

# Medications Associated with Geriatric Syndromes and Prescribing Patterns: The Impact of Excessive Polypharmacy in Older Adult Patients

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**Aims of the Study:** To assess the prescribing patterns of medications associated with geriatric syndromes (MAGS) in older adult patients with multiple comorbidities and to identify factors that may increase the risk of MAGS prescribing in the same population.

**Methodology:** This study involved a retrospective analysis of the electronic medical records of older adult patients ( $\geq 65$  years) who visited outpatient clinics at King Abdullah University Hospital (KAUH) in Jordan between January 1, 2019, and June 1, 2024. The collected data included patient demographics, medical history, and medications, focusing on those associated with geriatric syndromes. Descriptive and logistic regression statistical analyses were performed using SPSS with the significance level set at  $p < 0.05$ .

**Results:** The study included 1087 older adult patients (52.7% female), with a median age of 71 years. The common conditions existed were peptic ulcer disease (57.1%), hypertension (54.65%), and uncomplicated diabetes (50%). Polypharmacy was presented in 94.8% of total patients number, with 41.6% experiencing excessive polypharmacy. Antihypertensives (78.4%), non-opioid analgesics (56.5%), and antidiabetics (51.8%) were the most frequently prescribed MAGS, which frequently resulted in falls (96%), urinary incontinence (87.6%), and depression (87.3%). Patients with excessive polypharmacy had significantly higher MAGS scores than those with moderate or mild polypharmacy (95% CI:  $-2.230$  to  $-1.770$  and  $-3.322$  to  $-2.678$ , respectively,  $P < 0.001$ ).

**Conclusion:** The findings demonstrate a high prevalence of excessive polypharmacy among older adult patients, significantly contributing to the elevated prescription level of medications associated with geriatric syndrome occurrence, particularly falls, urinary incontinence, and depression.

**Keywords:** polypharmacy, geriatric syndromes, older adult, excessive polypharmacy, medications, elderly

## Introduction

Geriatric syndromes (GSs) represent a wide range of multifactorial health conditions that are highly prevalent among older adults. These health problems include cognitive impairment, delirium, depression disorders, falls, unexplained weight loss, appetite loss, and urinary incontinence.<sup>1</sup> These syndromes typically arise from numerous physiological functions that decline due to either the aging process itself or the adverse events associated with the use of an excessive number of medications for different indications simultaneously (polypharmacy).<sup>2–5</sup> Although medications are prescribed to alleviate symptoms and improve health outcomes in this population, paradoxically, they can contribute to or worsen these symptoms.<sup>6</sup> Furthermore, prescribing specific drugs to treat unwanted adverse events of another medication, rather than a new indication, will add up to the drug burden and may lead to the development of GSs among older adult patients.<sup>2</sup>

Both the Beers and START/STOPP criteria mainly focus on specific medications that have been identified as potentially inappropriate for older adults due to their known risks, adverse drug events, and drug-drug interactions.<sup>7,8</sup> In comparison, medications associated with geriatric syndromes (MAGS) list refer to a broader inclusion of GSs that may result from medication use, such as unintentional weight loss, delirium, depression, and urinary incontinence.<sup>9</sup>

MAGS include a wide range of medications that are commonly prescribed to older adults for the management of chronic conditions. Previous reports have identified eighteen medication categories which contribute to six GSs development in older patients including antiepileptic, drugs used for Parkinson disease, antipsychotics, opioid agonist, benzodiazepines, antihypertensive medications, antidiabetic, anticholinergic, antihistamines, and others.<sup>3,9</sup>

Therefore, it is necessary to address all medications that may be associated with geriatric syndromes. Identifying these medications is a key step in preventing or minimizing the risk of developing geriatric syndromes and ultimately enhancing treatment outcomes in older adult patients.

In this context, the current study aimed to identify the prevalence of MAGS prescriptions among older adult patients with various comorbidities and to determine predictors that may predispose them to the onset of geriatric syndromes.

## Methodology

### Ethical Approval

Ethical approval for this study was obtained from the Institutional Review Board (IRB) of Jordan University of Science and Technology (JUST) and King Abdullah University Hospital (KAUH) under reference number (4/166/2024). The Institutional Review Board (IRB) at JUST/KAUH waived the requirement for informed consent, as the data were extracted retrospectively from electronic patient records, with no direct interaction or intervention involving the patients. All patient data were anonymized to ensure confidentiality and protect their privacy. The study adhered to the principles of the Declaration of Helsinki.

