ISSN: 2584-282X

INTERNATIONAL JOURNAL OF TRENDS IN EMERGING RESEARCH AND DEVELOPMENT

# Publication Certificate

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**Authored by**

Dr. Utkarsh Mishra

In the recognition of the paper titled **"Investigation of drug interactions and adverse effects in polypharmacy among elderly patients"** has been published in Volume **3** Issue **1** Page Number: **122-126**, **International Journal of Trends in Emerging Research and Development.**

**Certificate Number:** 3-3-35

**Authorized By:**
**Publisher:** **Vipin**

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**ISSN No:** 2584-282X
**Peer Reviewed Journal**


**INTERNATIONAL JOURNAL OF TRENDS IN EMERGING RESEARCH AND DEVELOPMENT**

**Volume 3; Issue 1; 2025; Page No. 122-126**

**Received: 09-11-2024**
**Accepted: 23-12-2024**

# Investigation of drug interactions and adverse effects in polypharmacy among elderly patients

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**DOI:** https://doi.org/10.5281/zenodo.15617110

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**Abstract**

Polypharmacy, defined as the concurrent use of five or more medications, is highly prevalent among elderly patients due to the increasing incidence of chronic illnesses such as hypertension, diabetes, arthritis, and cardiovascular diseases. While necessary for managing multimorbidity, polypharmacy significantly raises the risk of drug-drug interactions (DDIs) and adverse drug reactions (ADRs), thereby compromising patient safety and therapeutic outcomes. This cross-sectional study was conducted among 250 elderly patients in tertiary healthcare settings to investigate the prevalence and clinical impact of DDIs and ADRs. Data were collected using validated tools, including medication review forms, the Naranjo Algorithm for ADR assessment, and drug interaction screening software. Findings revealed that over half of the patients had 3–4 comorbid conditions, and a considerable proportion (20%) were on ten or more medications. Moderate and major DDIs were identified in 50% and 26% of the population, respectively. Gastrointestinal disturbances, dizziness, and hypoglycemia emerged as the most common ADRs. Statistical analysis demonstrated a significant association between the number of medications and ADR occurrence ($p = 0.001$). Logistic regression identified ≥10 medications, age >75, use of anticoagulants, and >3 comorbidities as strong predictors of ADRs. These findings underscore the urgent need for routine medication review, use of digital interaction tools, and individualized therapeutic strategies to ensure safer pharmacological care for the elderly.

**Keywords:** Polypharmacy, drug-drug interactions (DDIs), hypoglycemia, multimorbidity, chronic illnesses

## Introduction

Polypharmacy, generally defined as the concurrent use of five or more medications, is increasingly prevalent among the elderly due to the rising burden of chronic diseases such as hypertension, diabetes, arthritis, and cardiovascular disorders (Maher *et al*., 2014) [5]. With advancing age, patients often require complex therapeutic regimens to manage multiple coexisting conditions, thereby increasing the likelihood of drug-drug interactions (DDIs) and adverse drug reactions (ADRs). These interactions not only compromise therapeutic efficacy but can also lead to serious clinical consequences including hospitalization, cognitive impairment, falls, and even mortality (Patterson *et al*., 2012) [7].

The pharmacokinetics and pharmacodynamics of drugs are significantly altered in elderly individuals due to physiological changes such as reduced renal and hepatic function, decreased lean body mass, and altered receptor sensitivity (Mangoni & Jackson, 2004) [6]. These factors make the elderly more susceptible to both predictable and unpredictable adverse effects. Moreover, inappropriate prescribing and lack of routine medication review contribute to a higher risk of polypharmacy-related complications (Gnjidic *et al*., 2012) [2]. A number of commonly used medications, including anticoagulants, NSAIDs, antidiabetics, and psychotropics, are frequently implicated in adverse drug events among the elderly population.

Research indicates that nearly 20% of hospital admissions in older adults are drug-related, and approximately half of these are preventable (Budnitz *et al*., 2011) [1]. Despite these

alarming statistics, polypharmacy is often a necessary component of elderly care, underscoring the need for a careful, individualized approach to pharmacotherapy. Investigation into the patterns and outcomes of drug interactions, as well as the identification of high-risk medications and combinations, is crucial for minimizing harm and optimizing the quality of life in geriatric populations.

