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Review Article

Polypharmacy in the elderly populations: frequency, outcomes and prevention approaches

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ABSTRACT

Advancements in medical technologies, expanded access to healthcare services, and improvements in living conditions have significantly increased the average life expectancy worldwide. This demographic shift, coupled with declining fertility rates, has led to a rapid rise in the proportion of elderly individuals within populations. The increase in the prevalence of chronic diseases is leading to the widespread use of multiple medications and making the importance of appropriate medication use more visible in primary health care.

Polypharmacy is a natural consequence of the burden of age-related chronic diseases, but it can also introduce additional risks during treatment processes. Studies report that the prevalence of polypharmacy varies widely. Among older adults, polypharmacy is associated with numerous adverse clinical and economic outcomes, including drug interactions, inappropriate medication use, poor treatment adherence, adverse drug reactions, increased risk of falls, functional decline, and higher rates of hospitalization.

Prescription review programs, the implementation of guidelines that support appropriate medication use (Beers, STOPP/START, TIME, etc.), and patient-centered education approaches play an important role in preventing polypharmacy. Family physicians working in primary health care play a central role in the early detection and appropriate management of polypharmacy, thanks to their ability to conduct long-term monitoring of elderly individuals and establish continuous physician-patient relationships. Additionally, AI-powered clinical decision support systems can enhance treatment safety by facilitating the detection of drug interactions and potentially inappropriate medication use. Strengthening collaboration between physicians and pharmacists in primary healthcare services, increasing awareness of medication management among older adults, and improving health literacy are among the key elements that support the effectiveness of the process.

The aim of this review is to evaluate the frequency of polypharmacy in older adults, its economic and health outcomes, and prevention approaches based on current literature.

Keywords: Polypharmacy, drug interactions, chronic disease, drug misuse, elderly

Introduction

Advances in healthcare have led to longer life expectancy and an increase in the proportion of elderly people in society.[1] According to the World Health Organization (WHO), the number of people aged 80 years and over is expected to triple between 2020 and 2050, reaching 426 million.[2] On a global scale, the aging population, together with the increase in the burden of disease, puts economic

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pressure on health services.[3-4] In Europe, chronic conditions are the main source of illness and disability and account for a large proportion of health care expenditure. The presence of multiple chronic conditions complicates the care process for older adults, necessitating long-term and comprehensive treatment approaches.[5]

WHO generally defines elderly individuals as 60 years and older in developing countries and 65 years and older in developed countries.[6] In Türkiye, the number of individuals aged 65 years and over, defined as the elderly population, was 7 million 550 thousand 727 people in 2019 and reached 9 million 112 thousand 298 people in 2024, showing an increase of 20.7% in the last five years. The proportion of the elderly population in the total population increased from 9.1% in 2019 to 10.6% in 2024.[7] Aging is a continuous process marked by gradual changes in health status over time, affecting the physical, mental, and social capacity of the individual. Healthy aging is defined as the process of preserving and improving the functional capacity of an elderly individual.[2]

The higher prevalence of chronic diseases in older adults has led to the widespread use of multiple medications in treatment processes. This situation is defined in the literature as polypharmacy. Although there is no universally accepted single definition for polypharmacy, it is generally defined as the simultaneous use of five or more medications.[8-10] Concurrent use of ten or more medications per day has been expressed with the concept of "intensive polypharmacy.[1] In individuals with chronic health problems, five or more medications may need to be prescribed to manage diseases effectively; this situation is defined as "appropriate polypharmacy" in the literature.[11] However, exposure to a large number of medications may be harmful in some cases; especially the continued use of medications that have ceased to be medically necessary is characterised as "inappropriate polypharmacy.[12]

The aim of this review is to evaluate the prevalence of polypharmacy in older adults, its health and economic impacts, and approaches to its prevention in line with the current literature, and to contribute to safe and effective medication management, particularly in primary care.

