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Factors Associated with Disability in Community-dwelling Oldest-old: Insights from Comprehensive Geriatric Assessment-based Nomogram

Seksen Yaş ve Üzeri Toplumda Yaşayan Yaşlılarda Disabilite ile İlişkili Faktörler: Kapsamlı Geriatrik Değerlendirmeye Dayalı Nomogram

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Abstract

Objective: This study aimed to identify multidomain factors associated with disability in community-dwelling adults aged ≥80 years and to develop a nomogram estimating the probability of existing disability.

Method: This cross-sectional study included 385 community-dwelling adults aged ≥80 years. Disability was defined as dependency in at least one domain of activities of daily living (ADL) and/or instrumental activities of daily living (IADL). Candidate variables included cognition [mini-mental state examination (MMSE)], nutritional status (mini nutritional assessment-short form), depressive symptoms (geriatric depression scale), frailty (Fried phenotype), inflammatory status (C-reactive protein), number of medications, and demographic characteristics. Factors independently associated with disability were assessed with multivariable logistic regression in 371 participants with complete data. The nomogram was constructed from a five-variable model including age, MMSE, frailty, number of medications, and log(CRP). Discrimination was quantified by the area under the receiver operating characteristic curve (AUC), and internal validity was assessed through bootstrap resampling combined with calibration analysis.

Results: Disability prevalence was 74.8%. Disabled participants were older and had worse physical performance, lower cognitive scores, poorer nutritional status, higher depressive symptoms, and greater medication burden (all $p<0.05$). In multivariable analysis,

Öz

Amaç: Bu çalışmada, toplumda yaşayan 80 yaş ve üzerindeki bireylerde kapsamlı geriatrik değerlendirme bileşenlerini kullanarak disabilite ile ilişkili çok boyutlu faktörlerin belirlenmesi ve disabilite olasılığını tahmin etmeye yönelik bir nomogramın geliştirilmesi amaçlandı.

Yöntem: Kesitsel tasarımdaki çalışmaya toplumda yaşayan 80 yaş ve üzerindeki 385 birey dahil edildi. Disabilite, temel günlük yaşam aktiviteleri ve/veya enstrümantal günlük yaşam aktivitelerinde (EGYA) en az bir alanda bağımlılık olarak tanımlandı. Aday değişkenler arasında bilişsel durum (mini-mental durum muayenesi; MMSE), beslenme durumu (mini nütrisyonel değerlendirme-kısa form), depresif belirtiler (geriatrik depresyon ölçeği), kırılganlık (Fried kırılganlık fenotipi), C-reaktif protein, ilaç sayısı ve demografik özellikler yer aldı. Disabilite ile ilişkili bağımsız faktörler tam verisi bulunan 371 katılımcıda çok değişkenli lojistik regresyon analizi ile değerlendirildi. Nomogram; yaş, MMSE, kırılganlık, ilaç sayısı ve log(CRP) içeren beş değişkenli model temel alınarak oluşturuldu. Modelin ayırt edici gücü ROC eğrisi altında kalan alan (AUC) ile değerlendirildi; iç doğrulama bootstrap yeniden örnekleme yöntemi ve kalibrasyon analizi ile gerçekleştirildi.

Bulgular: Katılımcıların %74,8'inde disabilite saptandı. Disabilitesi olan bireyler daha ileri yaşta olup fiziksel performansları daha düşük, bilişsel fonksiyonları ve beslenme durumları daha kötü, depresif belirti düzeyleri ve kullandıkları ilaç sayısı daha yüksekti

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Abstract

lower MMSE scores [odds ratio (OR) 0.81, 95% confidence interval (CI) 0.73-0.89, p<0.001], frailty (OR 3.41, 95% CI 1.46-7.97, p=0.005), higher medication count (OR 1.25, 95% CI 1.10-1.41, p<0.001), and older age (OR 1.12, 95% CI 1.02-1.23, p=0.023) were independently associated with disability. A separate five-variable model including these four variables and log(CRP) was used to construct the nomogram and demonstrated good discrimination (AUC=0.818, 95% CI 0.775-0.856). Bootstrap validation indicated good calibration and minimal overfitting.

Conclusion: Cognitive impairment, frailty, medication burden, and older age were independently associated with disability in community-dwelling adults aged ≥80 years. The nomogram estimates the probability of existing disability rather than predicting future disability and requires external validation before clinical use.

