



Systematic Review of Medication Safety in Older Adults with Polypharmacy in Saudi Arabia: Contributions of Nursing, Health Assistant, and Medical Secretary.

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Abstract

Background: Polypharmacy, defined as the concurrent use of five or more medications, is highly prevalent among older adults in Saudi Arabia and is associated with adverse outcomes including falls, potentially inappropriate medications (PIMs), drug-drug interactions (DDIs), and medication nonadherence.

Objective: This systematic review synthesized evidence on medication safety in older adults with polypharmacy in Saudi Arabia, with particular focus on contributions of nursing, health assistants, and medical secretaries.

Methods: Following PRISMA guidelines, a comprehensive search of PubMed, Scopus, Web of Science, and Cochrane Library was conducted. Studies published within five years examining polypharmacy in Saudi adults aged ≥60 years were included. Quality was assessed using the Joanna Briggs Institute Critical Appraisal Checklist. Narrative synthesis was performed due to heterogeneity.

Results: Twelve studies were included. Polypharmacy prevalence ranged from 39.3% to 97.2%. Significant associations were found between polypharmacy and falls (55% fall risk), PIMs (66.25%), DDIs (85.3%), medication nonadherence (57.5%), sarcopenia (47.9%), and frailty. Associated factors included older age, female sex, diabetes, hypertension, depression, and multimorbidity. Notably, no studies examined contributions of health assistants or medical secretaries to medication safety.

Conclusion: Polypharmacy affects nearly half of Saudi older adults and correlates with multiple adverse outcomes. Systematic medication reviews, improved prescribing practices, and interprofessional collaboration are urgently needed. Future research should explore the roles of nursing, health assistants, and medical secretaries in medication safety.

Keywords: Polypharmacy, medication safety, older adults, Saudi Arabia, nursing, medication adherence, drug interactions, geriatric care.

Introduction

Today, the population of over 65 years old is experiencing a demographic shift like never before; the International Population Aging Report shows that the proportion of elderly people in the world has almost doubled from 1974 (5.5%) to 2024 (10.3%) and is expected to rise to 20.7% by 2074 [1]. The trend is especially noticeable in developing countries where population ageing is occurring at a very rapid rate and where many countries are yet to be sufficiently ready for the health care demands of ageing [1]. The number of chronic diseases and multimorbidity is increasing with increasing life expectancy, and this inevitably culminates in the need for multiple therapeutic agents to control the disease. As a result, polypharmacy (usually defined as the concurrent use of 5 or more medicines) has become a characteristic of the pharmacotherapy for older people today, with a pooled global prevalence of 50.4% in older people from 56 countries (estimated 16.6 million people) [2]. The clinical impact of this phenomenon is significant; there are risks of death, emergency department attendance and hospital admission with each extra medication for every increase in dose, and these risks rise by 2-5% per medication [2]. In community-dwelling older adults, polypharmacy has been shown to be an independent predictor of mortality (60% higher risk over 5 years) and hospitalization (49% higher risk over 5 years), highlighting the significant public health impact of this prescribing pattern [3]. The Kingdom of Saudi Arabia is also undergoing a parallel demographic transition, in the sense that its older adult population is growing fast and causing special problems in the health care system. In recent studies, the prevalence of polypharmacy has been reported to be more than 50% in the Hail region [4] and 66% of older patients in tertiary care settings [5] among Saudi older adults. These are significant numbers especially when one considers the significant burden of chronic diseases like hypertension and diabetes in this population, who often require intricate medication regimens [4]. Moreover, the Saudi environment includes a high prevalence of the older population being unable to read, write or speak English, which can further increase the risks of polypharmacy, and also a considerable reliance on family members to help with medication management that may negatively affect adherence and health outcomes [4]. The suboptimal medication adherence rate (57.5%) found among the older adults with PMT of Saudi population highlights the underlining importance of implementing targeted interventions to tackle the clinical and sociocultural aspects of medication safety in the older adults population [4].