Frequency of polypharmacy

The prevalence of polypharmacy varies between 10% and 90% depending on the definition used, the age group, and the healthcare setting in which the study was conducted.[13] The fact that polypharmacy is not clearly defined and handled in different ways makes it difficult both to determine its prevalence and to evaluate the effects of the health problems related to it.[14] Polypharmacy can be observed not only in elderly individuals but also in young individuals with multiple diseases.[12] In the study conducted by Ye et al., it was found that polypharmacy was more prevalent in elderly individuals, those living alone, and those with more than one disease, and the risk of drug-related problems was also higher in these groups.[15]

In a large-scale study conducted in Sweden, 822,619 individuals aged 75 years and older were analyzed, and the prevalence of polypharmacy (≥5 drugs used) in this age group was found to be 45%.[16] In a cohort study conducted in Italy with the participation of 5,631 elderly individuals, 29% of the participants were found to have chronic polypharmacy.[17] In a study conducted in China, polypharmacy was observed in 91.30% of 276 individuals aged 65 years and older; it was also reported that the number of prescribed drugs increased with increasing age.[18] In a national cohort study conducted by Chang et al., a significant association was found between polypharmacy and hospitalisations in Korean elderly individuals.[19] In a cross-sectional analysis including seventeen European countries and Israel, polypharmacy rates in individuals over 65

years of age were found to vary between 26.3% and 39.9%. The highest rates of polypharmacy were found in Portugal (36.9%), Israel (37.5%) and Czech (39.9%), while the lowest rates were found in Switzerland (26.3%), Croatia (27.3%) and Slovenia (28.1%).[20] In a comprehensive population-based study involving more than 7.36 million individuals aged 65 years and older in South Korea, the prevalence of continuous polypharmacy among medications prescribed in outpatient care was reported as 41.9% for ≥90 days and 38% for ≥180 days.[21] In a study conducted on 404 patients admitted to a cardiology service in the United States of America, polypharmacy was found in 95% and hyperpolypharmacy in 69% of the patients.[22] In a study conducted in Qatar, 5,639 elderly individuals were analyzed and 75% of these individuals were found to be exposed to polypharmacy.[23] In a study conducted in Spain involving 21841 individuals aged 65 years and older, the prevalence of polypharmacy was found to be 23.2%.[24] In another study conducted in the United States of America, 81,295 patients aged 65 years and older were analyzed and the prevalence of polypharmacy was found to be 42%.[25] In a study conducted between 2013 and 2016 on a total of 1.62 million people aged ≥65 years in Asia, Australia and the United Kingdom, the country with the highest prevalence of polypharmacy was Hong Kong with 46.4%, followed by Taiwan (38.8%), South Korea (32.0%), the United Kingdom (23.5%) and Australia (20.1%).[26]

Various studies on the prevalence of polypharmacy in elderly individuals in Türkiye report varying rates depending on different definitions and sample groups. In an analysis conducted by Aydos et al. in 2020 using National Prescription Information System data, the rates of continuous polypharmacy (≥90 days) and cumulative polypharmacy (four or more prescriptions per year) were 41.9% and 38%, respectively, in individuals aged 65 years and older.[27] In a study conducted on 515 outpatient elderly women in Istanbul, the rate of individuals using more than five medications was found to be 47.6%.[28] In a study conducted by Albayrak et al., the rate of polypharmacy in elderly patients hospitalised in oncology wards of a university hospital in Türkiye was found to be 74.3%.[29] In this cross-sectional study conducted by Korkmaz et al. with 585 individuals aged 65 and over living in a district in western Türkiye, the prevalence of polypharmacy was found to be 24.1%. It was determined that 51.6% of the elderly used at least one non-prescription drug, 52.1% used herbal products, and 12.1% used alternative treatment methods. In addition, it was determined that individuals with four or more chronic diseases were exposed to polypharmacy approximately 9 times more than those with 1–3 chronic diseases.[30] In a cross-sectional study conducted by Gümüştakım et al. in Karaman province, Türkiye, among 300 individuals aged 65 years and older in primary care family medicine practice, the prevalence of polypharmacy (use of ≥4 medications) was reported to be 58.3%.[31] In a study conducted by Yayın et al. in primary care family medicine practice, it was found that individuals aged 65 and over who use multiple medications have insufficient knowledge about rational medication use. This suggests that polypharmacy is a widespread and noteworthy problem in primary care among the elderly population.[32] In a study conducted by Sayın et al., in a pharmacy in Istanbul, 158 patients were examined, and polypharmacy was found in 69% of these patients[33] (Table 1).