### Study Population and Setting

Electronic medical records of older adult patients ( $\geq 65$  years old) who visited various outpatient clinics (mainly psychiatric, endocrine, and cardiovascular clinics) at King Abdullah University Hospital (KAUH) in the last 5.5 years (1-1-2019 to 1-6-2024) were evaluated for further analysis.

### Study Design and Data Collection

This retrospective study assessed the electronic medical records of older adult patients who received outpatient clinic services (diagnosis, treatment, and follow-up). Data included patient demographics (age, sex, and social characteristics), past and current medical history, chronically administered medications.

The Polypharmacy was defined and categorized into three levels: mild polypharmacy (concurrent use of 2–4 medications), major polypharmacy (concurrent use 5–9 medications), and excessive polypharmacy (concurrent use of 10 or more medications).<sup>10–12</sup>

The MAGS was evaluated based on the list of medications previously documented to be associated with an increased incidence of geriatric syndromes.<sup>9</sup>

### Sample Size Calculation

At least 385 medical records pertaining to older adult patients were needed to achieve a 95% confidence interval with a margin of error of 5%. Population proportion will be considered equal to 50% to obtain the maximum possible number of records to include in this study.<sup>13</sup> To enhance and ensure the generalizability of the data, the investigators included all eligible patients' records (1087) during the assessment period.

### Statistical Analysis

Descriptive statistics were presented, medians and 25–75 percentiles were applied for continuous variables, percentages and frequencies were used for categorical variables, and the frequency of MAGS prescriptions was evaluated. A quantile

regression model was applied to evaluate variables associated with MAGS prescription frequency, including age, sex, number of comorbidities, and polypharmacy status. Statistical significance was set at a threshold of  $P < 0.05$ . Data analysis was performed using SPSS software.

## Results

The social and demographic profiles of older adult patients are presented in Table 1. This study included 1087 patients (52.7% females). The median age of patients was 71 (68–77). A significant proportion of patients had peptic ulcer disease (PUD) (57.1%), hypertension (54.65%), and uncomplicated diabetes mellitus (50%). Moreover, 14.9% of the patients had minor polypharmacy, 38.3% had major polypharmacy, and 41.6% had excessive polypharmacy. Finally, the median number of medications was 8 (5–12).

The classes of medications associated with MAGS in the studied patients are shown in Table 2. Most of them were taking antihypertensives (78.4%), non-opioid non-steroidal anti-inflammatory and/or analgesics (56.5%), and antidiabetics (51.8%).

As shown in Table 3, The majority of MAGS were linked to increased risks of falls (96%), followed by urinary incontinence (87.6%), depression (87.3%), unintentional weight and appetite loss (69.4%), cognitive impairment (53.6%), and delirium (53.5%).

A quantile regression model was fitted to identify the variables that were significantly associated with more MAGS prescriptions (Table 4). The results showed that patients who were on minor polypharmacy medication regimens or major polypharmacy regimens showed a significantly lower number of MAGS compared with patients who had excessive polypharmacy (coefficient =−3.000, 95% CI (−3.322, −2.678),  $p < 0.001$ ; coefficient =−2.000, 95% CI (−2.230, −1.770),  $p < 0.001$ , respectively).

**Table 1** Socio-Demographic Profiles of the Study Participants (n=1087)

		Number (%) or median (25–75) percentiles
Age		71 (68–77)
Gender	Female	573 (52.7%)
	Male	514 (47.3%)
Hypertension		594 (54.6%)
Dyslipidemia		68 (6.3%)
Chronic Kidney Diseases		66 (6.1%)
Heart Failure		467 (43%)
Myocardial Infarction		177 (16.3%)
Stroke		133 (12.2%)
Peripheral Vascular Diseases		5 (0.5%)
Chronic Obstructive Pulmonary Disease		55 (5.1%)
Leukemia		14 (1.3%)
Lymphoma		10 (0.9%)
Chronic Kidney Disease		80 (7.4%)
Peptic Ulcer Disease		621 (57.1%)
Localized Solid tumor		124 (11.4%)

(Continued)