Keywords: Activities of daily living, disability, frailty, geriatrics, older adults, nomogram

Öz

(tüm karşılaştırmalar için p<0,05). Çok değişkenli analizde düşük MMSE puanı [odds oranı (OR)=0,81; %95 güven aralığı (GA): 0,73-0,89; p<0,001], kırılganlık varlığı (OR=3,41; %95 GA: 1,46-7,97; p=0,005), daha fazla ilaç kullanımı (OR=1,25; %95 GA: 1,10-1,41; p<0,001) ve ileri yaş (OR=1,12; %95 GA: 1,02-1,23; p=0,023) disabilite ile bağımsız olarak ilişkili bulundu. Bu dört değişken ile log(CRP)'yi içeren ayrı bir beş değişkenli nomogram iyi düzeyde ayırt edici performans gösterdi (AUC=0,818; %95 GA: 0,775-0,856).

Sonuç: Toplumda yaşayan 80 yaş ve üzerindeki bireylerde bilişsel bozukluk, kırılganlık, ilaç yükü ve ileri yaş disabilite ile bağımsız olarak ilişkili bulundu. Nomogram, gelecekteki disabiliteyi öngörmek yerine mevcut disabilite olasılığını tahmin etmekte olup klinik kullanım öncesinde harici doğrulama gerektirmektedir.

Anahtar kelimeler: Disabilite, günlük yaşam aktiviteleri, kapsamlı geriatrik değerlendirme, kırılganlık, nomogram, yaşlı

Introduction

Population aging has led to a substantial increase in the number of adults aged ≥80 years, commonly referred to as the "oldest-old," who represent the fastest-growing segment of the global population (1). This age group is characterized by a high burden of chronic conditions (2), functional decline (3), and geriatric syndromes, making disability a major clinical and public health challenge (4).

Disability in older adults is increasingly recognized as a multifactorial condition arising from the interaction of multiple geriatric domains rather than a single disease process. Recent evidence highlights that cognitive impairment and physical frailty frequently coexist and synergistically increase the risk of functional decline and disability (5,6). Beyond these domains, treatment burden, often reflected by polypharmacy, has gained increasing recognition as a contributor to adverse outcomes in older adults (7). Similarly, systemic inflammation has been implicated as an underlying biological mechanism linking chronic disease burden, frailty, and functional decline (8).

Comprehensive geriatric assessment (CGA) provides an integrated framework to evaluate these interacting domains, enabling a holistic understanding of vulnerability in older adults. Disability, defined as dependence in activities of daily living (ADL) and instrumental activities of daily living (IADL), is strongly associated with increased morbidity and mortality in older adults (9,10). However, despite growing interest in multidimensional models, there remains limited evidence regarding the relative contributions of different geriatric domains within a single analytical framework, particularly among community-dwelling adults aged ≥80 years. Moreover, it remains unclear how domains such as cognition, frailty, inflammation, and treatment burden jointly relate to disability status in this age group

Accordingly, this study set out to identify the determinants of disability among community-dwelling adults 80 years of age and older through a CGA, with particular attention to how much each geriatric domain individually contributes to disability, and to develop a nomogram estimating the probability of existing disability

Materials and Methods

Study Design

This cross-sectional study was conducted at University of Health Sciences Turkey, Konya Beyhekim Research and Training Hospital. The study population consisted of community-dwelling adults aged ≥80 years enrolled in the Healthy Aging Program (YAŞAM). Within this program, participants undergo a CGA every 6 months. For the present study, only data obtained during each participant's first (index) home visit between January 2025 and January 2026 were included in the analysis. The CGA performed at this index visit included standardized assessments of cognitive function, nutritional status, depressive symptoms, physical performance, frailty, functional status, and medication use. Medical records of individuals aged ≥80 years who attended the YAŞAM outpatient clinic between January 2025 and January 2026 were retrospectively reviewed.

Clinical and functional data were obtained from routine CGAs performed during index visit. These assessments

included standardized tools evaluating cognitive function, nutritional status, depressive symptoms, physical performance, frailty, and medication use.

Laboratory data were obtained from blood samples collected on the same day as the index geriatric assessment and included routine biochemical parameters, including C-reactive protein (CRP). Due to its skewed distribution, CRP values were logarithmically transformed (log-CRP) before inclusion in statistical analyses.