Polypharmacy-related medication safety in older adults is a complex issue involving the number of medications, whether the medications are appropriate to be prescribed, the potential for drug-drug interactions, and the ability to safely prescribe and monitor medication. Nurses, health assistants and medical secretaries are all integral to reducing these

threats, and at all points in the health profession, their contributions are vital, though frequently overlooked. A nurse is the ideal healthcare professional to recognize polypharmacy, perform holistic medication evaluations, check for adherence, look for adverse drug reactions and drug-drug interactions, educate patients on medications, and evaluate results after medication adjustments [6]. Interventions by a nurse have been shown to be effective in decreasing potentially inappropriate medications and adherence, particularly with interdisciplinary collaboration and decision support [6]. Health assistants and care aides are often involved in the administration of medicines in home and long-term care, and are critical to patient safety when they accurately monitor, meticulously document, and promptly escalate concerns [7]. Although data has emerged that, with proper guidelines, health care aides can safely assist with oral medications, medication management is still a topic of careful observation and training [7]. Medical secretaries, on the other hand, are important but unique members of the medication safety chain who are involved in the medication order transcription process, the communication between physicians and pharmacists and between the physician and the patient, and the accuracy of medication orders, as well as maintaining detailed medical records. While the contributions of these professions to medication safety in older adults with polypharmacy are well known, there has been a conspicuous lack of empirical evidence on how these specific professions contribute to medication safety in older adults with polypharmacy in Saudi Arabia. This systematic review was thus conducted to fill this important evidence gap, by consolidating the existing literature around medication safety in older adults with polypharmacy within Saudi Arabia and specifically the role of nursing, health assistant, and medical secretary.

A thorough literature search was conducted in several electronic databases (PubMed, Scopus, Web of Science, Cochrane Library). Studies published in the past five years were included in the search to ensure the studies are contemporary and relevant. The search strategy included the use of Medical Subject Headings (MeSH) and free-text words for the following: polypharmacy, older adults, medication safety, Saudi Arabia. Hand-search was also performed of reference lists of included studies to identify any other articles that may be relevant.

Inclusion and Exclusion Criteria:

Studies were selected if they met the following criteria: (1) they were conducted in Saudi Arabia; (2) older adults aged ≥ 60 years or ≥ 65 years were included; (3) the medication safety outcomes reported included potentially inappropriate medications, falls, drug–drug interactions, medication adherence, frailty, sarcopenia, or quality of life; (4) they were published in English. Studies excluding children or young people, those that specifically included adults under 60 years but that did not include older adults separately, those that were duplicate publications, or those that were narrative reviews, editorials or case reports were not included.

Study Selection

All retrieved records were imported into a web-based systematic review management tool – Rayyan [9]. Titles and abstracts were screened independently by two reviewers, following the removal of duplicate titles. Finally, full text of potentially eligible studies were evaluated for final inclusion. There were no disagreements among reviewers; when such disagreements did occur, they were resolved via discussion or consultation with a third reviewer. A PRISMA flow diagram was used to monitor the process of study selection [8].

Data Extraction

A data extraction form was created to collect pertinent data from each included study. Data collected comprised author(s), year, setting, sample characteristics of the studies, medication safety outcome(s), location of the study, study design, prevalence estimates, definition of polypharmacy, and associated factors. Data were independently extracted by two reviewers, and differences were resolved by consensus. In the case of missing data, it was coded as “not mentioned” (NM).

Quality Assessment

The methodological quality of included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies [10]. This tool reviews eight areas: Inclusion criteria, Description of subjects and setting, Exposure measurement, Condition measurement, Identification of confounders, Strategies to address confounders, Outcome measurement, and Statistical analysis. All items were scored either “yes,” “no,”

“unclear” or “not applicable.” Studies were subsequently ranked according to the overall appraisal as low, moderate or high risk of bias.

