ORIGINAL RESEARCH

DOI: 10.4274/ejgg.galenos.2026.2025-11-10
Eur J Geriatr Gerontol 2026;8(2):101-107

Reducing Polypharmacy and Inappropriate Medication Use in Elderly Individuals: Effects on Sleep Quality, Anxiety, and Quality of Life

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Abstract

Objective: This study aimed to evaluate the impact of reducing polypharmacy and inappropriate medication use on sleep quality, anxiety levels, and quality of life (QOL) in older adults. The primary objective was to investigate whether reducing the number of medications deemed potentially inappropriate leads to improvements in outcomes, such as sleep quality, anxiety, and QOL.

Materials and Methods: This prospective study enrolled sixty-five participants from a geriatric outpatient clinic, aged 65 and older, who were using five or more medications. Participants were followed for 6 months, during which inappropriate medication use was reduced. Assessments of sleep, anxiety, and QOL were performed repeatedly.

Results: After 6 months, significant improvements in sleep quality were observed ($p < 0.01$). Regression analysis showed that a reduction in the number of medications had independent effects on QOL and anxiety ($p < 0.01$).

Conclusion: The study found that reducing the number of medications, particularly inappropriate medications, significantly improved sleep quality in elderly patients. Furthermore, a reduction in the number of medications was identified as an independent risk factor for both QOL and anxiety. This highlights the importance of managing polypharmacy in the care of older adults.

Keywords: Anxiety, inappropriate medication use, polypharmacy, quality of life, sleep quality

Introduction

Medications are essential in treating older adults, who account for the highest share of prescription drug spending (30-40%). Due to multiple chronic conditions (multimorbidity), this population often uses several medications (polypharmacy), increasing the risk of potentially inappropriate medication (PIM) use (1).

Polypharmacy refers to the concomitant use of five or more medications. Since the geriatric population often has multiple health conditions, the use of five or more medications may be insufficient to adequately manage or treat these disease (2). Polypharmacy has been associated with various adverse outcomes, including adverse drug reactions (ADRs), falls, frailty, hospitalizations, and mortality (3).

One of the significant health issues faced by the geriatric population is the prescription of PIMs. PIMs are drugs that should not be given in the geriatric patient group due to their high risk of adverse reactions (4).

Increased medication use also raises the likelihood of exposure to PIMs, in which the potential harms outweigh the benefits for the individual. Deprescribing is supervised withdrawal of inappropriate medications conducted by a healthcare professional. The goal of this practice is to manage polypharmacy and improve health outcomes (5).

In Türkiye, the Turkish Geriatrics Academy has developed the Turkish inappropriate medication use in the elderly (TIME) to assist healthcare professionals in writing optimal prescriptions (6).

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Received: 17.11.2025 **Accepted:** 10.04.2026 **Publication Date:** 24.08.2025

Cite this article as: Akbaş ES, Karacaoğlu P. Reducing polypharmacy and inappropriate medication use in elderly individuals: effects on sleep quality, anxiety, and quality of life. Eur J Geriatr Gerontol. 2026;8(2):101-107

The TIME criteria guide clinical practice by identifying commonly prescribed but PIMs in older adults. While the main goal of our study was to reduce polypharmacy, medications were evaluated both quantitatively and qualitatively. The deprescribing process was conducted based on the TIME criteria, primarily focusing on discontinuing or substituting inappropriate medications. This approach aimed to reduce the number of drugs while improving treatment quality. Additionally, the study examined changes in patients' general characteristics after six months and explored the relationship between the number of medications and both sleep quality and psychosocial parameters.

Materials and Methods

Study Design and Participants

This study was approved by the Gaziantep University Ethics Committee (approval no: 2023/308, date: 20.09.2023) and was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all patients included in the study.

This was a prospective observational study. Our study included 65 patients aged 65 years or older who were on five or more medications and who presented to the geriatric outpatient clinic at our university hospital between 01.10.2023 and 01.10.2024. Before applying standardized, validated measurements and questionnaires, all participants were asked to complete a questionnaire assessing their characteristics and sociodemographic data. The deprescribing process was conducted by a team of physicians. Each patient's medications were reviewed using the TIME criteria to identify PIMs. These were prioritized for discontinuation; clinically unnecessary but appropriate medications were also reduced based on individual judgment. All changes were explained to the patient or caregiver, and the process was closely monitored.