Participants were excluded if they were unable to comply with the assessment procedures or had communication difficulties that precluded reliable evaluation during the CGA. Applying these criteria yielded a study sample of 385 participants. MMSE data were missing for five participants and CRP data for nine participants; these 14 participants were excluded from the multivariable and nomogram analyses, which were therefore performed as complete-case analyses in 371 participants (277 with and 94 without disability). Variable-specific missing data for descriptive characteristics are reported in Table 1.

CGA

All participants underwent a CGA as part of routine clinical care. Cognitive function was evaluated using the MMSE (11), nutritional status using the mini nutritional assessment-short form (MNA-SF) (12), and depressive symptoms with the geriatric depression scale (GDS) (13).

Functional status was assessed using ADL (14) and IADL (15). ADL encompassed six basic self-care activities: Bathing, dressing, toileting, transferring, continence, and feeding. IADL was assessed across all eight domains of the Lawton-Brody scale: Using the telephone, shopping, food preparation, housekeeping, laundry, transportation, responsibility for own medications, and handling finances. A participant was considered to have disability if dependence was present in at least one ADL or IADL domain.

Frailty was assessed using the Fried frailty phenotype (16), which includes unintentional weight loss, exhaustion, weakness, slow walking speed, and low physical activity. A participant was classified as frail if three or more of these criteria were met.

Gait performance was quantified with a 6-meter walk test, in which each participant walked this distance at a self-selected, comfortable pace while the elapsed time was captured with a stopwatch; dividing the distance by this time yielded walking speed in m/s.

A Takei handgrip dynamometer was used to quantify muscle strength, with participants seated and the elbow

Table 1. Baseline characteristics of participants according to disability status

Variable	Total (n=385)	Non-disabled (n=97)	Disabled (n=288)	p-value
Age, years (mean ± SD)	83.05±3.43	81.90±2.39	83.44±3.63	<0.001
Female sex, n (%)	238 (61.8)	49 (50.5)	189 (65.6)	0.008
BMI, kg/m² (mean ± SD)	28.39±5.43	27.30±4.76	28.77±5.60	0.021
Handgrip, kg (mean ± SD)	18.25±6.80	21.20±6.67	17.20±6.54	<0.001
Gait speed, m/s (mean ± SD)	0.80±0.31	0.98±0.29	0.74±0.29	<0.001
MMSE, median (IQR)	26 (22-29)	28 (27-30)	25 (19-28)	<0.001
MNA-SF, median (IQR)	12 (10-14)	13 (11-14)	12 (10-13)	<0.001
GDS score, median (IQR)	2 (1-5)	1 (0-3)	3 (1-6)	<0.001
Number of medications, median (IQR)	4 (3-6)	3 (2-5)	4 (3-6)	<0.001
Polypharmacy (≥5 medications), n (%)	158 (41.0)	28 (28.9)	130 (45.1)	0.005
Frailty (Fried phenotype; frail), n (%)	129 (33.5)	10 (10.3)	119 (41.3)	<0.001
Falls in the previous year, n (%)	128 (33.2)	27 (27.8)	101 (35.1)	0.19
Diabetes mellitus, n (%)	131 (34.0)	26 (26.8)	105 (36.5)	0.08
Hypertension, n (%)	286 (74.3)	70 (72.2)	216 (75.0)	0.58
Coronary artery disease, n (%)	113 (29.4)	22 (22.7)	91 (31.6)	0.10
CRP, mg/L, median (IQR)	3.78 (2.30-7.34)	3.08 (2.17-5.16)	4.10 (2.33-8.47)	0.018

BMI: Body mass index, MMSE: Mini-mental state examination, MNA-SF: Mini-nutritional assessment short form, GDS: Geriatric depression scale, CRP: C-reactive protein, SD: Standard deviation, IQR: Interquartile range. Data were available for BMI in 376 participants (97 non-disabled, 279 disabled), handgrip strength in 372 (97, 275), gait speed in 359 (95, 264), MMSE in 380 (97, 283), and CRP in 376 (94, 282); all other variables were complete. BMI and gait speed were compared with the independent-samples t-test, other continuous variables with the Mann-Whitney U test, and categorical variables with Pearson's chi-square test.

positioned at a 90-degree angle in line with standard protocol; the highest reading across repeated trials was retained for analysis.

