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# Association of Polypharmacy with Medication Transport Behaviors and Therapeutic Indication Awareness Among Older Outpatients: A Cross-Sectional Study

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## Abstract

# Background:

Polypharmacy is a major geriatric syndrome that compromises treatment adherence and increases adverse drug events. In ambulatory geriatric care, encouraging patients to bring their physical medications (the "bag-of-medications" approach) plays a key role in medication reconciliation. However, data on how medication-carrying behavior relates to therapeutic indication awareness among older adults attending geriatric outpatient clinics remain limited. This study aimed to determine the prevalence of polypharmacy in an outpatient geriatric population, evaluate patients' medication-carrying habits and indication awareness during routine clinic visits, and assess their clinical correlates.

# Methods

This cross-sectional study included 152 geriatric outpatients (aged ≥ 65 years) who presented to a hospital geriatric outpatient clinic in Türkiye between July 28 and August 8, 2025. Data on sociodemographics, Katz ADL, Lawton-Brody IADL, and Clinical Frailty Scale (CFS) were collected. Active regimens were verified via electronic health records and the national e-Nabız digital repository. Polypharmacy was defined as ≥ 5 concurrent medications, hyperpolypharmacy as ≥ 10. Potentially inappropriate medications (PIMs) were identified using STOPP/START criteria (version 3). Group differences were evaluated using Chi-square, Fisher's exact, or Mann–Whitney U tests.

# Results

Among 152 outpatients (75.0% female, median age 74 years), polypharmacy was present in 55.3% (n = 84) and hyperpolypharmacy in 9.9% (n = 15). Male patients had a significantly higher rate of hyperpolypharmacy than females (21.1% vs. 6.1%, p = 0.008). Polypharmacy was significantly associated with living with a spouse (p = 0.002), being a caregiver (30.95% vs. 17.65%, p = 0.044), lower ADL scores (median 5.0 vs. 6.0, p = 0.039), higher CFS frailty (p = 0.009), higher burden of cardiovascular and metabolic comorbidities, and dramatically elevated PIM use (33.33% vs. 4.41%, p < 0.001). Overall, 50.0% (n = 76) brought their physical medications to their clinic appointment. Patients who brought their medications demonstrated significantly higher indication awareness compared to those who did not (77.6% vs. 32.9%, p < 0.001). Patients unaware of their indications trended toward higher polypharmacy rates (63.8% vs. 48.8%, p = 0.075).

# Conclusions

Polypharmacy and PIM use are highly prevalent among geriatric outpatients and strongly linked to frailty and functional decline. Physical medication transport behavior serves as a robust clinical proxy for

therapeutic indication awareness during outpatient clinic visits. Routine geriatric outpatient appointments should integrate systematic medication reconciliation and "brown-bag" review strategies to enhance medication literacy and rational prescribing.

# BACKGROUND

Globally, the population aged 65 years and older is projected to reach approximately 1.5 billion by 2050, with a substantial proportion of this demographic expansion occurring in developing countries [1]. In parallel with population aging, the prevalence of chronic conditions—such as hypertension, diabetes mellitus, coronary artery disease, and dyslipidemia—is rising markedly, frequently culminating in multimorbidity and, consequently, the concomitant use of multiple medications [2, 3].

Polypharmacy, commonly defined as the routine concurrent use of five or more medications, is currently recognized as a complex geriatric syndrome [2–5]. Nevertheless, polypharmacy is not merely a quantitative numerical threshold; it can also be conceptualized qualitatively as the inappropriate or unindicated use of even a single agent [6]. In ambulatory settings, it is estimated that over 40% of adults aged 65 years and older experience polypharmacy, while approximately 12% reach the threshold of hyperpolypharmacy, defined as the concurrent use of 10 or more medications [7]. However, the true extent and clinical burden of this issue among older adults remain inadequately defined across many countries [7].

As a direct consequence of multiple drug therapy, inappropriate medication use contributes to an increased incidence of drug–drug and drug–disease interactions, serious adverse drug reactions, and cognitive and functional decline [2, 7]. In clinical practice, low medication literacy—broadly defined as patients' insufficient awareness of the names, dosages, and therapeutic indications of their prescribed regimens—serves as a primary barrier to treatment optimization. This deficit compromises medication adherence, promotes duplicate prescribing, and increases the frequency of preventable adverse drug events [2, 7].