Patients were invited for a follow-up visit approximately six months later, during which the same assessor re-administered all standardized and validated assessments. All participants gave informed consent. A priori power analysis using G*Power 3.9.1 (Cohen's $d = 0.5$, $\alpha = 0.05$, power = 95%) indicated a required sample size of 45. With 65 participants, the study had sufficient power to detect medium or larger effects.

Inclusion and Exclusion Criteria

Patients who were under 65 years of age or who were using fewer than five medications were excluded. Those with severe inflammatory conditions, critical illness, cognitive impairments affecting communication, and comorbidities impairing muscle function, walking, or balance were also excluded. Patients diagnosed with specific sleep disorders, such as restless legs syndrome or obstructive sleep apnea, were also excluded.

Evaluation of Inappropriate Medication Use

In our study, we used the TIME criteria to evaluate inappropriate medication use (6). Medications used inappropriately were discontinued according to these criteria. Patients were advised to report any new prescriptions from other outpatient clinics to prevent the introduction of inappropriate medications between evaluations. Participants were informed that the study aimed to assess the health effects of reducing medications, noting that, while some participants may benefit, results could vary among individuals.

Sleep Quality Assessment

Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI) (7). The PSQI examines seven categories when measuring sleep quality: overall quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, sleep medication use, and daytime functioning. The total score from these categories ranges from 0 to 21, with a score above 5 indicating poor sleep quality (8).

Assessment of Depression

The geriatric depression scale, which includes 30 questions, was used to assess depressive symptoms. A total score of ≥14 is considered indicative of depression according to the scale (9,10).

Assessment of Anxiety

The beck anxiety inventory (BAI), developed by Beck, Brown, Steer, and Epstein in 1988, is a 21-item clinical test that measures anxiety levels. The patient is prompted to rate the symptoms "in the previous week, including today". Scores range from 0 to 63. Ulusoy et al. (11) tested the validity of the BAI on Turkish patients and found high internal consistency.

Assessment of Quality of Life

Quality of life (QOL) was assessed using the three-level EQ-5D instrument (EQ-5D-3L), which includes two parts: the EQ-5D descriptive system and the EQ visual analogue scale (EQ-VAS). The descriptive system evaluates five dimensions—mobility, self-care, daily activities, anxiety/depression, and pain/discomfort. Caregivers' responses generate a five-digit code representing their overall health status. In the EQ-VAS, caregivers rate their perceived health on a scale from 0 to 100 (12). The Turkish version of this scale has been validated in patients with cardiovascular disease (13).

Assessment of Activities of Daily Living and Instrumental Activities of Daily Living

Patients were assessed using the Katz activities of daily living (ADL) rating scale for activities such as personal hygiene, urinary and fecal control, toilet use, dressing, feeding, and walking. High scores were considered as a high degree of independence (14).

The Lawton-Brody scale assessed instrumental ADL like house cleaning, laundry, shopping, medication management, meal preparation, communication, transportation, and financial management; higher scores reflect greater independence (15).

Statistical Analysis

Statistical analyses were performed using IBM SPSS, version 24.0 (IBM Inc., Armonk, NY, USA). The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to assess data normality. Normally distributed data were analyzed with parametric tests, and non-parametric tests were used otherwise. Descriptive measures included the mean, median, and standard deviation (SD). The paired-samples t-test was used to compare means, and the Wilcoxon test was applied to non-normal data. To minimize false positives in multiple PSQI subcomponent analyses, the Bonferroni correction was applied. Because there were seven subcomponents, the significance threshold was set at $p < 0.0071$. Only results below this value were considered statistically significant.

