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Associations of polypharmacy with cognitive impairment and functional status among older adults

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Abstract

Aim: Polypharmacy is increasingly prevalent among older adults and has been suggested as a potential risk factor for adverse health outcomes, including cognitive impairment and functional decline. Therefore, this study aimed to investigate the associations of polypharmacy with cognitive impairment and functional status among community-dwelling older adults using nationally representative data from the 2023 Korean Elderly Survey.

Methods: A cross-sectional analysis was conducted using data from 9,898 community-dwelling older adults without a diagnosis of dementia. Polypharmacy was defined as the concurrent use of five or more physician-prescribed medications. Cognitive function was assessed using the Korean version of the Mini-Mental State Examination (K-MMSE), with cognitive impairment defined as a score ≤ 23. Functional status was evaluated using the Korean Activities of Daily Living (K-ADL) and Korean Instrumental Activities of Daily Living (K-IADL). Logistic regression was used to estimate odds ratios and 95% confidence intervals (CIs) for cognitive impairment, while multiple linear regression analyses examined associations with functional status. Models were sequentially adjusted for sociodemographic characteristics, health behaviors, and the number of chronic diseases.

Results: Polypharmacy was associated with increased odds of cognitive impairment in the crude model (OR = 1.70, 95% CI: 1.40–2.05); however, this association was attenuated and became non-significant after adjustment for sociodemographic and health-related factors. In contrast, polypharmacy remained independently associated with poorer functional status in fully adjusted models, showing higher K-ADL scores (B = 0.14, p = 0.007) and K-IADL scores (B = 0.43, p < 0.001).

Conclusions: Polypharmacy was independently associated with functional impairment but not with cognitive impairment after comprehensive adjustment, suggesting that functional decline may represent a more sensitive and immediate consequence of complex medication use in older adults. These findings underscore the need for comprehensive geriatric assessment approaches that integrate medication review with functional evaluation.

Keywords

Activities of Daily Living, cognitive impairment, functional status, polypharmacy, older adults

Introduction

The global demographic landscape is undergoing an unprecedented shift, with the proportion of individuals aged 65 and older rising faster than any other age group [1]. This transition is inextricably linked to an increased prevalence of multimorbidity—the coexistence of two or more chronic conditions—which necessitates complex pharmacological interventions [2]. Consequently, polypharmacy, typically defined as the concurrent administration of five or more physician-prescribed medications, has become a hallmark of geriatric care [3]. While the primary goal of such regimens is to manage chronic pathologies and extend life expectancy, the escalating medication burden in the elderly population presents a paradoxical challenge to clinical medicine, often bridging the gap between therapeutic benefit and iatrogenic harm [4].

Although pharmacological treatment is essential for managing chronic diseases and extending life expectancy, polypharmacy poses a paradoxical challenge in older populations. Age-related changes in pharmacokinetics and pharmacodynamics, including reduced renal clearance, impaired hepatic metabolism, and diminished physiological reserve, increase vulnerability to adverse drug reactions and drug–drug interactions [5–7]. These risks raise concerns that polypharmacy may function not only as a marker of disease burden but also as an independent contributor to geriatric syndromes [8, 9].

Cognitive health is perhaps the most critical determinant of successful aging and autonomy. The relationship between polypharmacy and cognitive impairment is multifaceted and potentially bidirectional [10, 11]. Chronic exposure to central nervous system (CNS)-active drugs, such as anticholinergics or sedatives, has been consistently linked to acute delirium and long-term cognitive decline [12, 13]. However, the debate persists regarding whether the sheer number of medications serves as an independent neurotoxic factor or if it merely reflects the high burden of comorbidities that independently contribute to vascular or neurodegenerative changes [14, 15]. Previous studies have yielded conflicting results, often due to limitations in controlling for confounding variables such as education, income, and the severity of chronic diseases.