In outpatient settings, encouraging patients to bring all currently used medications (including prescription drugs, over-the-counter agents, and dietary supplements) to their consultations—often referred to as the "bag-of-medications" approach—plays a pivotal role in enabling clinicians to comprehensively reconcile active therapies and execute deprescribing protocols. Nevertheless, routine clinical observations suggest that a substantial proportion of older adults fail to transport their medications to outpatient visits and demonstrate inadequate awareness regarding the underlying therapeutic indications of their regimens.

Although research addressing polypharmacy exists, studies directly investigating the relationship between polypharmacy and specific components of medication literacy—namely, medication-carrying behaviors during outpatient visits and therapeutic indication awareness—remain limited among older adults. In light of these considerations, this study aimed to determine the prevalence of polypharmacy in an outpatient geriatric population, evaluate patients' medication-carrying habits and indication

awareness, and investigate the association between these factors, polypharmacy, and potentially inappropriate medication use.

# METHODS

### Study Design and Setting

This cross-sectional and descriptive study was conducted among geriatric outpatients aged 65 years and older who presented to the geriatric outpatient clinic of a city hospital in Türkiye between July 28, 2025, and August 8, 2025. During the 10-day data collection period, a total of 152 patients who attended outpatient clinic visits and provided informed consent were included in the study.

### Study Population and Eligibility Criteria

Patients or their relatives with mental or physical disabilities that precluded them from providing informed consent were excluded from the study. Patients who initially provided informed consent but subsequently wished to withdraw from the study for any reason were excluded. Additionally, patients with mental or physical disabilities that rendered them unable to respond to questions regarding the therapeutic reasons/indications for their medications were excluded.

### Data Collection and Measurements

Data regarding sociodemographics, clinical characteristics, medication transport behaviors, and therapeutic indication awareness were collected using a custom-designed data collection form developed specifically for this study (see Supplementary File 1).

Functional and clinical statuses were evaluated using the following standardized tools:
• **Functional Status:** Katz Index of Activities of Daily Living (ADL) and Lawton-Brody Instrumental Activities of Daily Living (IADL) Scale.
• **Frailty:** Clinical Frailty Scale (CFS).

All active prescription drugs, over-the-counter (OTC) medications, and dietary/herbal supplements used by the patients were questioned and cross-verified via the hospital electronic health record system and the national e-Nabız (digital health repository) system.

### Study Definitions and Outcome Variables

**Polypharmacy and Hyperpolypharmacy:** Polypharmacy was defined as the concomitant use of five or more medications, whereas hyperpolypharmacy was defined as the concurrent use of ten or more medications.

**Medication Awareness:** Evaluated based on two primary components:
1. Medication-Carrying Behavior (Bag-of-Medications Behavior): Whether patients physically brought all of their active medications to the outpatient visit.

2. Indication Awareness: The ability of patients to correctly state the therapeutic reasons/indications for all of their currently used medications.

**Potentially Inappropriate Medication (PIM) Use:** Potentially inappropriate prescribing and omission of indicated therapies were evaluated and recorded according to the updated STOPP/START criteria (version 3).

### Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics software (version 27.0; IBM Corp., Armonk, NY, USA). The normality distribution of continuous variables was evaluated using the Kolmogorov-Smirnov test. Because non-parametric assumptions were met, continuous variables were presented as median and interquartile range (IQR), and comparisons between two groups were conducted using the Mann–Whitney U test. Categorical variables were expressed as frequencies (n) and percentages (%), and group comparisons were performed using the Chi-square test or Fisher's exact test. A two-tailed p-value of $< 0.05$ was considered statistically significant.

## RESULTS

### Sociodemographic Characteristics and Prevalence of Polypharmacy

Among the 152 geriatric outpatients evaluated, 75.0% (n = 114) were female, and the overall median age was 74 years (interquartile range [IQR] = 10). The median number of daily medications across the entire study population was 5 (IQR = 4). Polypharmacy (≥ 5 drugs) was identified in 55.3% (n = 84) of the patients, while hyperpolypharmacy (≥ 10 drugs) was detected in 9.9% (n = 15).