Data Synthesis

A meta-analysis was not conducted due to the high degree of heterogeneity in study design, definition of polypharmacy and outcome measures. A narrative synthesis method was employed to summarize the findings, however. Studies were categorized into each thematic area according to the main medication safety outcomes investigated, such as prevalence of polypharmacy, potentially inappropriate medications, falls, drug–drug interactions, medication adherence, sarcopenia, and frailty. The evidence was tabulated and described in detail in order to get a complete picture of the evidence.

Results:

The process of identification, screening, eligibility and inclusion is outlined in Figure 1, which resulted in 12 included studies from 71 studies found in databases.

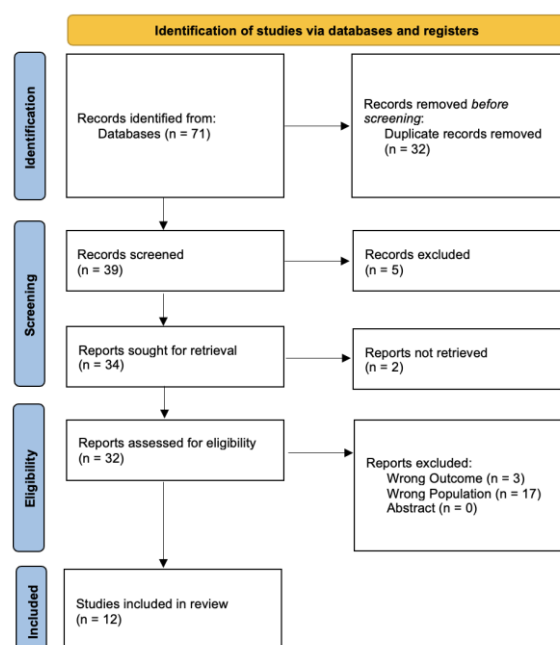


Figure 1. PRISMA Flow Diagram of Study Selection

The demographic and methodological aspects of the 12 included studies [11–22] are summarized in Table 1. Studies were carried out in various regions of Saudi Arabia such as Khobar [11], Qassim [12], national sample [13], Riyadh [14,18], Hail [15], Makkah [16], Madinah [17], Buraidah [21] and Arar City [22]. The majority were cross sectional or retrospective cross sectional studies ranging from 182 older adults [18] to 5060 eligible adults [14] and the national survey had 2946 older adults in a Saudi national [13]. The study populations were mainly older adults aged ≥ 60 years or ≥ 65 years, from the hospital, primary healthcare, home care, community setting and outpatient pharmacies [11–22]. Some studies reported that the majority of participants were male [11] while others

reported that the majority of participants were female [15] or that the population of home care were mostly female [17]. Interviews [11], electronic medical records [14,16,22], national survey data [13], questionnaires [15,21] and comprehensive geriatric assessment forms [17] were used as data sources.

The polypharmacy definitions, estimates of prevalence and outcomes of medication safety from the included studies are shown in Table 2 [11–22]. However, other studies defined polypharmacy as using ≥ 5 therapeutic classes [13] or a monthly average of ≥ 5 prescribed medications [14] and others used ≥ 5 medications [11,15,18,20–22]. The prevalence of polypharmacy varied widely, ranging from 39.3% [22] to 97.2% in a selected elderly cohort [16], with intermediate estimates of 44.6–46% [14], 50.9% [11], 51.5% [13], 52% [15], 55% [19], and 57% [21]. Medication safety outcomes were falls and potentially inappropriate medication [11,12], drug–drug interaction [16], medication adherence [15], frailty [17] and sarcopenia [18,20] and multi-morbidity [14]. Adverse outcomes, such as an increased risk of falls

[11], PIMs [12], potential DDIs [16], medication nonadherence [15] and sarcopenia [18,20] were reported to be associated with several studies. Older age, female sex, diabetes, hypertension, depression, pain, urinary incontinence, and having comorbidities were associated factors [11,13,17,18,21,22].