Health and economic consequences of polypharmacy

Polypharmacy may lead to issues such as cognitive impairment, dosing and usage errors, poor medication adherence, drug interactions, and adverse health events in homebound individuals[3]; it also increases treatment costs.[34] Patients exposed to polypharmacy are at higher risk for various adverse outcomes such as

misuse of medication, medication-related errors, low treatment adherence, inadequate disease management, and death.[35]

Studies conducted in primary care and family medicine practices have reported that regular medication reviews and prescription renewal processes are associated with the frequency of polypharmacy. Studies covering elderly individuals registered at Family Health Centers have shown that a significant portion of prescription renewals are arranged at the primary care level and that this situation places family physicians in a central position in monitoring polypharmacy.[36] It has been reported that drug reviews conducted at the primary care level can identify potentially inappropriate medications and reduce prescription burden; rational drug use approaches implemented in family medicine settings have been associated with reductions in prescription volume and medication costs.[33,37] A study conducted by Gharekhani et al., it was reported that overweight and obesity were significant factors contributing to the prevalence of polypharmacy.[38] In a study conducted by Kutty et al., it was found that polypharmacy was significantly associated with an increased risk of postoperative complications.[39] In another study by Bayrak et al., it was observed that polypharmacy posed a high risk of falls in geriatric patients.[40]

The use of multiple medications may lead to various adverse outcomes, such as falls, drug-related harms, loss of function, hospitalisations, and even death, by increasing the risk of exposure to potentially inappropriate drugs or drug interactions. This may also increase the economic burden on the healthcare system.[20-41] In a study conducted in a hospital in the UK, it was reported that 18.4% of hospitalisations were due to adverse drug reactions, which cost the healthcare system approximately £2.1 billion.[42]

When the risks of side effects of a drug outweigh its expected benefits, it is classified as a potentially inappropriate drug.[43] Elderly patients often have complex treatment regimens involving more than five medicines and potentially inappropriate prescribing has been reported to be common in these patients.[33] Potentially inappropriate prescribing is recognised as one of the major causes of hospital-acquired complications and ranks third among the reasons for hospitalisation.[44] Prevention of polypharmacy and potential inappropriate drug use plays an important role in reducing health system costs and alleviating the burden of disease in elderly patients.[45] According to 2023 data, while the USA ranked first with a drug expenditure of $2,142 per capita, this amount exceeded $750 in countries such as Switzerland, Canada, Germany, and Austria. The OECD average was $528. However, with a per capita drug expenditure of only 119 USD, Türkiye was one of the OECD countries with the lowest level after Mexico and Colombia.[46]

Polypharmacy prevention approaches

The effectiveness and quality of the drug prescribing process depend on many factors. These factors include determining whether the drug is necessary, selecting the most appropriate drug, ensuring that the drug is administered in the correct dose and form, avoiding potentially inappropriate drugs, monitoring adverse drug effects and preventing possible interactions between drugs or between drugs and chronic diseases.[47] The prescription dispensing process requires the assessment of the total risk arising from the coexistence of multiple drugs and diseases and the identification of drug-drug interactions.[48]

A major barrier to identifying successful interventions targeting inappropriate polypharmacy is the complexity of treating patients with polypharmacy due to multiple diseases.[12] There are numerous screening tools designed to detect inappropriate polypharmacy. Among these, widely used guidelines, Beers criteria[49], Screening Tool of Older Persons' Prescriptions (STOPP) and

Table 1. Summary of studies on the prevalence of polypharmacy in elderly people in different countries

Authors	Research location	Study type	Number of samples	Sample age group (years)	Findings (prevalence of polypharmacy) (%)
Wastesson et al. (2018) [16]	Sweden	Cross-sectional	822619	≥75	45
Costanzo et al. (2024)[17]	Italy	Cohort	5631	≥65	29
Zhu et al. (2024)[18]	China	Cross-sectional	276	≥65	91.3
Cho et al. (2022)[21]	South Korea	Cohort	7.36 million	≥65	41.9
Dahshan et al. (2020)[23]	Qatar	Cross-sectional	5639	≥65	75
Cebrino et al. (2023)[24]	Spain	Cross-sectional	21841	≥65	23.2
Nguyen et al. (2023)[25]	USA	Cross-sectional	81295	≥65	42
Lee et al. (2023)[26]	Taiwan	Cohort	253627	≥65	38.8
	Hong Kong	Cohort	52760	≥65	46.4
	United Kingdom	Cohort	819476	≥65	23.5
	Australia	Cohort	353106	≥65	20.1
Bahat et al. (2014)[29]	Türkiye	Cohort	515	≥65	47.6