The relationship between binary and categorical variables was analyzed using McNemar's test. In this study, simple linear regression analyses were performed for each outcome (QOL, sleep, anxiety, among others) at the second assessment, with the number of medications at that time as the sole independent variable. Thus, multicollinearity was not a concern. The independent variable in all models was the total number of medications used at the end of 6 months. Each row in the table represents a separate simple linear regression model. All dependent variables are values measured at the second follow-up (6 months). Statistical significance was defined as $p < 0.05$.

Results

This prospective study included 80 patients aged 65 and older who used five or more medications; however, 15 patients were lost to follow-up, resulting in a final sample of 65 (Figure 1). Data were collected at baseline and six months later. Of the participants, 33.8% were male and 66.2% female, with an average age of 70.75 ± 5.46 years (males 72.86 ± 7.09, females 69.67 ± 4.11). The most common comorbidities were hypertension (83.1%), diabetes mellitus (72.3%), hyperlipidemia (67.7%), coronary artery disease (35.4%), and osteoporosis (23.1%), highlighting the prevalence of cardiometabolic diseases among these comorbidities.

Socio-demographic characteristics are summarized in Table 1. The number of patients using PIM decreased significantly from 29.2% to 3.1% between evaluations ($p < 0.05$) (Table 2). The most frequently discontinued drugs were long-acting sulfonylureas, tricyclic antidepressants, proton pump inhibitors, non-steroidal anti-inflammatory drugs (NSAIDs), and diuretics.

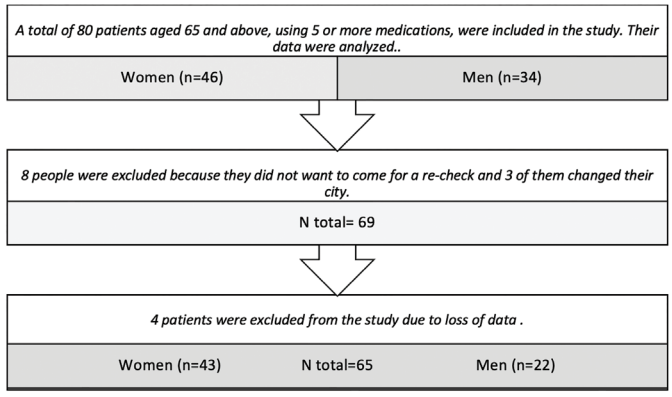

Figure 1. Flow diagram of the patients included in the study.

Table 1. Socio-demographic and general characteristics of the patients.

		Frequency	Percent (%)
Gender	Male	22	33.8
	Female	43	66.2
Marital status	Married	51	78.5
	Widowed/divorced	14	21.5
Education level	Illiterate	22	33.8
	Primary School	29	44.6
	Middle School	7	10.8
	High School	4	6.2
	University	3	4.6
Living with	Alone	7	10.8
	With family members	58	89.2
Smoking	No	58	89.2
	Yes	7	10.8
Alcohol	No	65	100.0
Exercise	No	57	87.7
	Yes	8	12.3

The mean number of medications used dropped from 8.03 (SD = 2.83) to 7.06 (SD = 1.99) post-intervention. The median remained 7 both before [interquartile range (IQR): 5-19] and after (IQR: 4-14) the intervention, but the narrower IQR indicates a significant reduction in some cases ($p < 0.05$). Significant improvements were observed in PSQI subcomponents, including sleep latency, habitual sleep efficiency, and sleep disturbances ($p < 0.01$). After applying the Bonferroni correction for the PSQI subcomponents (significance set at $p < 0.0071$), the PSQI global score also decreased significantly ($p < 0.01$) (Table 3). Although EQ-5D Index and visual analog scale scores increased, these changes were not statistically significant.

The regression analysis used data from the 6-month follow-up after the intervention. The number of medications currently used by patients was the independent variable, while clinical outcomes measured at 6 months were the dependent variables. Regression analysis showed that the number of medications was significantly negatively associated with QOL scores and significantly positively associated with anxiety scores ($p < 0.05$) (Table 4). These findings suggest that deprescribing may improve QOL and reduce anxiety in older adults.