Simultaneously, functional status—defined by a person's ability to perform activities essential for daily living (ADL) and Instrumental Activities of Daily Living (IADL)—serves as a comprehensive indicator of an older adult's health and social integration. Functional decline is often a precursor to institutionalization and increased caregiver burden [16, 17]. Polypharmacy may impair functional status through various pathways, including drug-induced dizziness, muscular weakness, or cognitive slowing, all of which increase the risk of falls and disability [18, 19]. Despite the clinical importance of these outcomes, empirical evidence from large-scale, nationally representative cohorts that simultaneously examines the dual impact of polypharmacy on cognition and function remains insufficient, particularly in the post-pandemic era, where healthcare utilization patterns have shifted significantly.

South Korea represents a unique and urgent case study, as it is currently experiencing one of the fastest rates of population aging in the world. As of 2023, the complexity of medication use among Korean community-dwelling older adults has reached a level that demands rigorous scientific scrutiny. To address these gaps, the present study utilizes the 2023 Korean Elderly Survey (KES), a robust, nationally representative dataset administered by the Ministry of Health and Welfare [20]. Unlike previous regional or clinic-based studies, this analysis incorporates a vast sample of 9,898 non-demented older adults, allowing for a high degree of generalizability and the power to perform sophisticated sequential adjustment models.

By leveraging this comprehensive dataset, we seek to provide a nuanced understanding of how polypharmacy independently contributes to the geriatric syndrome of decline. Therefore, this study aimed to investigate the associations of polypharmacy with cognitive impairment and functional status, including basic and IADL, among community-dwelling older adults. By accounting for sociodemographic

characteristics, health-related behaviors, and the number of chronic diseases, this study sought to elucidate the independent contribution of polypharmacy to cognitive decline and functional deterioration, and to provide empirical evidence to inform comprehensive geriatric assessment and rational medication management in aging populations.

Materials and methods

Study design and data source

This cross-sectional study used data from the 2023 KES, a nationally representative survey conducted by the Ministry of Health and Welfare and Statistics Korea [20]. The survey employed a stratified, multistage cluster sampling design to collect detailed information on sociodemographic characteristics, health conditions, medication use, cognitive function, and functional status among community-dwelling older adults aged 65 years or older in Korea. This study was conducted in accordance with the Declaration of Helsinki. Since the study utilized anonymized, publicly available data from the KES, ethical approval and informed consent were exempted according to institutional policy.

Study population

Among 10,078 participants who completed the 2023 survey, individuals with a physician-diagnosed dementia were excluded to avoid misclassification of cognitive outcomes and reverse causality. After additionally excluding participants with missing data in key variables, 9,898 older adults without dementia were included in the final analysis. Sampling weights provided by the survey were applied in all analyses to account for the complex survey design and ensure national representativeness.

Definition of polypharmacy

Polypharmacy was defined as the concurrent use of five or more physician-prescribed medications for a duration of at least three months, based on self-reported medication use. This cutoff (≥ 5 medications) is widely used in geriatric research and clinical guidelines to indicate clinically meaningful polypharmacy. Participants were categorized into two groups: non-polypharmacy (0–4 medications) and polypharmacy (≥ 5 medications).

Assessment and definition of cognitive function and cognitive impairment

Cognitive function was assessed using the Korean version of the Mini-Mental State Examination (K-MMSE). Total scores range from 0 to 30, with higher scores indicating better cognitive performance.

Cognitive impairment was operationally defined as a K-MMSE score of 23 or lower (≤ 23), while scores of 24 or higher (≥ 24) were classified as cognitively normal, consistent with commonly applied cutoff values in population-based studies of older adults. Cognitive function was analyzed both as a continuous variable (total score) and as a dichotomous outcome (cognitive impairment vs. normal cognition).

Assessment of functional status

Functional status was evaluated using validated Korean versions of the Activities of Daily Living (K-ADL) and Instrumental Activities of Daily Living (K-IADL) scales. The K-ADL consists of seven items assessing basic self-care abilities, with total scores ranging from 7 to 21. The K-IADL includes ten items measuring more complex daily activities, with total scores ranging from 10 to 33. Higher scores indicate greater functional dependency. Given the skewed distribution of these measures, functional status outcomes were treated as continuous variables in regression analyses.

