reflex) were included in a model to identify independent predictors of falls. Logistic regression analysis was performed using a stepwise backward selection procedure. Statistical significance was set at $p < 0.05$. Model adequacy and explanatory power for each independent primitive reflex model were evaluated using the Hosmer-Lemeshow goodness-of-fit test, Cox & Snell R^2, and Nagelkerke R^2 statistics.

Results

A total of 668 participants were included in the study. Of these, 427 (63.9%) reported no history of falls, while 241 (36.1%) reported at least one fall.

As shown in Table 1, participants in the fallers group were significantly older (75.85 ± 7.92) than those in the non-fallers group (73.22 ± 7.85; $p < 0.001$). The frequency of female participants was significantly higher among fallers than among non-fallers (76.8% vs. 60.2%, $p < 0.001$). Additionally, the fallers group had significantly fewer years of education compared to the non-fallers group (7.91 ± 4.65 vs. 8.77 ± 4.65; $p = 0.030$). Regarding clinical characteristics, the fallers group had a higher CCI ($p = 0.030$) and a significantly higher number of medications (5.32 ± 3.35 vs. 4.11 ± 3.06, $p < 0.001$). Laboratory parameters showed that fallers had significantly lower hemoglobin ($p < 0.001$) and eGFR ($p = 0.040$) levels. Additionally, the use of antidiabetics ($p = 0.029$) and antidepressants ($p < 0.001$) was significantly more frequent among fallers. The prevalence of urinary incontinence was notably higher in those who fell (57.2% vs. 41.4%, $p < 0.001$). Furthermore, PRs, including the

PMR (31.1% vs. 18.5%, p < 0.001), snout reflex (12.8% vs. 7.2%, p = 0.020), and glabellar reflex (12.3% vs. 6.9%, p = 0.020), were significantly more common in the fallers' group.

To evaluate the independent predictive value of PRs for fall risk, binary logistic regression analyses using a backward elimination approach were conducted. The final model for the PMR, selected at step 6, demonstrated adequate goodness-of-fit (Hosmer-Lemeshow χ^2 = 12.022, p = 0.150) and descriptive strength, as indicated by a Cox & Snell R^2 of 0.115 and a Nagelkerke R^2 of 0.150. In this final step, the presence of the PMR remained a statistically significant independent predictor of increased fall risk [odds ratio (OR) = 1.877; 95% confidence interval (CI): 1.162-3.033; p = 0.010] (Table 2). Similarly, the model assessing the glabellar reflex completed its estimation at step 8. In the final adjusted model, the glabellar reflex was identified as a significant independent risk factor, and its presence more than doubled the odds of falling (OR = 2.363; 95% CI: 1.130–4.943; p = 0.022) (Table 3). Model summary statistics yielded a Cox & Snell R^2 of 0.100 and a Nagelkerke R^2 of 0.138; however, the Hosmer-Lemeshow test indicated a suboptimal overall model fit at this step (χ^2 = 18.012, p = 0.021). Conversely, stepwise regression for the snout reflex, which was finalized at step 7, did not identify the reflex as a significant independent predictor. Prior to its exclusion at step 6, the step 5 model demonstrated adequate fit

Table 1. Characteristics of participants according to fall status.