Discussion

In our study, data collected after 6 months showed a significant reduction in both the number of medications used and the number of inappropriate medications used. Improvements were also observed in sleep subscores, including habitual sleep efficiency, sleep latency, and sleep disturbance, along with an overall improvement in the main sleep score. Regression analysis indicated that the number of medications had an independent

Table 2. The relationship between the first and second control data of variables.

Variable	Category	Measurement 1 (n, %)	Measurement 2 (n, %)	p-value
Fall history	No	50 (76.9%)	47 (72.3%)	0.607
	Yes	15 (23.1%)	18 (27.7%)	
Urinary incontinence	No	40 (61.5%)	42 (64.6%)	0.791
	Yes	25 (38.5%)	23 (35.4%)	
Inappropriate medication	No	46 (70.8%)	63 (96.9%)	**0.001**
	Yes	19 (29.2%)	2 (3.1%)	

The McNemar test was used to determine whether there is an association between the first and second control of dichotomous categorical data. A p-value of < 0.05 was considered statistically significant.

Table 3. Comparison of the first and second data of the patients.

Variables	First assessment (n = 65)	Second assessment (n = 65)	p
	Mean ± SD	Mean ± SD	
Number of falls[1α]	0.0 (0-6)	0.0 (0-2)	0.030
Number of drugs[2]	8.03 ± 2.82	7.06 ± 1.99	**<0.01**
Katz score[3α]	6 (3-6)	6 (5-6)	1.000
Lawton brody score[4]	6.78 ± 1.71	7.14 ± 1.07	0.107
EQ-5D index score[5]	0.640 ± 0.25	0.65 ± 0.20	0.693
EQ-5D visual analogue scale[5]	60.92 ± 16.36	62.77 ± 16.13	0.313
Depression score[6]	13.03 ± 6.91	12.65 ± 6.90	0.448
Anxiety score[7]	14.20 ± 10.67	13.22 ± 9.29	0.267
Subjective sleep quality[8]	1.40 ± 0.78	1.28 ± 0.54	0.145
Sleep latency[8]	1.95 ± 1.03	1.58 ± 1.01	**<0.01**
Sleep duration[8]	0.86 ± 0.98	0.62 ± 0.70	0.62
Habitual sleep efficiency[8]	0.92 ± 0.95	0.58 ± 0.72	**<0.01**
Sleep Disorder[8]	1.51 ± 0.61	1.26 ± 0.50	**<0.01**
Use of sleeping drugs[8α]	0.0 (0-3)	0.00 (0-3)	0.739
Daytime dysfunction[8α]	0.00 (0-3)	0.00 (0-3)	0.554
Pittsburgh total score[8]	7.40 ± 3.34	6.02 ± 2.80	**<0.01**

*Significant at 0.05 level. [1]Number of falls in the last 6 months. [2]Number of medicines used. [3]Katz Index of independence in activities of daily living. [4]Lawton-brody instrumental activities of daily living scale. [5]EQ-5D health-related quality of life questionnaire. [6]Geriatric depression scale. [7]Beck anxiety inventory. [8]Pittsburgh Sleep Quality Index total score and subheading scores.
SD: Standard deviation.

Table 4. Analysis of variables independently affected by the number of drugs used.

Dependent variables			95% confidence interval for B		p
	B	Std. error	Lower bound	Upper bound	
[α]Lawton brody score[1]	-0.065	0.067	-0.200	0.069	0.337
[α]EQ-5D index score[2]	-0.038	0.012	-0.063	-0.013	**<0.01**
[α]EQ-5D visual analogue scale[2]	-2.290	0.979	-4.246	-0.334	**<0.01**
[α]Depression score[3]	0.810	0.425	-0.039	1.658	0.061
[α]Anxiety score[4]	1.671	0.549	0.575	2.768	**<0.01**
[α]Pittsburgh total score[5]	0.197	0.176	-0.155	0.548	0.268

*p < 0.05 according to simple linear regression analysis.
[α]Second assessment.
[1]Lawton-brody instrumental activities of daily living scale. [2]EQ-5D health-related quality of life questionnaire. [3] Geriatric depression scale. [4]Beck anxiety inventory. [5]Pittsburgh Sleep Quality Index total score.
B: Beta weight, CI: Confidence interval.

negative effect on QOL scores and an independent positive effect on anxiety scores. We found that sleep quality improved after deprescribing.