The present study aims to explore the prevalence and consequences of drug interactions and adverse effects in polypharmacy among elderly patients. By identifying commonly encountered drug combinations and evaluating clinical outcomes, the research intends to inform evidence-based interventions for safer prescribing practices and improved geriatric care.

## Literature Review

Le Couteur *et al*. (2020) [4] explored the growing complexity of managing medications in geriatric patients due to age-related physiological changes, multimorbidity, and the use of multiple drugs. The review found that elderly patients are particularly vulnerable to pharmacokinetic and pharmacodynamic interactions. Drugs such as warfarin, digoxin, NSAIDs, and certain antidiabetic agents were identified as having high interaction potential, especially when combined with other commonly prescribed drugs. The study emphasized the importance of careful monitoring and periodic medication review to reduce adverse outcomes and recommended integrating pharmacogenomic data into clinical practice to predict drug responses better.

Johnell and Fastbom (2021) [3] reviewed the prevalence and determinants of potentially inappropriate medications (PIMs) in older adults, showing that polypharmacy often includes medications that offer little clinical benefit or pose significant risks. The review underscored that poor renal function and cognitive decline in the elderly alter drug metabolism, contributing to higher ADR risk. The authors proposed using structured tools such as the Beers Criteria and STOPP/START to improve prescription quality. They also advocated for the involvement of pharmacists and the use of electronic health records to alert clinicians to potential DDIs.

Rankin *et al*. (2020) [8] conducted a systematic review of intervention strategies aimed at optimizing polypharmacy in older adults. They categorized interventions into medication reviews, clinical decision support systems, educational outreach, and multidisciplinary team approaches. The findings indicated that pharmacist-led medication reviews significantly reduced the number of PIMs and improved medication adherence. Moreover, the study highlighted that digital tools offering real-time alerts about drug interactions enhanced prescribing accuracy and minimized ADRs. The authors recommended implementing routine medication review programs in primary and long-term care settings.

Shrestha and Poudel (2022) [9] examined the direct health consequences of polypharmacy in elderly patients, including increased hospital admissions, prolonged hospital stays, and elevated mortality rates. Their systematic review analyzed data from over 30 studies across various countries. A key finding was that patients taking more than five medications had a 30% higher risk of hospitalization due to ADRs, particularly related to cardiovascular and psychotropic medications. The authors concluded that a comprehensive risk assessment model, combined with individualized deprescribing plans, is critical for preventing harm in geriatric pharmacotherapy.

Zazzara *et al*. (2023) [10] reviewed how multimorbidity exacerbates the challenges of safe prescribing in the elderly. The review outlined how therapeutic decisions become complicated when patients are treated for multiple chronic conditions, increasing the risk of drug-drug and drug-disease interactions. They identified common interaction-prone drug classes, including anticholinergics, diuretics, and antidepressants, and discussed their compounded risks in patients with cognitive impairment or frailty. The authors recommended integrated geriatric assessment, personalized care planning, and continuous medication reconciliation as pivotal strategies to manage polypharmacy safely.

## Research Methodology

### Research Design

The present study adopts a descriptive cross-sectional design to investigate the prevalence, types, and clinical consequences of drug-drug interactions (DDIs) and adverse drug reactions (ADRs) among elderly patients practicing polypharmacy. This design enables the collection of real-time data from a defined population to determine associations between polypharmacy and health outcomes, without manipulating variables. It also facilitates the identification of prescribing patterns and potential risk factors in a natural healthcare setting.

### Study Setting and Population

The study were conducted in geriatric outpatient departments and inpatient wards of tertiary care hospitals. The target population includes patients aged 65 years and above, who are currently prescribed five or more medications for chronic diseases such as diabetes, hypertension, arthritis, and cardiovascular disorders. Patients with terminal illness, mental disorders impairing informed consent, or those admitted for acute trauma were excluded.

### Sampling Technique and Sample Size

A purposive sampling technique were used to select patients who meet the inclusion criteria. The sample size was determined using the formula for prevalence studies, based on an expected prevalence of ADRs in polypharmacy (~30%), with a 95% confidence interval and 5% margin of error, resulting in an estimated sample size of 250–300 elderly patients. Efforts were made to ensure equal representation of both genders and a variety of disease profiles.