Although the prevalence of polypharmacy appeared higher in male patients (68.4%) than in female patients (50.9%), this difference did not reach statistical significance (p = 0.060). However, the prevalence of hyperpolypharmacy was significantly higher in males compared to females (21.1% vs. 6.1%, respectively; p = 0.008). No statistically significant difference in age was observed between patients with and without polypharmacy (p = 0.818) (Table 1).

**Table 1. Distribution of Polypharmacy and Hyperpolypharmacy by Sex and Age**

| Variable | Overall Population (N=152) | Present | Absent | p-value |
|---|---|---|---|---|
| Polypharmacy Status | - | (n = 84, 55.3%) | (n = 68, 44.7%) | - |
| Sex, n (%) | | | | 0.060 |
| Female | 114 (75.0) | 58 (50.9) | 56 (49.1) | |
| Male | 38 (25.0) | 26 (68.4) | 12 (31.6) | |
| Age (years), Median (IQR) | 74 (10) | 75 (9.5) | 73 (10.5) | 0.818 |
| Hyperpolypharmacy Status | - | (n = 15, 9.9%) | (n = 137, 90.1%) | - |
| Sex, n (%) | | | | 0.008* |
| Female | 114 (75.0) | 7 (6.1) | 107 (93.9) | |
| Male | 38 (25.0) | 8 (21.1) | 30 (78.9) | |
| Age (years), Median (IQR) | 74 (10) | 73 (7.0) | 75 (10.0) | 0.237 |

*p < 0.05 indicates statistical significance;  Chi-square test;  Mann-Whitney U test; IQR: Interquartile range.

**Factors Associated with Polypharmacy**

Living arrangements differed significantly between the non-polypharmacy and polypharmacy groups (p = 0.002). Patients without polypharmacy lived alone more frequently (30.88%), whereas those with polypharmacy predominantly resided with their spouses (44.05%). Furthermore, the proportion of active caregivers was significantly higher among patients with polypharmacy compared to those without polypharmacy (30.95% vs. 17.65%, respectively; p = 0.044). No statistically significant differences were detected between the groups in terms of marital status, income level, educational level, smoking status, alcohol consumption, or history of falls within the past year (p > 0.05 for all).

The Katz Index of Activities of Daily Living (ADL) score was lower in the polypharmacy group (median 5.0 vs. 6.0; p = 0.039), indicating greater dependence in activities of daily living. The Clinical Frailty Scale (CFS) score distribution was significantly skewed toward higher frailty levels in the polypharmacy group (p = 0.009). No statistically significant difference was observed in Lawton-Brody Instrumental Activities of Daily Living (IADL) scores (p = 0.112). Potentially inappropriate medication (PIM) use was identified in 20.4% (n = 31) of the overall study population and was dramatically higher in the polypharmacy group (33.33% vs. 4.41%; p < 0.001) (Table 2). Furthermore, according to the STOPP/START (v3) criteria, PIMs were most frequently observed in medications acting on the central nervous system (35.4%, n = 11).

**Table 2. Distribution of Sociodemographic Characteristics, Functional Scales, and Clinical Parameters by Polypharmacy Status**