Covariates

Sociodemographic covariates included sex, age, education level, household income, and employment status. Health-related behaviors included current smoking status, alcohol consumption, and regular physical activity. Multimorbidity was assessed as the number of physician-diagnosed chronic diseases, treated as a continuous variable.

Statistical analysis

All statistical analyses were conducted using complex survey procedures that accounted for the stratified, multistage cluster sampling design of the KES, incorporating sampling weights to obtain nationally representative estimates. Weighted descriptive statistics were used to summarize the general characteristics of the study population. Differences in categorical variables according to polypharmacy status were examined using chi-square tests. Cognitive function scores, K-ADL scores, K-IADL scores, and the number of chronic diseases did not follow a normal distribution. Therefore, differences according to polypharmacy status were assessed using the Mann–Whitney *U* test, and results were presented as medians with interquartile ranges (IQRs).

Logistic regression analyses were performed to examine the association between polypharmacy and cognitive impairment, with odds ratios and 95% confidence intervals (CIs) calculated. Linear regression analyses were conducted to evaluate the associations between polypharmacy and functional status outcomes (K-ADL and K-IADL). A crude model was first estimated, followed by Model 1 adjusted for demographic covariates (sex, age, educational level, and employment status). Model 2 further adjusted for the number of chronic diseases. In addition, Spearman's rank correlation analysis was performed to examine the relationships among polypharmacy, cognitive function, functional status, and the number of chronic diseases. All statistical analyses were performed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA), and statistical significance was defined as $p < 0.05$.

Results

General characteristics of the study population

The general characteristics of the study population are presented in Table 1. A total of 9,898 community-dwelling older adults without dementia were included in the analysis; 44.1% were male, and 55.9% were female. Participants aged 70–79 years constituted the largest age group (41.2%), followed by those aged 65–69 years (35.0%) and those aged 80 years or older (23.8%). Most participants had an education level of middle school or less (61.2%), and 39.5% were currently employed.

Table 1. General characteristics of the study population without dementia (*N* = 9,898).

Variables	Categories	*N* (%)	Median (IQR)
Sex	Male	4,367 (44.1)	
	Female	5,531 (55.9)	
Age group (years)	65–69	3,464 (35.0)	
	70–79	4,078 (41.2)	
	≥ 80	2,356 (23.8)	
Education level	≤ Middle school	6,059 (61.2)	
	High school	3,134 (31.7)	
	≥ University	705 (7.1)	
Household income	Low (Q1–2)	6,414 (64.8)	
	Middle (Q3)	1,661 (16.8)	
	High (Q4–5)	1,823 (18.4)	
Employment status	Unemployed	5,988 (60.5)	
	Employed	3,910 (39.5)	
Smoking status	Non-smoker	8,956 (90.5)	
	Smoker	942 (9.5)	
Alcohol consumption	No	6,168 (62.3)	
	Yes	3,730 (37.7)	
Regular exercise	No	4,646 (46.9)	
	Yes	5,252 (53.1)	

Table 1. General characteristics of the study population without dementia (*N* = 9,898). (*continued*)

Variables	Categories	*N* (%)	Median (IQR)
Polypharmacy	0–4 drugs	9,422 (95.2)	
	≥ 5 drugs	476 (4.8)	
Number of chronic diseases			2.0 (2.0)
Cognitive category (K-MMSE)	0–17	711 (7.2)	
	18–23	2,371 (24.1)	
	24–30	6,735 (68.7)	
Cognitive function score			26.0 (5.0)
K-ADL score			7.0 (0.0)
K-IADL score			10.0 (0.0)

All categorical variables are presented as weighted frequencies and percentages. Continuous variables that did not follow a normal distribution are presented as medians with interquartile ranges (IQR). Sampling weights were applied to all analyses to account for the complex survey design. Due to weighting procedures and rounding, the sum of frequencies was adjusted to the total sample size (*N* = 9,898). The total frequency for cognitive categories is 9,817 due to missing values in the K-MMSE assessment. K-ADL: Korean Activities of Daily Living; K-IADL: Korean Instrumental Activities of Daily Living; K-MMSE: Korean version of the Mini-Mental State Examination.