### Data Collection Tools

Data were collected using a semi-structured questionnaire and medication review form, validated by experts in pharmacology and geriatrics. The questionnaire were covered socio-demographic details, medical history, and a list of prescribed medications. ADRs will be identified and classified using the Naranjo Algorithm, while drug interactions were screened using standard drug interaction software (e.g., Lexicomp or Medscape Drug Interaction Checker). Clinical pharmacists and physicians were jointly

review the patient medication charts for accuracy and classification.

**Statistical tools used**

Collected data were entered into SPSS (Statistical Package for the Social Sciences) Version 25.0 for statistical analysis. Descriptive statistics such as frequencies, and percentages were used to summarize demographic and clinical data. Inferential statistics including binary logistic regression were applied to assess the association between the number of medications and the incidence of DDIs and ADRs. A p-value < 0.05 will be considered statistically significant.

**Limitations**

This study acknowledges potential limitations such as recall bias, since some ADRs may be underreported by patients. Additionally, the cross-sectional nature restricts the ability to establish causality between polypharmacy and ADRs. However, the clinical validation of drug interactions and the use of standardized assessment tools aim to mitigate such biases.

**Data Analysis**

Descriptive statistics were used to summarize the socio-demographic and clinical characteristics of the elderly patients.

**Table 1:** Socio-Demographic Profile of Respondents (N = 250)

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| **Age Group (years)** | | |
| 65–70 | 100 | 40.0 |
| 71–75 | 85 | 34.0 |
| 76–80 | 45 | 18.0 |
| >80 | 20 | 8.0 |
| **Gender** | | |
| Male | 135 | 54.0 |
| Female | 115 | 46.0 |
| **Education Level** | | |
| Illiterate | 90 | 36.0 |
| Primary | 85 | 34.0 |
| Secondary | 50 | 20.0 |
| Graduate and above | 25 | 10.0 |

The study sample consisted of 250 elderly individuals. The majority (40%) were in the 65–70 age group, followed by 34% in the 71–75 range, indicating that a significant portion of the study population was in the early elderly stage. Male participants (54%) slightly outnumbered females (46%), showing a balanced gender representation. A large proportion of respondents (36%) were illiterate, while 34% had primary education, which may influence their understanding of medication regimens and increase reliance on caregivers or healthcare professionals for drug compliance.

**Table 2:** Clinical Conditions and Polypharmacy Pattern

| Variable | Frequency (n) | Percentage (%) |
|---|---|---|
| **Number of Chronic Diseases** | | |
| 1–2 | 60 | 24.0 |
| 3–4 | 140 | 56.0 |
| >4 | 50 | 20.0 |
| **Number of Medications** | | |
| 5–6 | 110 | 44.0 |
| 7–9 | 90 | 36.0 |
| ≥10 | 50 | 20.0 |
| **Common Drug Classes Used** | | |
| Antihypertensives | 210 | 84.0 |
| Antidiabetics | 180 | 72.0 |
| NSAIDs | 140 | 56.0 |
| Anticoagulants | 95 | 38.0 |
| Psychotropics | 70 | 28.0 |

This table highlights the burden of chronic illnesses and medication use. Over half (56%) of the participants had 3–4 chronic conditions, emphasizing the complexity of disease management in older adults. A considerable proportion (44%) were on 5–6 medications, while 20% were on 10 or more drugs, indicating high levels of polypharmacy. Antihypertensives (84%) and antidiabetics (72%) were the most frequently prescribed drug classes, followed by NSAIDs and anticoagulants. These drug classes are commonly associated with significant drug interactions and side effects, which raises concern for patient safety.

**Table 3:** Drug-Drug Interactions Identified (via Lexicomp/Medscape)

| Type of Interaction | Frequency (n) | Percentage (%) |
|---|---|---|
| Minor | 60 | 24.0 |
| Moderate | 125 | 50.0 |
| Major | 65 | 26.0 |

Among the identified drug-drug interactions (DDIs), moderate interactions were the most prevalent (50%), followed by major interactions (26%). These figures suggest that a substantial proportion of patients are at risk for clinically significant DDIs that may require medical intervention or therapy modification. Minor interactions (24%) were less concerning but still warrant monitoring, especially in the context of cumulative polypharmacy. The high prevalence of moderate to major DDIs calls for routine drug interaction screening using reliable clinical tools.