	Non-fallers (n = 427)	Fallers (n = 241)	p**
Age, years*	73.22 ± 7.85	75.85 ± 7.92	**<0.001**
Female sex (%)	60.2	76.8	**<0.001**
Education years*	8.77 ± 4.65	7.91 ± 4.65	**0.030**
Charlson Comorbidity Index*	3.93 ± 1.78	4.18 ± 1.71	**0.030**
Number of medications*	4.11 ± 3.06	5.32 ± 3.35	**<0.001**
Hemoglobin, g/dL*	13.08 ± 1.61	12.36 ± 1.56	**<0.001**
eGFR, mL/min/1.73 m^2*	76.09 ± 17.83	72.71 ± 19.53	**0.040**
Vitamin B12 pg/mL*	379.88 ± 291.02	391.07 ± 295.44	0.797
TSH mIU/L*	2.11 ± 2.34	2.00 ± 3.68	0.338
25-hydroxy vitamin D ng/mL*	23.49 ± 29.68	23.90 ± 14.25	0.163
Antidiabetic use (%)	24.9	32.8	**0.029**
Antihypertensive use (%)	67.1	71.8	0.213
Antidepressant use (%)	24.2	40.7	**<0.001**
Antipsychotic use (%)	4.0	7.5	0.054
Urinary incontinence (%)	41.4	57.2	**<0.001**
Palmomental reflex (%)	18.5	31.1	**<0.001**
Snout reflex (%)	7.2	12.8	**0.020**
Glabellar reflex (%)	6.9	12.3	**0.020**
Grasp reflex (%)	6	9.4	0.104

* Mean ± SD.
**Statistically significant p-values (p < 0.05) are shown in bold characters.
eGFR: Estimated glomerular filtration rate, SD: Standard deviation, TSH: Thyroid-stimulating hormone.

Table 2. Adjusted logistic regression model for palmomental reflex and fall risk.

	OR	95% CI	p*
Palmomental reflex	1.877	1.162-3.033	**0.010**
Sex	1.700	1.077-2.686	**0.023**
Hemoglobin	0.837	0.729-0.960	**0.011**
Urinary Incontinence	1.434	0.955-2.152	0.082
Antidepressant usage	1.600	1.033-2.478	**0.035**
Number of medications	1.095	1.024-1.170	**0.008**

*Statistically significant p-values (p < 0.05) are shown in bold characters.
Multivariate logistic regression analysis was performed to identify independent predictors of falls (age, female sex, education years, Charlson Comorbidity Index, number of medications, hemoglobin, eGFR, antidiabetic and antidepressant, urinary incontinence and palmomental reflex).
CI: Confidence interval, OR: Odds ratio, eGFR: Estimated glomerular filtration rate.

Table 3. Adjusted logistic regression model for glabellar reflex and fall risk.

	OR	95% CI	p*
Glabellar reflex	2.363	1.130-4.943	**0.022**
Sex	1.862	1.173-2.956	**0.008**
Hemoglobin	0.848	0.737-0.974	**0.020**
Number of medications	1.143	1.069-1.223	**<0.001**

*Statistically significant p-values ($p < 0.05$) are shown in bold characters.
Multivariate logistic regression analysis was performed to identify independent predictors of falls (age, female sex, education years, Charlson Comorbidity Index, number of medications, hemoglobin, eGFR, antidiabetic and antidepressant, urinary incontinence and glabellar reflex).
CI: Confidence interval, OR: Odds ratio, eGFR: Estimated glomerular filtration rate.

(Hosmer-Lemeshow χ^2 = 14.146, p = 0.078), with a Cox & Snell R^2 of 0.109 and a Nagelkerke R^2 of 0.150. At this pre-exclusion stage, the adjusted effect of the snout reflex was not statistically significant (OR = 1.578; 95% CI: 0.788-3.160; p = 0.198), leading to its subsequent removal from the final equation.

Discussion

This retrospective, cross-sectional study demonstrates that the PMR and the glabellar reflex are associated with falls in older adults without neurodegenerative disease. Accordingly, the re-emergence of these PRs may suggest a subclinical compromise in postural control in this demographic.