Regarding health-related behaviors, 9.5% of participants were current smokers, 37.7% reported alcohol consumption, and 53.1% engaged in regular exercise. The median number of chronic diseases was 2.0 (IQR, 2.0), and 4.8% of participants met the criteria for polypharmacy (≥ 5 medications). Cognitive assessment indicated that 68.7% of participants were cognitively normal, whereas 31.3% exhibited some degree of cognitive impairment. The median cognitive function score was 26.0 (IQR, 5.0). The median scores for functional status were 7.0 (IQR, 0.0) for basic K-ADL and 10.0 (IQR, 0.0) for K-IADL.

General characteristics by polypharmacy status

General characteristics of participants by polypharmacy status are presented in Table 2. Participants with polypharmacy accounted for 4.8% of the total analyzed sample (*n* = 476). The polypharmacy group included a higher proportion of women (63.2% vs. 55.5%) and adults aged 80 years or older (37.4% vs. 23.1%) compared with the non-polypharmacy group. Participants with polypharmacy more frequently had lower educational attainment (≤ middle school, 83.4% vs. 60.1%) and lower household income (80.0% vs. 64.0%), and were more often unemployed (77.5% vs. 59.6%).

Table 2. Comparison of general characteristics according to polypharmacy status.

Variables	0–4 drugs (*n* = 9,422) *N* (%)	≥ 5 drugs (*n* = 476) *N* (%)	**p*-value
Sex			0.001
Male	4,192 (44.5)	175 (36.8)	
Female	5,230 (55.5)	301 (63.2)	
Age group (years)			< 0.001
65–69	3,391 (36.0)	73 (15.3)	
70–79	3,853 (40.9)	225 (47.3)	
≥ 80	2,178 (23.1)	178 (37.4)	
Education			< 0.001
≤ Middle school	5,663 (60.1)	397 (83.4)	
High school	3,072 (32.6)	62 (13.0)	
≥ University	687 (7.3)	17 (3.6)	
Household income			< 0.001
Low	6,033 (64.0)	381 (80.0)	
Middle	1,610 (17.1)	51 (10.7)	
High	1,779 (18.9)	44 (9.3)	

Table 2. Comparison of general characteristics according to polypharmacy status. (*continued*)

Variables	0–4 drugs (*n* = 9,422) *N* (%)	≥ 5 drugs (*n* = 476) *N* (%)	*p-value
Employment status			< 0.001
Unemployed	5,619 (59.6)	369 (77.5)	
Employed	3,803 (40.4)	107 (22.5)	
Current smoker			0.500
No	8,521 (90.4)	435 (91.4)	
Yes	901 (9.6)	41 (8.6)	
Alcohol consumption			< 0.001
No	5,790 (61.5)	378 (79.4)	
Yes	3,632 (38.5)	98 (20.6)	
Regular exercise			0.003
No	4,391 (46.6)	256 (53.7)	
Yes	5,031 (53.4)	220 (46.3)	
Number of chronic diseases	2 (2)	5 (2)	< 0.001

*p-values were calculated using chi-square tests for categorical variables and the Mann-Whitney U test for continuous variables. All analyses applied sampling weights. Due to weighting procedures and rounding, the sums of frequencies and percentages may not exactly match the group totals or equal 100%.

Regarding health-related behaviors, regular exercise was less prevalent in the polypharmacy group (46.3% vs. 53.4%), whereas smoking status did not differ significantly between groups. The median number of chronic diseases was markedly higher among participants with polypharmacy than among those without polypharmacy (5 [IQR, 2] vs. 2 [IQR, 2], $p < 0.001$).

Differences in cognitive function and functional status by polypharmacy status

Differences in cognitive function and functional status by polypharmacy status are presented in Table 3. Older adults with polypharmacy had a higher proportion of cognitive impairment than those without polypharmacy, with fewer participants classified as cognitively normal (56.9% vs. 69.2%) and more classified in the moderate impairment range (18–23 points; 33.8% vs. 23.7%). The median cognitive function score was lower in the polypharmacy group than in the non-polypharmacy group (25 [IQR, 6] vs. 26 [IQR, 5], $p < 0.001$).