| Variable | Categories / Scales | No Polypharmacy (n = 68) | Polypharmacy (n = 84) | p-value |
|---|---|---|---|---|
| Katz ADL Index | Median (IQR) | 6.0 (1.0) | 5.0 (2.0) | 0.039*□ |
| Lawton-Brody IADL | Median (IQR) | 8.0 (3.0) | 7.0 (4.0) | 0.112□ |
| Clinical Frailty Scale (CFS) | Median (IQR) | 4.0 (0.5) | 4.0 (1.0) | 0.009*□ |
| Living Arrangement | Alone | 21 (30.88) | 7 (8.33) | 0.002*□ |
| | Spouse | 15 (22.06) | 37 (44.05) | |
| | Children | 29 (42.65) | 32 (38.10) | |
| | Other Relative / Caregiver | 3 (4.41) | 8 (9.52) | |
| Caregiver Status | Absent | 56 (82.35) | 58 (69.05) | 0.044*□ |
| | Present | 12 (17.65) | 26 (30.95) | |
| Income Level | Below Minimum Wage | 24 (35.29) | 17 (20.24) | 0.102□ |
| | Minimum Wage | 11 (16.18) | 14 (16.67) | |
| | Above Minimum Wage | 33 (48.53) | 53 (63.10) | |
| Educational Level | Illiterate | 22 (32.35) | 27 (32.14) | 0.164□ |
| | Literate (Without Diploma) | 8 (11.76) | 8 (9.52) | |
| | Primary School | 35 (51.47) | 36 (42.86) | |
| | High School or Higher | 3 (4.41) | 13 (15.48) | |
| History of Falls (Past year) | Present | 22 (32.35) | 28 (33.33) | 0.519□ |
| Over-the-Counter (OTC) Drug Use | Present | 5 (7.35) | 6 (7.14) | 0.600□ |
| Potentially Inappropriate Medication (PIM) | Present | 3 (4.41) | 28 (33.33) | <0.001*□ |

*p < 0.05 indicates statistical significance; □ Chi-square test; □ Mann-Whitney U test; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living; IQR: Interquartile range.

Hypertension (83.33% vs. 67.65%; p = 0.019), diabetes mellitus (60.71% vs. 30.88%; p < 0.001), hyperlipidemia (19.05% vs. 4.41%; p = 0.005), atherosclerotic cardiovascular disease (38.10% vs. 10.29%;

p < 0.001), and cerebrovascular disease (5.95% vs. 0.00%; p = 0.049) were significantly more prevalent in the polypharmacy group (Table 3).

**Table 3. Distribution of Comorbidities According to Polypharmacy Status**

| Comorbidity | No Polypharmacy (n = 68) n (%) | Polypharmacy (n = 84) n (%) | p-value |
|---|---|---|---|
| Hypertension (HT) | 46 (67.65) | 70 (83.33) | 0.019* |
| Diabetes Mellitus (DM) | 21 (30.88) | 51 (60.71) | <0.001* |
| Hyperlipidemia (HL) | 3 (4.41) | 16 (19.05) | 0.005* |
| ASCVD | 7 (10.29) | 32 (38.10) | <0.001* |
| Cerebrovascular Disease (CVD) | 0 (0.00) | 5 (5.95) | 0.049* |
| Asthma / COPD | 3 (4.41) | 10 (11.90) | 0.086 |
| Chronic Kidney Disease (CKD) | 3 (4.41) | 7 (8.33) | 0.264 |
| Dementia | 4 (5.88) | 10 (11.90) | 0.161 |
| Thyroid Disease | 7 (10.29) | 5 (5.95) | 0.246 |
| Malignancy | 3 (4.41) | 6 (7.14) | 0.363 |

*p < 0.05 (Chi-square test / Fisher's exact test); ASCVD: Atherosclerotic Cardiovascular Disease; COPD: Chronic Obstructive Pulmonary Disease; CVD: Cerebrovascular Disease; CKD: Chronic Kidney Disease; HT: Hypertension; DM: Diabetes Mellitus; HL: Hyperlipidemia.

**Association Between Polypharmacy, Medication Transport Behavior, and Indication Awareness**

Fifty percent (n = 76) of the patients brought their physical medications to the outpatient clinic examination. Among patients who brought their medications, 77.6% (n = 59) accurately knew the indications for their medications, whereas only 32.9% (n = 25) of those who did not bring their medications possessed indication knowledge, a difference that was highly statistically significant (p < 0.001). No direct association was observed between medication transport status and either polypharmacy (p = 0.514) or hyperpolypharmacy (p = 0.786). The prevalence of polypharmacy was higher among patients who did not know their medication indications (63.8%) compared to those who did (48.8%); however, this difference demonstrated only a borderline statistical trend (p = 0.075) (Table 4).