Covariates

Patient demographic characteristics and comorbid conditions were obtained from the electronic medical records. Information on medication use was recorded, and polypharmacy was defined as the concurrent use of five or more medications (17).

Ethical Considerations

The study protocol was approved by the KTO Karatay University Ethics Committee (decision no: 2026/026, date: 30.04.2026), and institutional authorization was obtained from the host institution. The study was conducted in accordance with the Declaration of Helsinki. Because of the study's retrospective design, informed consent was waived.

Statistical Analyses

All statistical computations were carried out in SPSS (version 26.0; IBM Corp., Armonk, NY, USA), MedCalc (version 15.2; MedCalc Software Ltd., Ostend, Belgium), and R (version 4.4.2; R Foundation for Statistical Computing, Vienna, Austria). Depending on whether a continuous variable followed a normal distribution, its summary was reported either as the mean with standard deviation or as the median with the interquartile range; categorical variables were summarized as counts and proportions. Normality was checked with the Kolmogorov-Smirnov test. Group differences between participants with and without disability were examined with the independent-samples t-test when normality held, and with the Mann-Whitney U test otherwise; associations between categorical variables were tested with Pearson's chi-square test.

Factors independently associated with disability were identified through multivariable logistic regression (full model), in which candidate predictors were selected on the basis of clinical relevance together with statistical significance on univariate testing; effect estimates are presented as odds ratios (ORs) with corresponding 95% confidence intervals (CIs). Prior to model fitting, variance inflation factors were computed to rule out problematic collinearity among predictors; every value remained below 1.5, indicating that collinearity was not a concern for the multivariable model.

For the nomogram, a reduced model was fitted in the same complete-case sample (n=371), including the variables independently associated with disability in the full model (age, MMSE, frailty, and number of medications) together with log(CRP), which was retained because inflammation represented a clinically relevant biological domain in the multidimensional assessment of disability. The regression coefficients and intercept of this five-variable model (Table 3) were translated into a nomogram for individual-level estimation of the probability of existing disability. All performance measures reported below refer to this five-variable model. Model discrimination was quantified with the area under the receiver operating characteristic curve (AUC) with its 95% confidence interval, and the optimal probability cutoff was determined with the Youden index. The robustness of discrimination was checked internally through bootstrap resampling with 1000 iterations. Agreement between predicted and observed probabilities was examined graphically with a bootstrap-based calibration plot and with the Hosmer-Lemeshow goodness-of-fit test. As a sensitivity analysis, the models were re-estimated after excluding participants with CRP >10 mg/L, a level potentially indicative of acute-phase inflammation. A p-value below 0.05 (two-tailed) was taken as the threshold for statistical significance.

Results

The study sample comprised 385 community-dwelling adults aged 80 years or older, of whom 288 (74.8%) met criteria for disability. Compared with their non-disabled counterparts, disabled participants were, on average, older (83.44±3.63 vs. 81.90±2.39 years, $p<0.001$) and disproportionately female (65.6% vs. 50.5%, $p=0.008$). Mean BMI was slightly higher in the disabled group (28.77±5.60 vs. 27.30±4.76 kg/m², $p=0.021$). They had lower handgrip strength and gait speed, as well as poorer cognitive (MMSE), nutritional (MNA-SF), and depressive (GDS) scores (all $p<0.001$). Medication burden and polypharmacy were higher among disabled individuals ($p\leq0.005$), and frailty was more prevalent (41.3% vs. 10.3%, $p<0.001$). CRP levels were modestly higher in the disabled group ($p=0.018$), while no significant differences were observed for falls or comorbidities (Table 1).

In the multivariable logistic regression model (n=371), lower MMSE scores (OR 0.81, 95% CI 0.73-0.89, $p<0.001$), frailty (OR 3.41, 95% CI 1.46-7.97, $p=0.005$), higher medication count (OR 1.25, 95% CI 1.10-1.41, $p<0.001$), and older age (OR 1.12, 95% CI 1.02-1.23, $p=0.023$) were independently associated with disability. Nutritional status, depressive symptoms, sex, and log-CRP were not independently associated with disability (Table 2). In the sensitivity

analysis excluding participants with CRP >10 mg/L (n=72; remaining n=299), the association between log-CRP and disability was no longer observed (OR 0.99, 95% CI 0.58-1.69, p=0.97), while the associations for age, MMSE, frailty, and medication count remained materially unchanged.