**Table 1** (Continued).

	Number (%) or median (25–75) percentiles
Metastatic solid tumor	12 (1.1%)
Mild liver disease chronic hepatitis or cirrhosis without portal hypertension	20 (1.8%)
Diabetes Mellitus - uncomplicated	544 (50%)
Diabetes Mellitus with organ damage	173 (15.9%)
Hypothyroidism	58 (5.3%)
Asthma	95 (8.7%)
Deep Venous Thrombosis	73 (6.7%)
Benign Prostatic Hyperplasia	142 (13.1%)
Atrial Fibrillation	18 (1.7%)
Ischemic Heart Diseases	145 (13.3%)
Osteoporosis	109 (10%)
Single medication	57 (5.2%)
Minor polypharmacy (2–4 drugs)	157 (14.9%)
Major polypharmacy (5–9 drugs)	416 (38.3%)
Excessive polypharmacy ( $\geq 10$ drugs)	452 (41.6%)
Number of comorbidities per patient	3 (2–5)
Number of medications per patient	8 (5–12)

**Table 2** Frequency of Medication Classes Associated with Geriatric Syndromes for the Study Participants

Drug Class/Category associated with Potential Risk of Geriatric Syndromes	Number and percentage of patients (n=1087) receiving $\geq 1$ MAGS*
Antiarrhythmic	29 (2.7%)
Anticholinergics and/or Antihistamines	192 (17.7%)
Antidepressants	19 (1.7%)
Antidiabetics	563 (51.8%)
Antiemetics	19 (1.7%)
Antiepileptics	187 (17.2%)
Antihypertensives	852 (78.4%)
Antimicrobials	78 (7.2%)
Antiparkinsonism	25 (2.3%)
Antipsychotics	6 (0.6%)
Benzodiazepines	55 (5.1%)

(Continued)

**Table 2** (Continued).

Drug Class/Category associated with Potential Risk of Geriatric Syndromes	Number and percentage of patients (n=1087) receiving $\geq 1$ MAGS*
Hormone Replacement	207 (19%)
Immunosuppressants	48 (4.4%)
Muscle Relaxers	16 (1.5%)
Non-opioid Non-Steroidal Anti-inflammatory and/or Analgesics	614 (56.5%)
Opioid agonists	59 (5.4%)
Others	246 (22.6%)

**Note:** \*MAGS: Medications Associated with Geriatric Syndromes.

**Table 3** Number and Percentage of Patients Who Received Medications Associated with Specific Geriatric Syndromes

Medications associated with Geriatric Syndromes	Number and percentage of patients (n=1087)
Medications associated with Delirium	582 (53.5%)
Medications associated with Cognitive Impairment	583 (53.6%)
Medications associated with Falls	1043 (96%)
Medications associated with Unintentional Weight and appetite loss	754 (69.4%)
Medications associated with Urinary Incontinence	952 (87.6%)
Medications associated with Depression	949 (87.3%)

**Table 4** Quantile Regression of the Variables Associated with Prescription Frequency of Medications Associated with Geriatrics Syndromes

Parameter		Coefficient	Std. Error	T	Df	*P-value	95% Confidence Interval	
							Lower Bound	Upper Bound
(Intercept)		6.000	0.5915	10.144	1081	<0.001	4.839	7.161
Age		−9.658E-17	0.0078	<0.001	1081	1.000	−0.015	0.015
Number of comorbidities per patient		9.806E-16	0.0319	<0.001	1081	1.000	−0.063	0.063
Gender	Female	−4.512E-16	0.0954	<0.001	1081	1.000	−0.187	0.187
	Male	(REF)						
Polypharmacy	Minor polypharmacy (2–4 drugs)	−3.000	0.1642	−18.270	1081	<0.001	−3.322	−2.678
	Major polypharmacy (5–9 drugs)	−2.000	0.1172	−17.060	1081	<0.001	−2.230	−1.770
	Excessive polypharmacy (≥10 rugs)	(REF)						

**Note:** \*Significance set at  $p < 0.05$ .

## Discussion

This study assessed the prevalence of medications associated with geriatric syndrome (MAGS) in a cohort of 1087 older adult patients. Furthermore, we identified factors, including polypharmacy, which were associated with increased levels of MAGS prescription among the same population presenting various chronic comorbidities.

The median patient age was 71 years. The most common chronic conditions encountered in this study included peptic ulcer disease (57.1%), hypertension (54.65%), and uncomplicated diabetes mellitus (50%). Polypharmacy was prevalent in 94.8% of the patients, while excessive polypharmacy was observed in 41.6%. The median number of medications taken by the patients was 8, which is consistent with other studies reporting a high burden of polypharmacy in older adults.<sup>14,15</sup>

Our findings on the prevalence of excessive polypharmacy are in line with the global rate variation reported in the literature, where the prevalence of excessive polypharmacy has been found to range from 8.67% to 31%, underscoring the widespread occurrence of this issue among the older adult patients.<sup>16–18</sup>