Medications can affect sleep in different ways, and even medications prescribed to treat insomnia can sometimes have unwanted side effects. A study by Lande and Gragnani (16) found that as the number of medications prescribed increased, the percentage of deep sleep decreased markedly, while the percentage of light sleep increased. Furthermore, the proportion of REM sleep decreased, while the onset of the deep sleep phase was delayed (16).

Aging causes changes in sleep structure, and numerous studies show that older individuals are more susceptible to sleep disturbances. It is natural to expect changes in sleep structure with increasing age, but age alone does not cause insomnia. However, the ability to sleep decreases with age and this can be caused by different factors related to aging (17).

Polypharmacy is associated with adverse outcomes such as increased mortality, falls, ADRs, prolonged hospital stays, and rehospitalization shortly after discharge (17). Increasing the number of medicines increases the risk of harm and adverse effects (18).

Aging has been associated with multiple diseases and polypharmacy. Sleep disorders are common among the elderly. Another factor that may increase the risk of sleep disorders among older adults is medication use. Polypharmacy can lead to an increased risk of sleep disorders among older patients (19).

In geriatric patients, sleep is an important indicator of overall health and a significant dimension of QOL. Sleep quality affects individuals' daily activities and can have notable impacts on cognitive, physical, and psychological domains. Poor sleep quality can lead to noticeable effects such as unhealthy eating habits, burnout, tension, or fatigue (20).

Decreased sleep quality in older people can lead to insomnia, irritability, fatigue, depression, muscle tremors, pain and reduced mental and functional abilities (20). The literature reveals that chronic diseases and the number of medications used are associated with sleep disorders in elderly individuals (21). In our study, we observed a significant improvement in sleep quality scores six months after reducing the number of medications used. This finding was consistent with the literature.

Polypharmacy affects 20% of elderly patients in primary care and 37% of the general elderly population. People aged 65 years and older typically take 4.5 to 8 medications daily. Polypharmacy often leads to potentially inappropriate prescriptions, increasing risks of nonadherence, drug interactions, and side effects. This is linked to higher rates of hospitalizations, fractures, morbidity, and mortality (22).

Medications can reduce symptoms, treat and prevent diseases, with the ultimate aim of contributing to years of quality life for patients. However, polypharmacy has been associated with multiple adverse health outcomes. For example, increased morbidity and mortality associated with polypharmacy may reduce QOL. Furthermore, age-related changes in pharmacokinetics and pharmacodynamics may make older individuals more susceptible to adverse effects of drugs (23). In our study, the number of medications used decreased significantly at the second follow-up compared with the first. Although patients' QOL scores improved, the change was not statistically significant, possibly due to the sample size, which, if increased, might have yielded significant results. Regression analysis showed that the number of medications was a negative predictor of QOL scores, suggesting that fewer medications may be associated with better QOL.

PIMs are drugs that carry more risks than benefits for older adults. Their use can lead to longer hospital stays and various health complications. PIMs also increase the risk of drug–drug interactions and ADRs. Specifically, they can cause prolonged sedation, higher fall risk, and greater chances of upper gastrointestinal bleeding in the elderly (24).

Many commonly used criteria for identifying inappropriate medications in older adults list numerous anticholinergic drugs. These medications can cause various ADRs such as falls, confusion, malnutrition, acute urinary retention, and constipation. These effects are especially harmful for frail elderly patients and those with geriatric syndromes (25). Anticholinergic medications are used to treat conditions such as Parkinson's disease, psychotic disorders, depression, overactive bladder, asthma, and allergies; they are also used to induce mydriasis. Many psychotropic drugs—such as antipsychotics, antidepressants, mood stabilizers, and anxiolytics—also have anticholinergic effects. In older adults without dementia, cognitive decline is often linked to age-related brain changes, but medication-related anticholinergic effects may also contribute (26). In our study, reducing the number of patients using PIM from 19 to 2 represented a significant success. The most commonly discontinued drugs were long-acting sulfonylureas, tricyclic antidepressants with anticholinergic effects, proton pump inhibitors, NSAIDs, and diuretics because of risks such as hypoglycemia, falls, cognitive decline, and kidney damage. Although high-anticholinergic drugs were avoided, the anticholinergic burden was not quantitatively measured, which is a limitation. Future research using anticholinergic burden scales could better assess the impact of anticholinergic burden on sleep and anxiety.