Building on these results, a five-variable model including age, MMSE score, frailty status, medication count, and log(CRP) was fitted in the same sample (Table 3). In this model, all five variables were significantly associated with disability, including log(CRP) (OR 1.39, 95% CI 1.02-1.89, p=0.038); this association was no longer observed after excluding participants with CRP >10 mg/L (OR 1.08, 95% CI 0.64-1.81, p=0.78). The nomogram was constructed from this model (Figure 1). Each predictor contributed points in proportion to its regression coefficient, and summing these points across all five variables yielded each participant's estimated probability of existing disability, equivalent to 1/[1+exp(–LP)], where LP=-3.601+0.108 × age -0.226 × MMSE +1.188 × frailty (0/1) +0.227× number of medications +0.328 × ln(CRP).

Plotting the ROC curve of the five-variable model yielded an area under the curve (AUC) of 0.818 (95% CI, 0.775-0.856) (Figure 2), reflecting the model's ability to distinguish participants with disability from those without. Applying the Youden index identified 0.735 as the optimal probability cut-off, at which sensitivity was 69.3% (192/277) and specificity was 83.0% (78/94) (Youden's J =0.523; true positives 192, false negatives 85, true negatives 78, false positives 16).

Bootstrap resampling (1000 repetitions) yielded an optimism-corrected C-index of approximately 0.81, indicating minimal overfitting. Predicted and observed disability probabilities showed close agreement across the risk range (Figure 3), and the Hosmer-Lemeshow test indicated adequate calibration (χ^2=6.03, df=8, p=0.644).

