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POLYPHARMACY AND POTENTIALLY INAPPROPRIATE MEDICATION USE AMONG ELDERLY PATIENTS IN A TERTIARY CARE HOSPITAL IN NORTH INDIA: A CROSS-SECTIONAL OBSERVATIONAL STUDY

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ABSTRACT

Background: Population ageing has led to an increasing prevalence of chronic diseases requiring long-term pharmacotherapy. Elderly patients frequently receive multiple medications, predisposing them to polypharmacy and potentially inappropriate medication (PIM) use. Such prescribing practices are associated with adverse drug reactions, drug interactions, increased healthcare utilization, and poor clinical outcomes. Data regarding the prevalence of polypharmacy and PIM use among elderly patients in tertiary care settings of North India remain limited.

Objectives: To assess the prevalence of polypharmacy and potentially inappropriate medication use among elderly patients attending a tertiary care hospital in North India and to evaluate the association between polypharmacy and PIM use.

Methods: A hospital-based cross-sectional observational study was conducted from September 2023 to December 2023 among 34 elderly patients aged 60 years and above attending the medicine outpatient department or admitted to medical wards of a tertiary care hospital in North India. Data regarding demographic characteristics, comorbidities, and prescribed medications were collected using a structured case record form. Polypharmacy was defined as the concurrent use of five or more medications. Potentially inappropriate medications were identified using the American Geriatrics Society Beers Criteria 2023. Statistical analysis was performed using SPSS version 26.0. Associations between categorical variables were assessed using the Chi-square test, and a p-value <0.05 was considered statistically significant.

Results: The mean age of the participants was 68.7 ±6.5 years, and 55.9% were male. Most patients had two or more comorbidities, with hypertension (64.7%) and diabetes mellitus (47.1%) being the most common conditions. The mean number of prescribed medications was 6.4 ±2.1. Polypharmacy

was observed in 24 (70.6%) patients. Potentially inappropriate medications were identified in 11 (32.4%) patients, with long-acting benzodiazepines, prolonged proton pump inhibitor use, first-generation antihistamines, and non-steroidal anti-inflammatory drugs being the most frequently encountered PIMs. A significant association was observed between polypharmacy and PIM use (p=0.048), indicating a higher likelihood of inappropriate prescribing among patients receiving multiple medications.

Conclusion: Polypharmacy and potentially inappropriate medication use are common among elderly patients in tertiary care settings. The significant relationship between polypharmacy and PIM use emphasizes the need for regular medication review, application of geriatric prescribing criteria, and multidisciplinary approaches to optimize pharmacotherapy and enhance patient safety in older adults.

Keywords: Polypharmacy; Potentially Inappropriate Medications; Elderly Patients; Beers Criteria; Geriatric Pharmacotherapy; Prescription Pattern; Drug Utilization

INTRODUCTION

The global population is ageing rapidly, with the number of individuals aged 60 years and above increasing substantially due to improvements in healthcare and life expectancy. Ageing is frequently accompanied by multiple chronic diseases such as hypertension, diabetes mellitus, ischemic heart disease, chronic kidney disease, and chronic obstructive pulmonary disease, necessitating the use of multiple medications for disease management [1]. While appropriate pharmacotherapy contributes significantly to improved health outcomes and quality of life among older adults, the concurrent use of multiple medications may also increase the risk of adverse drug events, medication non-adherence, drug-drug interactions, and healthcare utilization [2].

Polypharmacy, commonly defined as the simultaneous use of five or more medications, has emerged as a major public health concern among elderly patients worldwide [3]. The prevalence of polypharmacy has increased steadily over recent decades owing to the rising burden of chronic diseases and expanding therapeutic options. Although polypharmacy may be clinically justified in many circumstances, inappropriate polypharmacy can expose elderly patients to substantial risks due to age-related pharmacokinetic and pharmacodynamic changes that alter drug metabolism and response [4].

Potentially inappropriate medications (PIMs) refer to drugs for which the risks may outweigh the benefits in older adults, particularly when safer or more effective alternatives are available. Several explicit screening tools have been developed to identify PIM use in geriatric populations, among which the Beers Criteria developed by the American Geriatrics Society is one of the most widely accepted and validated instruments [5]. The use of PIMs has been associated with increased incidence of falls, cognitive impairment, hospitalization, prolonged hospital stay, healthcare expenditure, and mortality among older adults [6].The burden of polypharmacy and inappropriate prescribing is particularly significant in low- and middle-income countries, where healthcare systems often face challenges related to fragmented care, limited medication review services, and inadequate geriatric pharmacotherapy expertise [7]. In India, the elderly population is expanding rapidly, creating new challenges for healthcare providers in ensuring rational prescribing practices. Older adults frequently seek care from multiple specialists, leading to complex medication regimens and increased risk of therapeutic duplication and drug interactions [8].