This study demonstrated that antihypertensive medications were the most frequently prescribed MAGS. In a study from Malaysia, vasodilating antihypertensive agents were the second most prescribed MAGS.<sup>19</sup> Similarly, the Malaysian study identified opioid analgesics as the most frequently prescribed MAGS. In contrast, our findings revealed a notably lower prevalence of opioid analgesic prescriptions, potentially due to differences in patients-centered factors, prescribers' attitudes toward pain definition and criteria for prescribing opioids.<sup>20</sup> Additionally, healthcare providers in Jordan tend to prioritize non-steroidal anti-inflammatory drugs (NSAIDs) as a primary treatment option over opioids. Moreover, this current study revealed that antidepressants, antipsychotics, and muscle relaxants were among the least frequently prescribed medications associated with MAGS, despite the relatively significant prevalence of depression, psychosocial and physical distress among older adults in Jordan.<sup>21–23</sup> This finding could be explained by the fact that healthcare providers often focus primarily on managing major chronic conditions, thus, mental health issues may be overlooked, leading to a lower prescribing frequency of antidepressants and other medications used to manage psychological and physical health conditions, which results in a lower reported prevalence of MAGS among older adult patients.

The rate of prescribing medications associated with geriatric syndromes (MAGS) varied significantly, with 96% of patients being prescribed medications associated with risk of falls and 53.5% associated with delirium risk. Falls, the most common AGS in our cohort, are a well-documented consequence of polypharmacy, particularly the use of antihypertensive and non-opioid analgesics, which were frequently prescribed in our study.

The prevalence rates of MAGS observed in our study showed variations compared to findings from previous studies. For example, similarly high rates of medication associated with fall prescriptions have been reported previously, where falls were the most common medication-associated syndrome, and every patient in the sample had at least one discharge medication associated with this syndrome.<sup>9</sup> Another study from Japan found that impaired appetite was the most common AGS in the geriatric population.<sup>24</sup>

However, the prescription rate of medications associated with delirium and cognitive impairment (53.5% and 53.6%, respectively) observed in our study, although lower than that for falls and other geriatric syndromes, still represents a significant risk. This is in line with a previous report that delirium and cognitive impairment are common but less prevalent in MAGS than in falls.<sup>9</sup> The relatively lower prevalence of the two MAGs, delirium, and cognitive impairment in our study compared to falls may be attributed to differences in the types of medications used or the underlying health conditions of the older adult patients. Nonetheless, the presence of medications associated with either delirium or cognitive impairment in over half of our patient population indicates the need to implement focused strategies that prioritize careful monitoring and adjustment of prescriptions, including MAGs, for older adult patients, ensuring that potential risks are minimized while maintaining therapeutic efficacy.

The regression analysis in this study further highlighted the impact of excessive polypharmacy on the prescription of MAGs. Patients with excessive polypharmacy were found to have a significantly higher number of MAGs than those with minor or major polypharmacy. This finding is consistent with the existing literature, which suggests that the likelihood of geriatric syndrome increases with the number of prescribed medications. A longitudinal study from England demonstrated a similar trend, where major polypharmacy existed in nearly one-third of study population was significantly associated with a 21% higher rate of falls over a period of 2 years. Another prospective cohort study reported that excessive polypharmacy was significantly associated with decreased functional and cognitive capabilities in contrast to the non-polypharmacy cohort.<sup>25</sup>

## Study Limitations

This study had several limitations. First, the sample was obtained only from outpatient clinics at a single medical center, which may limit the applicability of the findings to other medical settings. However, KAUH serves more than 20% of the population who reside nearby and have access to healthcare facilities there. Second, the retrospective nature of the study may introduce bias, as it relies on previously collected data, which could affect the accuracy and completeness of the information. However, the research teams ensured that completed patients records with all necessary data were included to achieve the study objectives.

## Conclusion

This study highlights the significant impact of excessive polypharmacy in older adult patients, demonstrating its major role in increasing the prescription pattern of MAGS. The significant correlation between excessive polypharmacy and the prevalence of MAGS, such as falls, urinary incontinence, and depression, emphasizes the complexity of managing multiple chronic conditions among older adult patients such as cardiovascular diseases, hypertension, and diabetes. Efforts to manage these comorbidities are often associated with increased MAGS prescribing, which complicates treatment regimens and elevates the risk of adverse events. These findings indicate the necessity for effective measures to reduce polypharmacy and optimize medication use, with the aim of reducing the MAGS and enhancing health-related outcomes in geriatric patients.

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## Disclosure

The authors report no conflicts of interest in this work.

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