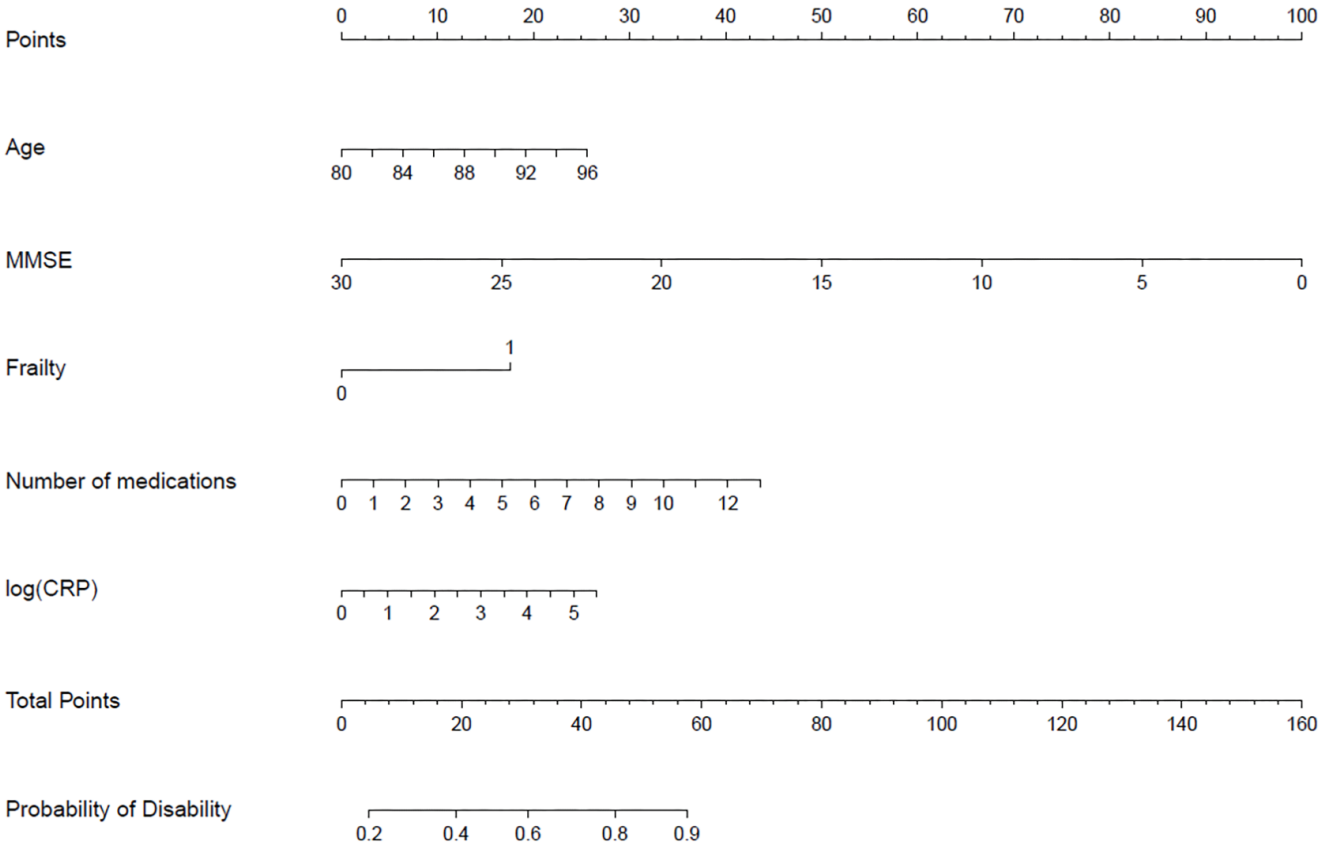

Figure 1. Nomogram based on the five-variable logistic regression model [age, MMSE, frailty, number of medications, and log(CRP); n=371] for estimating the probability of existing disability in community-dwelling adults aged 80 years and older. Frailty: 0= non-frail, 1= frail

MMSE: Mini-mental state examination, CRP: C-reactive protein

Table 2. Multivariable logistic regression for disability (full model; complete-case sample, n=371)

Variable	OR	95% CI	p-value
Age (per 1 year)	1.12	1.02-1.23	**0.023**
Sex (male)	0.84	0.48-1.47	0.55
MNA-SF	1.05	0.92-1.21	0.45
MMSE	0.81	0.73-0.89	**<0.001**
GDS	1.07	0.96-1.19	0.20
log(CRP)	1.35	0.99-1.85	0.056
Frailty (frail vs. non-frail)	3.41	1.46-7.97	**0.005**
Number of medications	1.25	1.10-1.41	**<0.001**

MNA-SF: Mini-nutritional assessment short form, MMSE: Mini-mental state examination, GDS: Geriatric depression scale, CRP: C-reactive protein, OR: Odds ratio, CI: Confidence interval

Table 3. Five-variable logistic regression model used to construct the nomogram (complete-case sample, n=371; 277 with and 94 without disability)

Variable	β (SE)	OR (95% CI)	p-value
Intercept	-3.601 (4.347)	—	0.407
Age (per 1 year)	0.108 (0.049)	1.11 (1.01-1.23)	**0.027**
MMSE (per 1 point)	-0.226 (0.048)	0.80 (0.73-0.88)	**<0.001**
Frailty (frail vs. non-frail)	1.188 (0.401)	3.28 (1.49-7.19)	**0.003**
Number of medications	0.227 (0.062)	1.25 (1.11-1.42)	**<0.001**
log(CRP)	0.328 (0.158)	1.39 (1.02-1.89)	**0.038**

MMSE: Mini-mental state examination, CRP: C-reactive protein (log = natural logarithm), SE: Standard error. Predicted probability of existing disability = 1/[1+exp(-LP)], where LP =-3.601+0.108 × age -0.226×MMSE +1.188× frailty (0/1) +0.227 × number of medications + 0.328 × ln(CRP). AUC 0.818 (95% CI 0.775–0.856); optimism-corrected C-index ≈0.81 (1000 bootstrap resamples); Hosmer-Lemeshow χ^2=6.03, df=8, p=0.644; Youden-optimal cut-off 0.735 (sensitivity 69.3%, specificity 83.0%)