Hospitalized elderly patients represent a particularly vulnerable group because they often have multiple comorbidities requiring intensive pharmacological management. Tertiary care hospitals receive patients with complex medical conditions who are likely to be exposed to a higher number of medications during hospitalization. Despite growing awareness of medication-related problems in older adults, evidence regarding the prevalence and patterns of polypharmacy and potentially inappropriate medication use in North Indian tertiary care settings remains limited. Existing studies

have reported varying estimates due to differences in patient populations, study settings, and assessment criteria [9].

Understanding the magnitude of polypharmacy and PIM use in elderly patients is essential for developing targeted interventions aimed at improving prescribing quality and patient safety. Identification of commonly prescribed potentially inappropriate medications and factors associated with their use can assist clinicians in optimizing medication regimens and reducing preventable adverse outcomes. Such evidence is particularly relevant for tertiary care hospitals where elderly patients often receive complex treatment regimens and are at greater risk of medication-related harm [10]. Therefore, the present study was undertaken to assess the prevalence of polypharmacy and potentially inappropriate medication use among elderly patients attending a tertiary care hospital in North India. The specific objectives were to determine the pattern of medication use, evaluate the prevalence of polypharmacy, identify potentially inappropriate medications using established prescribing criteria, and examine the association between polypharmacy and potentially inappropriate medication use in the study population.

METHODOLOGY

Study Design: This study was a hospital-based observational cross-sectional study conducted to assess the prevalence of polypharmacy and potentially inappropriate medication (PIM) use among elderly patients attending a tertiary care hospital in North India. The study was designed and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Study Setting: The study was conducted in the Department of Medicine and associated inpatient and outpatient services of a tertiary care teaching hospital in North India. The hospital caters to a large population from both urban and rural areas and provides specialized healthcare services for elderly patients with multiple chronic diseases.

Study Duration: The study was conducted over a period of four months from September 2023 to December 2023.

Study Population: The study population comprised elderly patients aged 60 years and above who attended the medicine outpatient department or were admitted to the medical wards during the study period and were receiving one or more medications for the management of acute or chronic illnesses.

Inclusion Criteria

Patients aged ≥60 years.
Patients receiving at least one prescribed medication.
Patients willing to participate and provide written informed consent.
Patients with complete prescription and clinical records available for review.

Exclusion Criteria

Patients aged less than 60 years.
Critically ill patients unable to provide reliable information and without a legally authorized representative.
Patients with incomplete medical or prescription records.
Patients who declined to provide informed consent.
Patients admitted for less than 24 hours.

Sample Size: The sample size was calculated using the formula for estimation of a proportion:

$n = Z^2 \times p \times q / d^2$

Where:

n = required sample size
Z = 1.96 at 95% confidence level
p = expected prevalence of polypharmacy among elderly patients

$q = 1 - p$
d = absolute precision

Considering an expected prevalence of polypharmacy of 70% based on previous literature, with 15% absolute precision:

$n = (1.96)^2 \times 0.70 \times 0.30 / (0.15)^2$

$n \approx 36$

During the study period, 34 eligible elderly patients fulfilling the inclusion criteria were enrolled consecutively. The achieved sample size was therefore 34 participants.

Sampling Technique: A consecutive sampling technique was employed. All eligible elderly patients presenting during the study period were screened, and those fulfilling the eligibility criteria were included until the end of the study period.

Data Collection Tools and Procedure: Data were collected using a predesigned and pretested case record form. Information regarding demographic characteristics (age, sex), clinical diagnoses, comorbid conditions, number of medications prescribed, therapeutic classes of drugs, and duration of treatment was obtained from patient interviews, prescription records, and medical case files. Polypharmacy was defined as the concurrent use of five or more medications. Potentially inappropriate medication use was assessed using the American Geriatrics Society Beers Criteria 2023. Each prescription was reviewed independently for the presence of medications considered potentially inappropriate for older adults. Any ambiguity in classification was resolved through consultation with the treating physician and pharmacology faculty.

Study Variables: The independent variables included age, sex, number of comorbidities, type of comorbid conditions, and total number of prescribed medications. The dependent variables were the presence of polypharmacy and the occurrence of potentially inappropriate medication use according to Beers Criteria. Additional variables evaluated included therapeutic drug classes prescribed and the number of PIMs identified per patient. These variables were analyzed to determine patterns of medication use and their relationship with inappropriate prescribing among elderly patients.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were summarized using mean and standard deviation or median and interquartile range as appropriate. Categorical variables were expressed as frequencies and percentages. Associations between categorical variables such as polypharmacy and PIM use were assessed using the Chi-square test or Fisher's exact test whenever appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: Written informed consent was obtained from all participants before enrollment. Confidentiality and anonymity of patient information were maintained throughout the study by assigning unique identification numbers and restricting access to study records. Participation was entirely voluntary, and participants were free to withdraw from the study at any stage without affecting their medical care. The study adhered to the ethical principles outlined in the Declaration of Helsinki and subsequent amendments governing research involving human participants.