Screening Tool to Alert to Right Treatment (START) criteria[50], Turkish Inappropriate Medication use in the Elderly (TIME) criteria[51], Fit fOR The Aged (FORTA) criteria[52], EU (7)-PIM[53] lists, which are aimed to establish specific criteria for the elderly in Türkiye, are among the potential inappropriate drug use criteria accepted in various European countries (Table 2). These criteria can guide physicians in prescribing and non-prescribing practices and may provide an important basis for future clinical studies and interventions aimed at improving the quality of drug prescribing in older individuals.[54]

In a study by Dautzenberg et al., it was shown that the implementation of medication review in combination with medication reconciliation, patient education and vocational training reduced the risk of rehospitalisation within 30 days compared to usual care.[55] It is reported that a decrease in drug use was observed with the introduction of the PharmaCloud program in Taiwan in 2014. PharmaCloud is used to improve medication management by enabling healthcare providers such as physicians, pharmacists and nurses to access the patient's medication information through a secure internet portal with the patient's consent. With the use of this program, the average number of prescribed drugs and medical expenditures have been reported to decrease.[41] In Japan, following the implementation of the "Guidelines on Appropriate Medication for Older Adults" and incentives for medical institutions in 2016 and 2018, respectively, and the subsequent revision of the definition of "older adult", it has been reported that a significant reduction in polypharmacy rates was achieved nationwide in individuals aged 75 years and older in four years (April 2015-March 2019). Especially in the 75-89 age group, a 19.3% decrease in polypharmacy rates was observed.[56] The Home Medical Integrated Program was initiated in 2016 within the scope of the restructuring of home health services in Taiwan and is a new model aiming to improve the quality of care. With this system, it was ensured that physicians visited patients at least once every three months, and as a result of this practice, a significant decrease in potential inappropriate drug use was observed. This system made it possible to monitor patients' drug use more closely and manage the treatment process more effectively.[57]

Table 2. Comparison of criteria assessing inappropriate drug use in the elderly

Criterion name	Scope	Country/ region of development	Objective	Advantages	Limitations
Beers Criteria[49]	Systematic list of potentially inappropriate medicines (PIM)	USA	Preventing the use of PIM in the elderly	Widely used, constantly updated	Does not take into account the clinical situation; not individualised
STOPP/START[50]	Identification of inappropriate medicines (STOPP) and incomplete treatments (START)	Europe (Ireland)	Discontinuation of medication and initiation of necessary treatments	Sensitive to clinical context, also indicates treatment deficiencies	Requires training, long implementation time
FORTA Criteria[52]	Classification of drugs in terms of efficacy and safety	Germany	Appropriate drug selection according to the benefit-to-benefit ratio	Provides clear categories, facilitates drug selection	Dependent on the physician in the decision-making process
TIME Criteria[51]	Potential inappropriate and incomplete treatment criteria specific to Türkiye	Türkiye	To identify PIM and under-treatment in Turkish elderly individuals	Suitable for national conditions, offers a unique list	Limited international recognition
EU(7)-PIM List[53]	Common list of potentially unsuitable medicines across Europe	European Union (7 countries)	Establishing a standardised list for the European elderly population	Based on polycentric consensus	May not adequately cover local differences

PIM: Potentially Inappropriate Medication, STOPP: Screening Tool of Older Persons' Prescriptions, START: Screening Tool to Alert to Right Treatment, FORTA: Fit fOR The Aged, TIME: Turkish Inappropriate Medication use in the Elderly.

The SPPiRE (Supporting Prescribing in Older Adults with Multimorbidity in Irish Primary Care) study, conducted in primary care, reported that individualized medication reviews and deprescribing interventions implemented by general practitioners resulted in a significant reduction in the number of medications among community-dwelling older adults.[58] In multidisciplinary deprescribing studies conducted in primary care settings, medication review processes have been reported to be planned and implemented under the leadership of general practitioners.[59]

In the study conducted by Toklu et al., the role of physicians and pharmacists in improving patient compliance in the rational use of medication was examined; it was emphasized that non-compliance with treatment becomes more pronounced with an increase in the number of medications, particularly in patients using multiple medications. The study stated that inadequate information and lack of coordination increase the risk of incorrect medication use and treatment failure associated with polypharmacy.[60] The Pharmacist Consultant Program implemented in Slovenia reduced medication-related problems, improved adherence to treatment guidelines and was cost-effective in older people with multiple diseases. The active involvement of pharmacists in the treatment process not only reduces the risk

of polypharmacy, but also improves the quality of treatment and cost-effectiveness of health care. In the first three months of the pilot project, a total of 189 patients were served in 51 shifts, and the average number of drugs per patient decreased from 12.5 to 9.9 after drug review.[61] Prescription discontinuation networks established to reduce polypharmacy brought together experts and volunteers to share knowledge, experience and resources, and created positive effects at both individual and collective levels by supporting policy initiatives.[62] In a study conducted by Gudi et al., it was shown that pharmacist-led home medication reviews identified very important drug-related problems such as drug-drug interactions, serious drug side effects, inappropriate drug use, non-compliance, overdoses and use of expired drugs. These reviews stand out as an effective strategy for improving medication management and reducing potential health risks in elderly