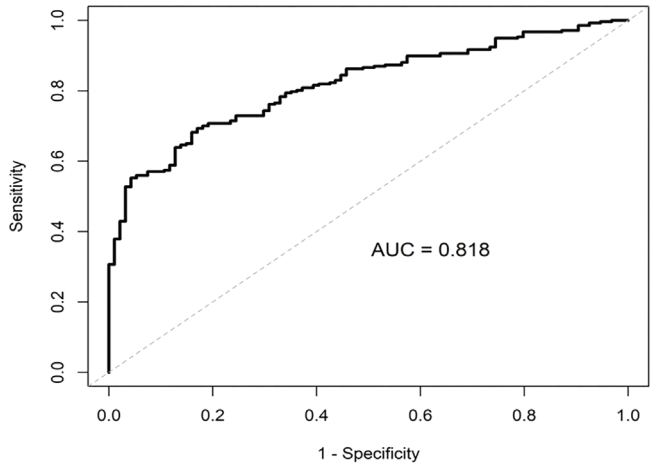

Figure 2. Receiver operating characteristic curve of the five-variable nomogram model for estimating the probability of existing disability (AUC 0.818, 95% confidence interval 0.775-0.856)

AUC: Area under the curve

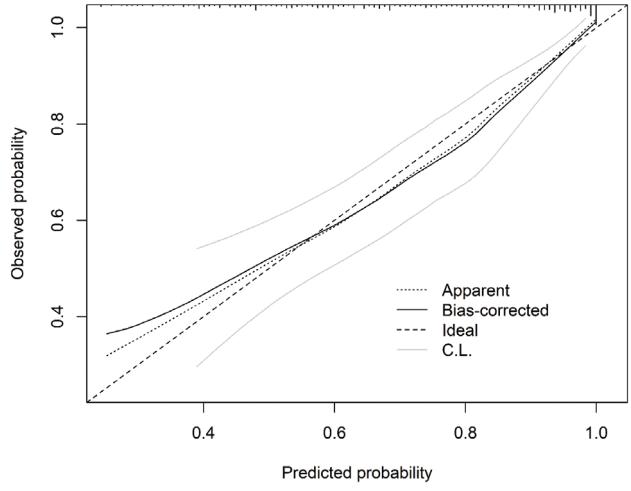

Figure 3. Bootstrap (1000 resamples) calibration plot of the five-variable nomogram model for estimating the probability of existing disability

C.L.: Confidence limits

Discussion

In this cohort of community-dwelling adults 80 years of age and older, disability was common, and independent associations emerged for cognitive performance, frailty status, medication burden, and age. Of these domains, cognition and frailty carried the greatest weight, while nutritional status and depressive symptoms were associated with disability in univariate analyses but lost statistical significance after full adjustment. These findings suggest that, in the oldest-old, disability is best understood as the cumulative expression of multidimensional vulnerability rather than as the consequence of a single isolated deficit.

The strong association between lower MMSE scores and disability in our cohort is clinically plausible and aligns with contemporary literature showing that cognitive impairment is closely linked to both basic and instrumental functional loss. Recent systematic evidence has shown that cognitive frailty and related cognitive deficits are associated with greater disability burden in community-dwelling older adults, particularly when cognitive decline coexists with reduced physical reserve (5,17). In practical terms, our findings support the notion that cognitive screening should not be viewed as ancillary for very old outpatients; rather, it should be considered a core component of disability risk assessment in the oldest-old.

Frailty was the other major independent determinant in our analysis. This is in line with a large body of evidence showing that frailty predicts incident and worsening ADL/IADL disability, and that the physical frailty phenotype captures frailty that is directly relevant to real-world function (18). Based on these findings, we developed and internally validated a practical nomogram incorporating age, MMSE, frailty status, medication burden, and log(CRP). The model demonstrated good discrimination (AUC =0.818) and good calibration after bootstrap validation, indicating reliable agreement between predicted and observed disability probabilities. This performance lies within the range reported for previously published disability prediction models in community-dwelling older adults (AUC 0.620–0.853)(19); however, most of those models predicted incident disability in longitudinal cohorts, whereas our model estimates the probability of existing disability, so this comparison should be interpreted with caution. Taken together, these data support frailty as a clinically meaningful and parsimonious indicator of disability in the oldest-old and suggest that the nomogram may help clinicians identify adults aged 80 years and older who are likely to have disability at the time of assessment.

Medication burden also remained independently associated with disability after multivariable adjustment. This finding is important because polypharmacy is often treated as a background characteristic rather than as an active determinant of poor outcomes. However, recent data suggest that polypharmacy is associated with incident disability in community-dwelling older adults and remains highly relevant in very old populations, even though the evidence base in those aged ≥85 years has historically been limited (20). Our results, therefore, reinforce the clinical relevance of medication review as part of the comprehensive assessment of disability. In a geriatric outpatient setting, the number of medications may function as a practical marker of treatment complexity, multimorbidity, and potential iatrogenic burden.