RESULTS

Among the 34 elderly patients studied, the majority belonged to the 60–69-year age group and more than three-fourths had at least two comorbid conditions (Table 1).

A total of 34 elderly patients were included in the study. The mean age of the participants was 68.7 ±6.5 years (range: 60–85 years). Males constituted a slight majority of the study population. Most patients had two or more comorbid conditions, with hypertension and diabetes mellitus being the most common diagnoses. Polypharmacy (≥5 medications) was observed in a substantial proportion of patients. Potentially inappropriate medications (PIMs) were identified according to the American Geriatrics Society Beers Criteria 2023.

Table 1. Demographic and Clinical Characteristics of Study Participants (N=34)

Characteristic	Category	Frequency (n)	Percentage (%)
Age (years)	60–69	18	52.9
	70–79	11	32.4
	≥80	5	14.7
Sex	Male	19	55.9
	Female	15	44.1
Number of Comorbidities	1	7	20.6
	2	14	41.2
	≥3	13	38.2
Mean age (years)	Mean ± SD	68.7 ± 6.5	—

Hypertension was the most frequently encountered comorbidity, followed by diabetes mellitus and dyslipidemia (Table 2).

Table 2. Distribution of Common Comorbid Conditions among Elderly Patients (N=34)

Comorbid Condition*	Number of Patients (n)	Percentage (%)
Hypertension	22	64.7
Diabetes mellitus	16	47.1
Ischemic heart disease	9	26.5
Chronic kidney disease	5	14.7
Chronic obstructive pulmonary disease	6	17.6
Osteoarthritis	8	23.5
Dyslipidemia	11	32.4

*Multiple responses possible.

The mean number of prescribed medications per patient was 6.4 ±2.1, and polypharmacy was observed in over two-thirds of the study population (Table 3)

Table 3. Medication Use Pattern and Prevalence of Polypharmacy (N=34)

Variable	Category	Frequency (n)	Percentage (%)
Number of medications prescribed	<5 drugs	10	29.4
	5–8 drugs	17	50.0
	>8 drugs	7	20.6
Polypharmacy status	Yes (≥5 drugs)	24	70.6
	No (<5 drugs)	10	29.4
Mean number of medications	Mean ± SD	6.4 ± 2.1	—

Potentially inappropriate medications were identified in approximately one-third of patients, with long-acting benzodiazepines and prolonged proton pump inhibitor use being the most commonly encountered PIMs (Table 4)

Table 4. Potentially Inappropriate Medication Use According to Beers Criteria 2023 (N=34)

Variable	Frequency (n)	Percentage (%)
Patients with at least one PIM	11	32.4
Patients without PIM	23	67.6
Total number of PIMs identified	14	—

Common Potentially Inappropriate Medications Identified

Medication Class	Number of PIMs (n)
Long-acting benzodiazepines	4
Proton pump inhibitors (long-term use)	3
First-generation antihistamines	3
Non-steroidal anti-inflammatory drugs	2
Sulfonylureas (glibenclamide)	2

A statistically significant association was observed between polypharmacy and potentially inappropriate medication use. Elderly patients exposed to polypharmacy were more likely to receive at least one potentially inappropriate medication compared with those receiving fewer than five medications (Table 5).

Table 5. Association Between Polypharmacy and Potentially Inappropriate Medication Use (N=34)

Polypharmacy Status	PIM Present n (%)	PIM Absent n (%)	Total	p-value
Polypharmacy (n=24)	10 (41.7)	14 (58.3)	24	
Non-polypharmacy (n=10)	1 (10.0)	9 (90.0)	10	0.048*
Total	11	23	34	

*Chi-square test; $p < 0.05$ considered statistically significant.

DISCUSSION

The present hospital-based cross-sectional study evaluated the prevalence of polypharmacy and potentially inappropriate medication (PIM) use among elderly patients attending a tertiary care hospital in North India. The study demonstrated a high prevalence of polypharmacy, with more than two-thirds of participants receiving five or more medications. Approximately one-third of the patients were prescribed at least one potentially inappropriate medication according to the American Geriatrics Society Beers Criteria 2023. Furthermore, a statistically significant association was observed between polypharmacy and PIM use, highlighting the increased vulnerability of elderly patients exposed to multiple medications.

The high prevalence of polypharmacy observed in the present study is consistent with global evidence indicating that medication burden increases substantially with advancing age and multimorbidity [2,10]. The majority of participants in our study had two or more chronic conditions, particularly hypertension and diabetes mellitus, necessitating the use of multiple therapeutic agents. Similar findings have been reported in studies conducted in both developed and developing countries, where the coexistence of cardiovascular, metabolic, and musculoskeletal disorders contributes significantly to polypharmacy among older adults [6,10]. The observed prevalence also aligns with previous Indian studies that have documented a substantial burden of polypharmacy among elderly patients attending tertiary healthcare facilities [8,9].