Anxiety is common among elderly patients and often co-occurs with other chronic conditions. This situation can be associated with increased polypharmacy and the use of inappropriate medications (PIMs) in order to effectively treat the accompanying chronic health issues (27).

The safety of population-specific medication use in older patients, particularly in geriatrics and psychiatry, is receiving increasing attention. There is increasing evidence of polypharmacy and PIM use in older people with diagnoses of anxiety disorders and depression (28). In our study, after we reduced the number of medications and inappropriate drug use, we examined their relationship with anxiety. Although both the medication count and inappropriate medication use decreased significantly, the reduction in anxiety scores was not statistically significant. Regression analysis revealed that the number of medications used was an independent positive predictor of anxiety scores. This study applied basic linear regression without adjusting for covariates; however, using more advanced methods like multivariate regression could offer deeper insights and guide future research. Discontinuing unnecessary and PIMs may help reduce anxiety levels, consistent with existing literature.

Strengths of the Study

This study has several strengths. Its prospective design enabled the assessment of causal links between medication reduction and health improvements. The use of validated scales for sleep quality, anxiety, depression, and QOL increases the reliability of the results. Conducting the study in a real-world geriatric outpatient clinic in a university hospital highlights the practical impact of deprescribing interventions. Notably, the rate of inappropriate medication use decreased significantly from 29.2% to 3.1% within six months, demonstrating the feasibility and effectiveness of targeted medication reviews among older adults.

Study Limitations

In our study, recruiting patients from a single center may limit the generalizability of the results to the broader population. Additionally, some patients either relocated or declined to attend follow-up visits, which reduced the sample size and may have affected the significance of certain data. Furthermore, missing data led to the exclusion of some patients, decreasing the total number of participants.

The absence of a control group limits the ability to attribute observed improvements solely to the deprescribing intervention, as external factors such as time, increased healthcare interactions, or seasonal variations may have influenced the results. Thus, the findings should be interpreted cautiously, and stronger study designs are needed to establish causality. Additionally, the lack of systematic assessment of key clinical variables such as cognitive status (e.g., Mini-Mental State Examination or Montreal Cognitive Assessment scores) restricts the analysis of potential cognitive effects. Future studies should include these measurements for a more comprehensive evaluation. Moreover, regression analyses were performed without adjusting for covariates, relying only on unadjusted associations; therefore, some results may be affected by confounding factors. Future research should incorporate multivariate modeling to control for these influences.

Conclusion

Reducing the number of drugs used, and especially the number of inappropriate drugs, is important for the country's economy, health system, patients' health and well-being. In our study, participants who experienced a statistically significant reduction in the number of medications had higher sleep quality. We have demonstrated in our study how important discontinuing the unnecessary use of even a single drug is for the country's economy, health system, and patients. More studies should be conducted to obtain more meaningful data.

Ethics

Ethics Committee Approval: Approval for the study was obtained from the Gaziantep University Clinical Research Ethics Committee (approval number: 2023/308; date: 20.09.2023).

Informed Consent: Written informed consent was obtained from all patients included in the study.

Acknowledgments

The authors would like to acknowledge that the researcher listed in the ethics committee application is aware that they are not included as an author of this manuscript, and this is with their knowledge.

Footnotes

Authorship Contributions

Concept: E.S.A., P.K., Design: E.S.A., P.K., Data Collection or Processing: E.S.A., P.K., Analysis or Interpretation: E.S.A., P.K., Literature Search: E.S.A., P.K., Writing: E.S.A., P.K.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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