Table 3. Polypharmacy prevention approaches

Authors	Research location	Prevention approaches	Findings
Dautzenberg et al. (2021)[55]	Switzerland	Drug review, drug reconciliation, patient and professional education	Reduced risk of rehospitalisation within 30 days
Meng et al. (2023)[41]	Taiwan	With PharmaCloud, launched in 2014, healthcare staff can access patients' medication information and reduce the rate of polypharmacy	Reduction in the number of prescribed medicines and medical expenditure
Ishıda et al. (2022)[56]	Japan	Reducing the rate of polypharmacy through prescription discontinuation incentive policies in 2016	19.3% reduction in polypharmacy rates in individuals over 75 years of age
Ho et al. (2024)[57]	Taiwan	Physician visit every 3 months with home medical integrated plan system	Reduced polypharmacy and inappropriate medicines
Stuhec et al. (2021)[61]	Slovenia	Reducing medication problems, improving guideline adherence and cost-effectiveness in older people with multiple diseases	Average number of drugs per patient decreased from 12.5 to 9.9
McDonald et al. (2024)[62]	Canada	Overcoming barriers by bringing together experts in prescription dispensing	Information, experience and resources were shared
Als et al. (2025)[64]	Denmark	Improving patient satisfaction through pharmacist review	Patients reported positive experiences of medication review with the pharmacist
Gama et al. (2025)[65]	Brazil	Clinical pharmacist integration in older people with cardiovascular disease	Better health outcomes and improved quality of life
Mustamıng et al. (2018)[66]	United Kingdom	Increasing knowledge of polypharmacy and understanding of drug therapy	32.5% improvement was achieved
Akyon et al. (2023)[47]	Türkiye	Interaction detection time with web application usage	Detection time per patient decreased from 2,278 seconds to 33.8 seconds

individuals.[63] In a study conducted in Denmark, pharmacists' review of medicines of patients taking multiple medications and patients' perspectives on this issue were investigated. The interviewees stated that they generally had positive experiences with medication review with a pharmacist.[64] In a study conducted in Brazil, the effect of clinical pharmacists on improving medication use in hospitalised elderly patients diagnosed with cardiovascular disease was evaluated. In the study, it was reported that the integration of clinical pharmacists into healthcare teams contributed to better health outcomes and improved quality of life in elderly individuals.[65] It was determined that health education for patients and their relatives significantly increased their knowledge about polypharmacy and provided an improvement of 32.5% in their understanding of drug treatment.[66] It has been reported that a high level of education in patients is associated with less polypharmacy, potentially inappropriate drug use, and unplanned hospitalisation compared to those with low literacy levels.[67]

Artificial intelligence can successfully detect polypharmacy patterns in elderly individuals with chronic diseases and thus can make important contributions in public health monitoring and clinical decision processes.[68] In a study conducted by Akyon et al., while the time required for a physician to detect interactions per patient was 2.278 seconds on average without a web application, this time decreased to 33.8 seconds on average per patient with the proposed web application and this difference was found to be statistically significant[47] (Table 3).

Conclusion and Recommendations

Polypharmacy continues to be a significant problem in society, both clinically and economically. Drug reviews, prescription renewals, and rational drug use practices carried out in primary health care services are effective in reducing potentially inappropriate drug use. Multidisciplinary approaches, contributions from clinical pharmacists, and strengthening physician-pharmacist collaboration increase the effectiveness of polypharmacy management. Improving health literacy among older adults and caregivers, and the use of prescription monitoring systems and clinical decision support technologies are emerging as key strategies that can reduce the adverse effects of polypharmacy.

Additionally, national awareness campaigns and community-based rational drug use and management programs can be implemented to protect public health.

Author contribution

The authors declare contribution to the paper as follows: Review conception and design: ZY and HS; literature review: ZY; draft manuscript preparation: ZY and HS. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare that there is no conflict of interest to disclose.

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