Table 3. Cognitive function and functional status according to polypharmacy status.

Variables	0–4 drugs (*n* = 9,355) *N* (%)	≥ 5 drugs (*n* = 462) *N* (%)	*p*-value
Cognitive category			< 0.001
0–17	668 (7.1)	43 (9.3)	
18–23	2,215 (23.7)	156 (33.8)	
24–30	6,472 (69.2)	263 (56.9)	
Cognitive score	26 (5)	25 (6)	< 0.001
K-ADL score	7 (0)	7 (1)	< 0.001
K-IADL score	10 (0)	10 (3)	< 0.001

*p-values were calculated using chi-square tests for categorical variables and the Mann-Whitney U test for continuous variables. Continuous variables are presented as median (interquartile range, IQR). All analyses applied sampling weights. Due to missing responses in the K-MMSE assessment, the total frequency for cognitive categories is lower than the group totals. K-ADL: Korean Activities of Daily Living; K-IADL: Korean Instrumental Activities of Daily Living; K-MMSE: Korean version of the Mini-Mental State Examination.

Functional status also differed by polypharmacy status. Participants with polypharmacy showed higher median K-ADL (7 [IQR, 1] vs. 7 [IQR, 0]) and K-IADL scores (10 [IQR, 3] vs. 10 [IQR, 0]), indicating greater dependency in both basic and IADL ($p < 0.001$).

Associations of polypharmacy with cognitive function and functional status

The associations between polypharmacy and cognitive impairment and functional status are presented in Table 4. In the crude model, polypharmacy was associated with higher odds of cognitive impairment (OR = 1.70, 95% CI = 1.40–2.05). This association was attenuated and became non-significant after adjustment for sociodemographic factors and health behaviors (OR = 1.03, 95% CI = 0.83–1.26). After further adjustment for the number of chronic diseases, the direction of the association changed, with polypharmacy showing lower odds of cognitive impairment (OR = 0.64, 95% CI = 0.51–0.81).

Table 4. Associations of polypharmacy with cognitive function and functional status.

Outcome	Model	Effect size (95% CI)	*p*-value
Cognitive impairment (≤ 23)	Crude	OR 1.70 (1.40–2.05)	< 0.001
	Model 1†	OR 1.03 (0.83–1.26)	0.811
	Model 2‡	OR 0.64 (0.51–0.81)	< 0.001
K-ADL score	Crude	B 0.47 (SE 0.05)	< 0.001
	Model 1†	B 0.36 (SE 0.05)	< 0.001
	Model 2‡	B 0.14 (SE 0.05)	0.007
K-IADL score	Crude	B 1.53 (SE 0.11)	< 0.001
	Model 1†	B 1.15 (SE 0.11)	< 0.001
	Model 2‡	B 0.43 (SE 0.12)	< 0.001

†Model 1: adjusted for sex, age, education, income, employment, alcohol, and exercise. ‡Model 2: Model 1 + number of chronic diseases. OR: odds ratio; B: unstandardized regression coefficient; SE: standard error; CI: confidence interval; K-ADL: Korean Activities of Daily Living; K-IADL: Korean Instrumental Activities of Daily Living.

For basic ADL, polypharmacy was associated with higher K-ADL scores in the crude model (B = 0.47, $p < 0.001$). This association remained significant after adjustment for sociodemographic factors and health behaviors (B = 0.36, $p < 0.001$) and persisted, although attenuated, after further adjustment for the number of chronic diseases (B = 0.14, $p = 0.007$). Regarding IADL, polypharmacy was consistently associated with higher K-IADL scores across all models, including the crude model (B = 1.53, $p < 0.001$), Model 1 (B = 1.15, $p < 0.001$), and Model 2 (B = 0.43, $p < 0.001$).