**Table 4. Association of Medication Transport Behavior and Indication Awareness with Polypharmacy and Hyperpolypharmacy**

| Parameter | Subgroup | Indication Aware n (%) | Indication Unaware n (%) | Polypharmacy Present n (%) | Hyperpolypharmacy Present n (%) |
|---|---|---|---|---|---|
| Medication Transport Status | Medications Brought (n = 76) | 59 (77.6) | 17 (22.4) | 44 (57.9) | 8 (10.5) |
| | Medications Not Brought (n = 76) | 25 (32.9) | 51 (67.1) | 40 (52.6) | 7 (9.2) |
| | p-value | <0.001* | - | 0.514 | 0.786 |
| Indication Awareness Status | Aware (n = 84) | - | - | 41 (48.8) | 9 (10.7) |
| | Unaware (n = 68) | - | - | 43 (63.8) | 6 (8.8) |
| | p-value | - | - | 0.075 | 0.698 |

*p < 0.05 (Chi-square test).

# DISCUSSION

In this study, polypharmacy was identified in more than half (55.3%) of patients aged 65 years and older presenting to the geriatric outpatient clinic, while hyperpolypharmacy was detected in approximately one in every ten patients (9.9%). Our findings broadly parallel the polypharmacy prevalence rates reported in the geriatric population worldwide and in our country. Literature reports indicate that the prevalence of polypharmacy among older outpatients ranges between 40% and 70% [7, 8]. Similarly, studies conducted in geriatric outpatient clinics in Türkiye have demonstrated polypharmacy rates of approximately 50% to 60% [9, 10]. The 55.3% rate identified in our study reaffirms the high frequency with which clinicians encounter multi-drug therapy in outpatient settings, underscoring the critical role of rational drug use principles in geriatric patient management. Regarding the gender factor, literature generally reports a higher prevalence of polypharmacy among females, a trend often attributed to their higher rate of healthcare utilization and greater burden of chronic comorbidities [11]. However, in our study, no statistically significant difference in overall polypharmacy was observed between females and males (p = 0.060); conversely, the rate of hyperpolypharmacy was significantly higher in males compared to females (21.1% vs. 6.1%, p = 0.008). This notable finding may stem from the presence of more complex chronic diseases with multisystemic involvement—such as atherosclerotic cardiovascular diseases—among the male patients in our sample cohort.

One of the most novel and striking findings of our study is the relationship between patients' habits of carrying their medications with them and their awareness of the therapeutic indications for these medications. The vast majority of the 76 patients who brought their medications (77.6%, n = 59) accurately knew the indications for all their medications, whereas only one-third of those who did not

bring their medications (32.9%, n = 25) were aware of their indications, a difference that was highly statistically significant ($p < 0.001$). In the literature, studies investigating medication literacy and treatment adherence among geriatric patients have demonstrated that patients presenting to clinic visits with their medication containers or lists exhibits enhanced treatment adherence and awareness [12, 13]. Our study reveals that bringing medications to an outpatient consultation may serve as an easily evaluable, practical clinical proxy behavior associated with higher medication indication awareness. On the other hand, the trend toward a higher polypharmacy rate among patients who did not know the indication for their medications ($p = 0.075$) aligns with literature data indicating that as the number of medications increases, the cognitive burden imposed on patients increases and medication awareness declines [14]. Conversely, polypharmacy rates were similar between those who brought their medications and those who did not ($p = 0.514$). The prevalence of polypharmacy was higher in patients who were unaware of their medication indications (63.8%) compared to those who were aware (48.8%), demonstrating a borderline statistical trend ($p = 0.075$).