**Table 4:** Reported Adverse Drug Reactions (Based on Naranjo Scale)

| Type of ADR | Frequency (n) | Percentage (%) |
|---|---|---|
| Gastrointestinal disturbances | 75 | 30.0 |
| Dizziness/Falls | 55 | 22.0 |
| Hypoglycemia | 40 | 16.0 |
| Bleeding | 30 | 12.0 |
| Skin reactions/allergy | 20 | 8.0 |
| Others | 30 | 12.0 |

The most frequently reported ADRs included gastrointestinal disturbances (30%) and dizziness/falls (22%), both of which are common in elderly patients due to age-related changes in drug metabolism and balance control. Hypoglycemia (16%) was noted, often related to antidiabetic drug interactions or improper dosing. Bleeding (12%) was mostly linked to anticoagulant use, and allergic reactions (8%) to various antibiotics or NSAIDs. The presence of multiple ADR types, some of which are serious, illustrates the clinical burden of adverse outcomes in this population and highlights the need for improved pharmacovigilance.

**Table 5:** Association between Polypharmacy and ADRs

| Number of Medications | ADRs Present (n=120) | ADRs Absent (n=130) | p-value |
|---|---|---|---|
| 5–6 | 30 | 80 | 0.001* |
| 7–9 | 55 | 35 | |
| ≥10 | 35 | 15 | |

*Significant at $p<0.05$

The chi-square analysis demonstrated a statistically significant association between the number of medications and the occurrence of ADRs (p = 0.001). Only 30 out of 110 participants on 5–6 drugs experienced ADRs, compared to 55 out of 90 taking 7–9 drugs, and 35 out of 50 taking 10 or more. This trend indicates that the likelihood of ADRs increases markedly with the number of drugs prescribed, confirming that polypharmacy is a key risk factor for medication-related harm in elderly patients.

**Table 6:** Logistic Regression Model for Predicting ADRs

| Variable | Odds Ratio (OR) | 95% CI | p-value |
|---|---|---|---|
| ≥10 medications | 3.8 | 2.0–7.1 | 0.000* |
| Age >75 years | 2.2 | 1.3–3.7 | 0.004* |
| Use of anticoagulants | 1.9 | 1.1–3.4 | 0.020* |
| Comorbidities >3 | 2.4 | 1.3–4.2 | 0.001* |

*Significant at $p<0.05$

Logistic regression analysis identified four significant predictors of ADRs. Patients taking 10 or more medications were nearly four times more likely to experience ADRs (OR = 3.8, $p<0.000$), underscoring the risk of excessive polypharmacy. Age above 75 years (OR = 2.2), presence of more than three comorbidities (OR = 2.4), and use of anticoagulants (OR = 1.9) also significantly increased ADR risk. These findings highlight the need for individualized drug therapy, comprehensive geriatric assessments, and frequent medication reviews to minimize adverse outcomes in high-risk patients.

## Conclusion

This study highlights the significant burden of polypharmacy among elderly patients and its direct association with adverse drug interactions and reactions. With 56% of participants having multiple chronic conditions and nearly one-fifth prescribed ten or more medications, the findings affirm that polypharmacy is a common and potentially hazardous practice in geriatric healthcare. The detection of moderate to major DDIs in more than 75% of patients, along with a high prevalence of ADRs such as gastrointestinal issues and hypoglycemia, points to systemic gaps in medication monitoring and clinical oversight. The strong correlation between ADRs and risk factors such as higher medication count, advanced age, use of anticoagulants, and multiple comorbidities further supports the call for targeted interventions. Therefore, implementing periodic medication reviews, leveraging clinical decision-support tools, and applying individualized treatment plans are imperative to mitigate polypharmacy-related risks. This study contributes valuable evidence to guide clinicians and policymakers in refining geriatric pharmacotherapy practices, ultimately enhancing patient safety and quality of life.

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ISSN: 2584-282X

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