Correlation among polypharmacy, cognitive function, functional status, and chronic diseases

The correlations among polypharmacy, cognitive function, functional status, and the number of chronic diseases are presented in Table 5. The number of prescribed medications showed a significant negative correlation with cognitive function scores ($r = -0.210$, $p < 0.001$) and significant positive correlations with K-ADL ($r = 0.199$, $p < 0.001$) and K-IADL scores ($r = 0.222$, $p < 0.001$). A strong positive correlation was observed between the number of prescribed medications and the number of chronic diseases ($r = 0.906$, $p < 0.001$). Cognitive function scores were negatively correlated with K-ADL ($r = -0.216$, $p < 0.001$), K-IADL ($r = -0.270$, $p < 0.001$), and the number of chronic diseases ($r = -0.229$, $p < 0.001$).

Table 5. Correlation among polypharmacy, cognitive function, functional status, and chronic diseases.

Variables	Polypharmacy	Cognitive function	K-ADL	K-IADL	Chronic diseases
Polypharmacy	1.000				
Cognitive function	−0.210***	1.000			
K-ADL	0.199***	−0.216***	1.000		
K-IADL	0.222***	−0.270***	0.673***	1.000	
Chronic diseases	0.906***	−0.229***	0.210***	0.256***	1.000

Spearman's rank correlation coefficients are presented. ***$p < 0.001$. K-ADL: Korean Activities of Daily Living; K-IADL: Korean Instrumental Activities of Daily Living.

These findings indicate that greater medication burden was associated with poorer cognitive function and greater functional dependency. In addition, the very strong correlation between the number of

prescribed medications and chronic disease burden suggests that medication use largely reflects the underlying multimorbidity in this population.

Discussion

This study investigated the complex associations between polypharmacy, cognitive impairment, and functional status among community-dwelling older adults, utilizing a large-scale, nationally representative dataset from the 2023 KES [20]. Our findings reveal a nuanced landscape of geriatric health: while polypharmacy was initially associated with both cognitive and functional decline in crude models, the independent effect of medication count remained statistically significant only for functional status (K-ADL and K-IADL) after rigorous adjustment for multimorbidity and socioeconomic factors. This discrepancy suggests that the pathways through which polypharmacy impacts the aging brain and body follow distinct biological and clinical trajectories, necessitating a more granular approach to medication management in late life [3, 21].

The attenuation of the association between polypharmacy and cognitive impairment in the final adjusted model warrants careful interpretation. Although polypharmacy was associated with increased odds of cognitive impairment in the crude model (OR = 1.70, 95% CI: 1.40–2.05), this significance vanished upon accounting for sociodemographic factors and the number of chronic diseases. This phenomenon suggests that cognitive deterioration may be more closely linked to the underlying pathophysiological burden of multimorbidity—such as chronic inflammation, vascular damage, or metabolic dysregulation—rather than the pharmacological agents themselves [11, 22]. In other words, the higher medication count often serves as a proxy for the severity of underlying health conditions that independently contribute to neurodegenerative changes [23]. This aligns with recent longitudinal studies suggesting that when vascular risk factors like hypertension and diabetes are optimally managed, the incremental risk posed by the number of medications may diminish [24]. Notably, after further adjustment for chronic disease burden, the direction of the association reversed (OR = 0.64, 95% CI: 0.51–0.81). This finding should not be interpreted as a protective effect of polypharmacy, but may instead reflect survival bias or the effects of adequate medical management among non-demented older adults, in whom effective control of vascular and metabolic conditions could mitigate cognitive. Because medication burden was strongly correlated with the number of chronic diseases in this study, adjustment for multimorbidity may have introduced statistical phenomena such as over-adjustment or collider bias. Therefore, the reversed association observed in the fully adjusted model should not be interpreted as a protective effect of polypharmacy but rather as a residual association after accounting for underlying disease burden.