Hypertension emerged as the most common comorbidity in the study population, followed by diabetes mellitus and dyslipidemia. These findings are in agreement with epidemiological data demonstrating that cardiovascular and metabolic disorders represent the predominant chronic illnesses among older adults in India and worldwide [1,7]. The clustering of these conditions frequently requires multidrug therapy in accordance with contemporary clinical practice guidelines, thereby increasing the likelihood of complex medication regimens.

Potentially inappropriate medications were identified in nearly one-third of study participants. This prevalence falls within the range reported in previous hospital-based studies involving elderly populations and suggests that inappropriate prescribing remains a significant concern despite growing awareness of geriatric pharmacotherapy principles [5,9]. Long-acting benzodiazepines constituted the

most commonly identified PIMs in the present study. Their continued use may be attributed to the management of insomnia, anxiety disorders, and other neuropsychiatric conditions in older adults. However, these medications are associated with an increased risk of falls, cognitive impairment, delirium, and fractures, making them unsuitable for routine use in many elderly patients [5].

Long-term use of proton pump inhibitors also represented a notable proportion of identified PIMs. Although these agents are commonly prescribed for gastroprotection and acid-related disorders, prolonged therapy without clear indications has been associated with adverse outcomes such as osteoporosis-related fractures, nutrient deficiencies, and infections [5]. Similar prescribing patterns have been documented in previous studies evaluating medication appropriateness among hospitalized older adults [11]. The identification of first-generation antihistamines and certain non-steroidal anti-inflammatory drugs as PIMs further emphasizes the need for regular medication review and deprescribing initiatives.

One of the most important findings of the present study was the significant association between polypharmacy and PIM use. Patients receiving five or more medications were considerably more likely to receive at least one potentially inappropriate medication. This observation is consistent with previous investigations demonstrating that the probability of prescribing errors, drug-drug interactions, and inappropriate medications increases with the number of prescribed drugs [12]. As medication regimens become increasingly complex, clinicians may face challenges in balancing therapeutic benefits against potential harms, particularly in elderly patients with multiple comorbidities.

The findings of this study have important clinical and public health implications. Routine medication review using validated tools such as the Beers Criteria can facilitate early identification of inappropriate prescriptions and improve medication safety among older adults. Multidisciplinary approaches involving physicians, clinical pharmacologists, pharmacists, and nursing staff may contribute to optimizing pharmacotherapy and reducing medication-related adverse events. In resource-constrained healthcare settings, targeted interventions aimed at minimizing unnecessary polypharmacy may improve patient outcomes while reducing healthcare expenditure.

The study possesses several strengths. It employed a standardized and internationally recognized screening tool for identifying potentially inappropriate medications and assessed prescribing practices in a real-world tertiary care setting. The study also explored the relationship between polypharmacy and inappropriate prescribing, thereby providing clinically relevant information for healthcare providers managing elderly patients.

However, certain limitations should be acknowledged. The study was conducted at a single tertiary care center and involved a relatively small sample size, which may limit the generalizability of the findings. The cross-sectional design precludes causal inference between polypharmacy and PIM use. In addition, medication appropriateness was evaluated using Beers Criteria alone, and other validated instruments such as STOPP/START criteria were not applied. Future multicenter studies with larger sample sizes and longitudinal follow-up are warranted to better understand prescribing trends and the long-term consequences of potentially inappropriate medication use among elderly Indian patients.

CONCLUSION

The present study highlights a substantial burden of polypharmacy and potentially inappropriate medication use among elderly patients attending a tertiary care hospital in North India. More than two-thirds of the study participants were exposed to polypharmacy, while nearly one-third received at least one potentially inappropriate medication according to the American Geriatrics Society Beers Criteria 2023. Hypertension and diabetes mellitus were the most common comorbid conditions contributing to increased medication use. Long-acting benzodiazepines, prolonged proton pump inhibitor therapy, and first-generation antihistamines were among the frequently identified potentially inappropriate medications.A significant association between polypharmacy and potentially inappropriate medication use underscores the need for careful medication review in older adults.

Regular assessment of prescriptions using validated screening tools, along with multidisciplinary interventions and rational prescribing practices, may reduce medication-related risks and improve patient safety. Future multicentric studies with larger sample sizes are recommended to further evaluate prescribing patterns and develop effective strategies for optimizing pharmacotherapy in the growing elderly population.

DECLARATIONS

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Conflict of Interest: The authors declare that there are no conflicts of interest related to this study.

Informed Consent: Written informed consent was obtained from all participants before enrollment in the study.

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