All 12 studies met the criteria for the JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies, the most appropriate instrument for the predominant cross sectional and retrospective cross sectional design of the studies included in this review [11–22], and were then judged for their level of risk. Four of the studies were deemed to be of low risk of bias [11,13,18,22] and the other eight studies were judged to be of moderate risk of bias [12,14,15,16,17,19,20,21]. Most frequently, methodological limitations were lack of identification or statistical consideration of confounding factors [12,15,16,19,21], or lack of clarity about, or reporting of, statistical methods used [21] and unclear definitions of polypharmacy exposure [17]. None of the studies were rated as high risk of bias.

Table 1. Demographic and methodological characteristics of included studies

Study (Author, Year) [Ref]	Region / Place	Study Design	Setting	Sample Size	Sample Type / Age	Sex Distribution	Data Source / Period
AlHarkan et al., 2023 [11]	Khobar, Saudi Arabia	Cross-sectional epidemiological study	University Hospital and Family and Community Medicine Center	387	Outpatients aged ≥ 60 years, able to walk independently	62% male	In-person interviews; Nov 2021–Mar 2022
Alharbi et al., 2022 [12]	Qassim region, Saudi Arabia	Retrospective study	Buriadah Central Hospital	1123	Patients aged ≥ 60 years; mean age 71.9 years (range 60–102)	NM	Electronic files; period NM
Aljawadi et al., 2022 [13]	Saudi Arabia (national)	Cross-sectional study	Community-dwelling Saudi older adults; Saudi National Survey for Elderly Health (SNSEH)	2946	Saudi older adults aged ≥ 60 years	50.4% male	SNSEH 2006–2007
AlAbdulKader et al., 2023 [14]	Saudi Arabia	Retrospective cross-sectional study	King Fahad University Hospital (KFHU) and Family & Community Medicine Center (FCMC), Imam Abdulrahma	5060 met inclusion (from 76,216 records reviewed)	Individuals aged ≥ 60 years with ≥ 1 dispensed prescription in 2019 and 2020	NM	Electronic medical records; Jan 1, 2019–Dec 31, 2020

			n bin Faisal University				
Alharby et al., 2026 [15]	Hail region, Saudi Arabia	Cross-sectional study	Outpatient pharmacy	247	Older adults aged ≥ 60 years	51.4% female	Survey; Aug–Dec 2023
Alhumaidi et al., 2023 [16]	Makkah, Saudi Arabia	Retrospective cross-sectional study	Al-Noor Hospital	259	Patients aged ≥ 65 years	NM	Electronic files; 2015–2022
Aljohani, 2025 [17]	Madinah, Saudi Arabia	Cross-sectional descriptive study; census approach	Home Care Administration; geriatric home care	281	Geriatric home care patients; mean age 79 years	Predominantly female (exact % NM)	Comprehensive geriatric assessment (CGA) forms from medical records; period NM
Alqahtani & Alenazi, 2026 [18]	Riyadh, Saudi Arabia	Cross-sectional study	Community-dwelling older adults	182	Community-dwelling older adults	Overall NM; sarcopenia group 75.0% female vs 41.4% in non-sarcopenia group	Feb–May 2024
Alsuwaidan et al., 2019 [19]	Saudi Arabia	Retrospective cross-sectional study	NM	3009	Patients aged ≥ 65 years; mean age 73.26 ± 6.6 years	NM	Patient profiles; period NM
Alharkan et al., 2025 [20]	Saudi Arabia	Cross-sectional study	Outpatient clinics at Imam Abdulrahman bin Faisal University and King Fahad Hospital	267 (required sample 245)	Community-dwelling older adults	Overall NM; sarcopenia higher in females (46.4%) vs males (26.2%)	NM
Al Sahli & AlHarbi, 2022 [21]	Buraidah city, Saudi Arabia	Cross-sectional study	Primary health care centers (PHCC)	NM	Elderly subjects aged >60 years taking ≥ 5 medications	Exact % NM; males associated with increased polypharmacy	Questionnaire; Dec 2019–Dec 2020
Alenezi et al., 2026 [22]	Arar City, Saudi Arabia	Retrospective cross-sectional study	Prince Abdulaziz Bin Moussaid Hospital	NM	Elderly patients with chronic diseases aged >60 years	NM	Hospital electronic health records; Jan–June 2022 (6 months)