Another notable observation was that inflammatory burden, reflected by log-transformed CRP, was higher among disabled individuals in unadjusted analyses but was not independently associated with disability in the fully adjusted model. This pattern is also biologically plausible. Recent prospective evidence indicates that elevated high-sensitivity CRP is associated with a higher risk of ADL disability in older adults, but the magnitude of this association may be attenuated after adjustment for coexisting geriatric vulnerabilities such as frailty, sarcopenia-related performance deficits, and chronic disease burden (21). In our cohort, CRP likely captured part of the biological vulnerability underpinning disability, but it did not outweigh the explanatory value of cognition, frailty, and medication burden. Notably, the association was attenuated after excluding participants with markedly elevated CRP (>10 mg/L), suggesting that the relationship between CRP and disability was not robust across different CRP ranges. The same pattern was observed in the five-variable nomogram model, in which log(CRP) was statistically significant in the complete sample (p=0.038) but not after excluding these participants (p=0.78). This finding argues for cautious interpretation of CRP as an independent determinant of disability in this population.

By contrast, nutritional status and depressive symptoms did not remain independently associated with disability in the fully adjusted model. This does not imply that these domains are unimportant; rather, it suggests that their effects may be mediated through or overlap with stronger determinants such as frailty and cognition. In older adults, poor nutritional status commonly coexists with frailty and disability, while depressive symptoms may amplify functional decline indirectly through reduced motivation, lower activity, and poorer adherence. Yet, once core physical and cognitive domains are taken into account, their additional independent contribution may diminish. This interpretation is consistent with current multidomain geriatric frameworks, which emphasize the interconnected nature of these vulnerabilities.

Our study has several strengths. It focuses specifically on community-dwelling adults aged ≥80 years, a population that remains underrepresented in risk modeling studies. It also uses routinely collected CGA data, allowing simultaneous evaluation of several clinically relevant domains within the same analytical framework. Finally, we developed and internally validated a nomogram based on routinely collected comprehensive geriatric assessment variables, providing a practical tool for estimating the individual probability of existing disability.

Study Limitations

Several limitations should also be acknowledged. First, the cross-sectional design precludes causal inference; therefore, the identified determinants should be interpreted as correlates rather than predictors in a temporal sense, and the nomogram estimates the probability of existing disability rather than the risk of future disability. Second, disability was defined broadly as dependence in one or more ADL and/or IADL domains, which may have increased prevalence and reduced granularity. Third, our population consisted of attendees of a structured healthy

aging outpatient clinic, which may limit generalizability to institutionalized or more medically unstable older adults. Fourth, the multivariable analyses were performed as complete-case analyses after excluding 14 participants with missing MMSE or CRP data; although this represents a small proportion of the sample, some selection bias cannot be ruled out. Finally, although bootstrap internal validation demonstrated minimal optimism, external validation in independent oldest-old cohorts is required before routine clinical implementation.

Conclusion

In conclusion, our findings indicate that disability in community-dwelling oldest-old adults is independently associated with cognitive impairment, frailty, greater medication burden, and older age.

These results support the clinical value of CGA and suggest that disability status in the oldest-old is most meaningfully captured when cognitive, physical, and treatment-related domains are considered together rather than in isolation. The proposed nomogram may help estimate the probability of existing disability in this population; however, it was derived from cross-sectional data, should not be used to predict future disability, and requires external validation.

Ethics

Ethics Committee Approval: The study protocol was approved by the KTO Karatay University Ethics Committee (decision no: 2026/026, date: 30.04.2026), and institutional authorization was obtained from the host institution.

Informed Consent: In our study, data from patients between January 2025 and January 2026 were analyzed retrospectively.

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For transparency, the authors note that an artificial intelligence-assisted language model (ChatGPT, OpenAI) was utilized to support text editing and language correction. This assistance was limited to linguistic refinement; all scientific content, critical analysis, and final editorial decisions were made exclusively by the authors.

Footnotes

Authorship Contributions

Concept: E.Ç., Design: E.Ç., A.F., Data Collection or Processing: E.Ç., Analysis or Interpretation: E.Ç., A.F., E.Çe., Literature Search: E.Ç., A.F., E.Çe., Writing: E.Ç., A.F., E.Çe.

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