In stark contrast to the findings on cognition, the association between polypharmacy and functional impairment remained robust and independent throughout all stages of analysis. Even after accounting for the number of chronic diseases, older adults taking five or more medications showed significantly higher dependency in both basic (B = 0.14, $p = 0.007$) and instrumental (B = 0.43, $p < 0.001$) ADL. This suggests that polypharmacy itself serves as a direct stressor to functional homeostasis [25]. The pharmacological burden may induce a state of subclinical toxicity, where drug-drug or drug-disease interactions lead to cumulative side effects such as muscular weakness, orthostatic hypotension, and impaired balance [26, 27]. For instance, the concurrent use of cardiovascular and psychotropic medications is a well-documented risk factor for falls and subsequent functional dependency. Our results reinforce the notion that functional status is a highly sensitive and immediate indicator of the physiological strain imposed by extensive medication use in the elderly, often preceding more permanent cognitive decline [28, 29]. These findings suggest that functional decline may represent a more immediate and clinically observable manifestation of medication-related vulnerability in older adults than cognitive impairment.

The persistence of functional decline as an independent outcome of polypharmacy underscores the urgent need for comprehensive geriatric assessments that integrate medication review with functional evaluation. In clinical practice, the management of multimorbidity often follows a disease-specific approach, which inadvertently leads to the accumulation of medications [30]. Our findings advocate for a paradigm shift toward patient-centered prescribing, where the potential for functional preservation

outweighs the incremental benefit of adding yet another guideline-directed therapy [31, 32]. Deprescribing—the supervised process of medication reduction—should be prioritized, particularly for patients showing early signs of IADL limitations, such as difficulty managing finances or using transportation, which often serve as early warning signs for escalating frailty [33].

A major strength of this study is the use of a recent, large-scale national cohort (n = 9,898), which provides high external validity for the South Korean elderly population. By excluding individuals already diagnosed with dementia, we focused on the "gray zone" of functional and cognitive decline where preventive interventions are most effective. However, several limitations must be acknowledged. First, the cross-sectional design precludes definitive causal inferences. In particular, reverse causation cannot be excluded, as declining functional status may lead to increased healthcare utilization and the accumulation of medications rather than being solely a consequence of polypharmacy. Second, the study relied on self-reported medication counts, which may be subject to recall bias. Furthermore, while we adjusted for the number of chronic diseases, we did not evaluate the impact of specific high-risk drug classes, such as those with high anticholinergic or sedative burdens. Additionally, certain medications with CNS effects, such as anticholinergic or sedative agents, may influence cognitive outcomes differently from medication count alone. Therefore, the absence of drug-class-specific information may have limited our ability to identify medication-specific cognitive risks. Future research should employ longitudinal designs and incorporate specialized scales to further elucidate the dose-response relationship between specific pharmacological properties and geriatric syndromes.

In conclusion, polypharmacy is a potent and independent risk factor for functional decline in community-dwelling older adults, whereas its impact on cognition appears to be largely mediated by the underlying burden of chronic disease. These findings emphasize that rational medication management is not merely about reducing numbers, but about safeguarding the functional independence and quality of life of the aging population.

Abbreviations

ADL: Activities of Daily Living

CIs: confidence intervals

CNS: central nervous system

IADL: Instrumental Activities of Daily Living

IQRs: interquartile ranges

K-ADL: Korean Activities of Daily Living

KES: Korean Elderly Survey

K-IADL: Korean Instrumental Activities of Daily Living

K-MMSE: Korean version of the Mini-Mental State Examination

Declarations

Author contributions

HMK: Investigation, Writing—original draft, Writing—review & editing. MKJ: Conceptualization, Validation, Writing—original draft, Writing—review & editing, Supervision. All authors read and approved the submitted version.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical approval

This study analyzed anonymized secondary data from the 2023 Korean Elderly Survey, administered by the Korea Institute for Health and Social Affairs (KIHASA) under the Ministry of Health and Welfare of the Republic of Korea. In accordance with national research ethics regulations, analyses using publicly available, de-identified data are exempt from Institutional Review Board (IRB) approval.

Consent to participate

Exempted according to the institution's policy.

Consent to publication

Not applicable.

Availability of data and materials

Data from the 2023 Korean Elderly Survey are publicly available from the KIHASA data portal [https://data.kihasa.re.kr].

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