As expected, polypharmacy was closely associated with comorbid disease burden. In our study, the prevalence of hypertension, diabetes mellitus, hyperlipidemia, atherosclerotic cardiovascular disease, and cerebrovascular disease was significantly higher in the polypharmacy group. This reflects the reality of multimorbidity—a chronic disease accumulation that necessitates multi-drug prescribing as a natural consequence of guideline-directed medical therapy [15]. Polypharmacy was associated with lower functional status and higher frailty levels. Patients in the polypharmacy group demonstrated significantly lower Katz Index of Activities of Daily Living scores ($p = 0.039$) and significantly higher Clinical Frailty Scale (CFS) scores ($p = 0.009$). Strong correlations between polypharmacy, functional decline, frailty syndrome, fall risk, and increased mortality are well-established in the literature [16, 17]. Multi-drug use impairs cognitive functions, induces orthostatic hypotension, or directly weakens muscle strength, thereby restricting an older adult's capacity for independent daily functioning and deepening physical frailty. Regarding social support mechanisms, patients without polypharmacy were more likely to live alone (30.88%), whereas those with polypharmacy predominantly lived with their spouse (44.05%) ($p = 0.002$). This observation suggests that older adults living alone may use fewer medications due to difficulties in accessing healthcare services, acquiring drugs, or maintaining adherence; alternatively, it may be explained by closer medical follow-up and subsequent treatment initiation among patients with family support [18]. Furthermore, the higher proportion of caregivers in the polypharmacy group ($p = 0.044$) indicates that these patients bear a dual burden—managing their own complex therapeutic regimens while simultaneously caring for another individual—which may heighten the risk of caregiver burnout and medication errors.

Finally, while the prevalence of potentially inappropriate medication (PIM) use evaluated according to the STOPP/START criteria was 20.4% in the overall population, this rate increased dramatically to 33.33% in the polypharmacy group ($p < 0.001$). The strong association between polypharmacy and potentially inappropriate prescribing represents one of the most widely established consensus points in geriatric literature [19, 20]. As the number of prescribed medications increases, the probability of introducing high-risk drugs that violate STOPP/START criteria inevitably rises. This finding highlights the critical

necessity of periodically reviewing medication lists and executing deprescribing protocols for medications that no longer have a clear indication in older adults.

# Strengths and Limitations

The single-center design of our study and its execution over a limited 10-day period in an outpatient setting represent the primary constraints on sample size. Due to the cross-sectional design, causal relationships and the directionality of associations cannot be established. The presence of only 15 patients in the hyperpolypharmacy subgroup limits the statistical power of subgroup analyses. Furthermore, the lack of a formal objective assessment of patients' cognitive status may constitute a limitation when interpreting medication awareness data. Conversely, key strengths of our study include the cross-verification of medication data using both institutional electronic records and the national e-Nabız digital health registry system, the application of validated geriatric instruments such as the STOPP/START criteria, and its specific focus on the relationship between medication transport behavior and therapeutic indication awareness—an area underrepresented in the current literature.

# CONCLUSIONS

In conclusion, the prevalence of polypharmacy and associated potentially inappropriate medication use among geriatric outpatients is remarkably high, with polypharmacy being significantly associated with increased frailty and reduced functional capacity. Medication transport behavior strongly correlates with therapeutic indication awareness and can serve as a practical clinical proxy for medication literacy in outpatient settings. To mitigate the burden of polypharmacy and inappropriate drug use in older adults, routine outpatient encounters should incorporate systematic medication reconciliation, actively encourage bag-of-medications review strategies, and enhance targeted educational interventions for patients and caregivers.

# Abbreviations

ADL: Activities of Daily Living

ASCVD: Atherosclerotic Cardiovascular Disease

CFS: Clinical Frailty Scale

CI: Confidence Interval

CKD: Chronic Kidney Disease

COPD: Chronic Obstructive Pulmonary Disease

CVD: Cerebrovascular Disease

DM: Diabetes Mellitus

HL: Hyperlipidemia

HT: Hypertension

IADL: Instrumental Activities of Daily Living

IQR: Interquartile Range

OR: Odds Ratio

OTC: Over-the-Counter

PIM: Potentially Inappropriate Medication

START: Screening Tool to Alert to Right Treatment

STOPP: Screening Tool of Older Persons' Prescriptions

# Declarations

**Ethics approval and consent to participate**: This study was approved by the Scientific Research Ethics Committee of Adana City Training and Research Hospital (Date: July 10, 2025; Decision No: 589). All procedures were conducted in accordance with the ethical standards of the Declaration of Helsinki. Informed consent was obtained from all individual participants or their legal guardians prior to inclusion.

**Consent for publication:** Not applicable.

**Availability of data and materials:** The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

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## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFile1StudyQuestionnaireDataCollectionForm.docx