Re-emergence of PRs, brainstem-regulated movements, may indicate the onset of neurodegenerative processes and dementia; however, they can also be observed in cognitively healthy individuals, signaling processes beyond cognitive impairment (7). It is widely acknowledged that the frontal regions regulate balance by planning body movements and postural responses, particularly in variable conditions that require conscious movement control (19). Accordingly, a recent study has reported that lesions in the frontal white matter are associated with poorer balance, slower gait speed, and a higher risk of falling (20). Moreover, modifiable lifestyle factors, particularly physical activity, may prevent not only the re-emergence of PRs but also falls (21,22). Among all PRs, of which re-emergence frequency increases with age, the PMR is one of the earliest to appear and the most prevalent, observed even in cognitively intact individuals (23-26). The presence of the PMR may predict the insidious onset of a neurodegenerative process. For example, a positive PMR has been reported to show reduced functional connectivity in frontal regions even without structural atrophy in patients with Alzheimer's disease (AD) (27). Accordingly, in a case-control study, Gabelle et al. (28) suggested that the PMR could be an early clinical sign of AD due to the likely frontal amyloid load at an early stage of the disease. Crucially, this underlying disruption in frontal networks is accompanied by impaired motor control mechanisms, which directly increase the risk of falling (20,25,29). Consistent with this pathophysiological link, Tinetti et al. (30) demonstrated an association between PMR and falls in 336 community-dwelling patients aged 75 years or over. Consistent with these findings, PMR was also the most prevalent PR among patients with falls in our study population. Furthermore, the study demonstrated that PMR and the glabellar reflex could be independent predictors of falls in older individuals. The glabellar reflex, which is considered a frontal release sign reflecting frontal lobe and executive dysfunction, as in the PMR, tends to re-emerge later than PMR and has increased prevalence in dementia and extrapyramidal syndromes (9,31). The frequency is particularly higher than that of the PMR in conditions affecting the extrapyramidal system (32). Considering that the risk of falls is increased in extrapyramidal system disorders, particularly due to postural instability and gait disturbances (33), evidence linking the glabellar reflex to falls is limited, unlike that for the PMR (30).

The study found between falls and the grasp reflex. In regression analysis, the relationship between the snout reflex and falls was no longer statistically significant. While the grasp reflex is the most strongly linked to frontal lobe dysfunction and cognitive decline, the snout reflex is the most commonly observed PR in patients with dementia (7,25). Accordingly, excluding patients diagnosed with dementia from the study may have prevented the examination of the relationship between falls and these reflexes.

To the best of our knowledge, this is one of the first studies to demonstrate that the re-emergence of PRs, PMR and the glabellar reflex, is independently associated with falls in older patients without previously diagnosed neurodegeneration. A major strength of this study is its large sample size and the specific exclusion of patients with pre-existing dementia, Parkinson's disease, Parkinson-plus syndromes, and cerebrovascular disease. Furthermore, our regression model was comprehensively adjusted for significant confounding factors.

Study Limitations

Our study has several limitations. First, its retrospective cross-sectional design precludes establishing a definitive causal relationship between the PRs and falls. Second, the history of falls was obtained from patient recall over the previous 12 months and from medical documentation, both of which inherently carry the risk of recall bias or underreporting. Third, although patients with dementia and neurodegenerative diseases were excluded, data on other important fall-related variables—such as frailty status, gait speed, balance performance, sarcopenia, and objective cognitive assessments (2,34)—were unavailable in our dataset, as the re-emergence of PRs may partly reflects underlying subclinical frailty or motor impairment. Lastly, the single-center nature of this study may restrict the generalizability of our findings.

Conclusion

This study demonstrated that both the PMR and the glabellar reflex are associated with falls in older adults without neurodegenerative disease. Our findings suggest that these PRs may serve as clinical indicators of compromised executive control of gait and postural stability. Moreover, PR evaluation may be used as a simple, low-cost bedside tool for fall risk stratification in geriatric practice. However, longitudinal studies are needed to further assess the predictive reliability of the presence of PR or its subsequent loss as clinical markers of future fall risk.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Dokuz Eylül University Non-Interventional Research Ethics Committee (approval no: 2025/45-09, date: 29.12.2025).

Informed Consent: Written informed consent was waived due to the study's retrospective design.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.S.O., F.S.D., A.T.I., Concept: M.S.O., A.T.I., Design: M.S.O., A.T.I., Data Collection or Processing: M.S.O., Analysis or Interpretation: M.S.O., F.S.D., Literature Search: M.S.O., Writing: M.S.O., F.S.D., A.T.I.

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