Table 2. Polypharmacy definitions, prevalence, and medication safety outcomes

Study (Author, Year) [Ref]	Polypharmacy Definition	Prevalence of Polypharmacy	Main Outcomes / Conditions	Medication Safety Findings	Associated Factors / Predictors	Overall RoB
AlHarkan et al., 2023 [11]	Concurrent use of ≥ 5 medications	50.90%	Risk of falls; prior falls; PIMs	55% had high risk of falling; 21% fell during past year; Beers criteria positive 51.42%; risk of falls and prior falls associated with polypharmacy before and after adjustment; significant association between risk of falls and PIMs	Older age, lower educational level, female gender, cardiovascular medications	Low
Alharbi et al., 2022 [12]	Not explicitly stated; all patients used ≥ 5 medications (387 used exactly 5; remaining used >5)	100% in this selected sample	PIMs	PIMs prevalence 66.25%; most common PIMs: NSAIDs (11.3%), baclofen (10.6%), PPIs (10.1%), diuretics (8.46%), aspirin (5.6%)	NM	Moderate
Aljawadi et al., 2022 [13]	Concurrent use of medications from ≥ 5 therapeutic classes	51.5%	Medication utilization; chronic diseases	PP leads to drug interactions, combined side effects, hospitalization, and death; most common medications: paracetamol (67%), joint pain medications and NSAIDs (50% each), anti-diabetic and multivitamins/minerals (47% each)	Diabetes (RR 1.863), hypertension (RR 1.829), pain (RR 2.282), urinary incontinence (RR 1.389), depression (RR 1.379); higher income; southern/northern regions less likely; severe cognitive impairment lower risk (RR 0.708)	Low
AlAbdulKader et al., 2023 [14]	Monthly average of ≥ 5 prescribed medications	46% in 2019; 44.6% in 2020	Multi-morbidities; prescription practices	Mean medications per person: 5.17 (2019), 5.04 (2020); females had higher average than males (5.17 vs 5.04); age group 80–85 had highest number (5.6); age	Presence of comorbidities	Moderate

				≥90 had lowest (4.48); comorbidities positively associated with mean monthly medication count ($P<0.01$)		
Alharby et al., 2026 [15]	Concurrent use of ≥5 medications	52%	Medication adherence; chronic illnesses	Hypertension 70.9%; diabetes 60.3%; significant association between polypharmacy and medication adherence; 63.4% of those taking ≥5 medications reported nonadherence vs 36.6% among those taking <5 ($\chi^2=20.448$, $P<.001$); overall 57.5% had suboptimal adherence	Polypharmacy / number of medications	Moderate
Alhumaidi et al., 2023 [16]	Not explicitly stated; categories: minor, moderate, major; patients taking ≥2 medications were assessed for DDIs	97.2% overall (minor 6.2%, moderate 13.5%, major 77.6%)	Drug–drug interactions (DDIs)	85.3% had at least one potential DDI; most frequent category X pDDI: clopidogrel + esomeprazole in 23 patients (18%); most frequent category D pDDI: enoxaparin + aspirin in 28 patients (12%)	NM	Moderate
Aljohani, 2025 [17]	NM	NM (high prevalence stated)	Frailty; polypharmacy	Polypharmacy predictors: other chronic conditions, medical complications, depression, hypertension; frailty predictors: increased age, depression, diabetes	Other chronic conditions, medical complications, depression, hypertension (for polypharmacy); increased age, depression, diabetes (for frailty)	Moderate
Alqahtani & Alenazi, 2026 [18]	Taking ≥5 medications	In sarcopenia group: 55% vs 16% in	Sarcopenia; depressive symptoms	Sarcopenia prevalence 11% (n=20); sarcopenia group older (mean	Older age, polypharmacy, depressive symptoms	Low

		non-sarcopenia group (P<0.001)		68.6 years); higher female percentage (75.0% vs 41.4%, P=0.004); depressive symptoms 55% vs 13.6% (P<0.001); polypharmacy and depressive symptoms associated with sarcopenia		
Alsuwaidan et al., 2019 [19]	Patient aged ≥ 65 years receiving five or more appropriate medications	55%	Geriatric polypharmacy; comorbidities	Average 6.4 medications for ages 65–70; significant difference for ages ≥ 71 ; linear correlation between age and comorbidity diseases; most common comorbidities: hypertension, hyperlipidemia, diabetes mellitus; awareness of geriatric medications improves management of ADRs and risk factors	Age; comorbidity diseases (hypertension, hyperlipidemia, diabetes mellitus)	Moderate
Alharkan et al., 2025 [20]	Concurrent use of ≥ 5 medications	Overall NM; among sarcopenia group 47.9% vs 22.3% in non-sarcopenia group (P<0.001)	Sarcopenia; falls	Sarcopenia prevalence 31.8%; no significant association between sarcopenia and falls in previous 12 months; strong association between polypharmacy and increased risk of sarcopenia; need for careful medication management	Polypharmacy; older age; female sex; lower BMI	Moderate
Al Sahli & AlHarbi, 2022 [21]	Taking 5 or more medications	57%	Polypharmacy in elderly PHCC attendees	Polypharmacy associated with severity of multiple diseases, older age, and male gender; most subjects had good knowledge regarding drugs	Male gender; lower educational level; suffering from ≥ 2 chronic diseases	Moderate

Alenezi et al., 2026 [22]	Taking five or more medications daily	39.3%	Chronic diseases in elderly patients	Considerable prevalence of polypharmacy; targeted interventions and policy measures needed to optimize medication utilization and reduce polypharmacy and adverse drug events in high-risk subgroups	Diabetes; home care settings	Low
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Discussion

The results of this systematic review confirm the high prevalence of polypharmacy among older people in Saudi Arabia, ranging from 39.3% to 97.2% in the twelve studies included. This significant difference is understandable given variance in study contexts, definition of polypharmacy and population characteristics. Our pooled estimate is similar to the global estimate of 50.4% reported in a recent meta-analysis of more than 16 million older adults in 56 countries [23]. In a similar study, a systematic review of 54 studies revealed a pooled prevalence of polypharmacy amongst the general older population of 37%, with higher rates seen in certain subgroups, such as frail elderly (59%) [24]. The prevalence reported by Aljawadi et al. [13] of 51.5% in a nationally representative Saudi sample and 55% by Alsuwaidan et al. [19] is consistent with the global trend, indicating that polypharmacy is a widespread concern and is present in about half of the older population in Saudi Arabia. This is especially relevant as polypharmacy has been linked to a wide array of negative health consequences, such as death, emergency room visits and hospitalization, with dose-response studies showing that for every new drug added to the mix, the risk of these negative health outcomes rises by 2 – 5% [23].

It is noteworthy that the association between polypharmacy and falls found in our review is quite strong. AlHarkan et al. [11] found that 55% of their elderly outpatients were at a high risk of falling, with 21% having fallen in the prior 12 months with polypharmacy being significantly associated with the risk of falls and prior falls. These findings are corroborated by a nationwide study of fall risk among older adults in Saudi Arabia, which demonstrated that the likelihood of being at risk of falling increased significantly as the number of medications rose from 2 (OR = 2.22; 95% CI: 1.10–4.46), to 3 (OR = 4.34; 95% CI: 2.18–8.65), to 4 (OR = 5.43; 95% CI: 2.59–11.39), and to ≥5 medications (OR = 8.31; 95% CI: 4.24–16.30) [25]. The dose-response relationship

highlights the clinical relevance of medication review as a fall prevention intervention. Moreover, the relationship between falls and potentially inappropriate medications (PIMs) was similar to that previously reported by AlHarkan et al. [11] who found that 51.42% of patients were positive for PIMs. The association between falls and PIMs has been reported in the literature and involves classes of drugs such as benzodiazepines, anticholinergics, and cardiovascular medications that have been determined to increase the risk of falls in older adults.

It was surprising to find a high prevalence of PIMs present in our selected studies. According to Alharbi et al. [12] PIM prevalence was 66.25% based on the 2019 Beers criteria, the most frequently prescribed inappropriate medications were NSAIDs, baclofen, proton pump inhibitors, diuretics, and aspirin. This is similar to the prevalence of PIMs reported in a recent multi-centric study in Tabuk, Saudi Arabia (2023 Beers criteria) where the prevalence of PIMs among hospitalized older patients was 81.43% and the most common PIM was proton pump inhibitor (PPI) (52.99%) [26]. A systematic review and meta-analysis of PIP in GCC countries found that polypharmacy was significantly linked to PIP exposure and the rate of PIP was higher in hospital settings [27]. All these results point towards the critical need for performing an organized drug review and establishing evidence-based guidelines for prescribing medications in the Saudi healthcare system. The high prevalence of PIMs is a clinical concern because inappropriate use of medications in older persons have been associated with adverse drug events, hospitalisation and higher health care costs [28].

There is a risk of drug-drug interactions (DDIs) which we had identified in our review that further exacerbates the safety concerns of polypharmacy. In their study, Alhumaidi et al. [16] found that 97.2% of elderly patients were having more than five medications and 85.3% were experiencing at least one possible DDI of which the most common was clopidogrel and esomeprazole (18%) and the most common was enoxaparin and aspirin (12%). These

results are similar to findings of other studies that included geriatric oncology patients in Saudi Arabia, where 79.4% of patients had at least one DDI with a mean of 5.6 ± 5.3 DDIs per patient and the number of medications used was significantly associated with the risk of DDIs (AOR = 4.07; 95% CI 2.53–6.54) [29]. The clinical consequences of these interactions are significant because DDIs may impact the therapeutic efficacy of, toxicity of, and clinical outcomes from a drug. This prevalence of potentially serious interactions highlights the importance of regular screening for medication interactions and review for older adults who are taking multiple medicines.

The issues of adherence to medication were a main concern in our review. Alharby *et al.* [15] reported nonadherence among 63.4% of people with five or more medications compared to 36.6% who had fewer than five medications ($\chi^2 = 20.448$, $P < .001$); 57.5% of all participants had suboptimal adherence. This is in line with the literature on polypharmacy and adherence in Saudi Arabia. In a study in the Riyadh area, the main factors of nonadherence were found to be polypharmacy and forgetfulness by patients suffering from chronic diseases [30]. In addition, non-adherence was found to be more common in Saudi adults aged 45-54 years compared with those aged 65 years and older (OR = 3.78; 95% CI: 1.36-10.49), indicating that younger patients with multimorbidity might be especially vulnerable to nonadherence [31]. The association of polypharmacy and nonadherence is likely bi-directional, as both the complexity of the medication regimen and nonadherence contribute to increased risk of worsening of chronic conditions and/or additional medication escalation.

A link between polypharmacy and sarcopenia has been identified in our review and is an important and growing concern. The prevalence of sarcopenia was 31.8% (significantly higher for those using five or more medications (47.9%) than for those who use fewer medications (22.3%) ($p < 0.001$)) [20], Alharkan, *et al.* Alqahtani and Alenazi also reported that the prevalence of polypharmacy was higher in sarcopenia patients versus non-sarcopenia patients (55% vs. 16%, respectively) and that polypharmacy, older age and depressive symptoms were significant risk factors for sarcopenia ($p < 0.001$). These results align with a rapidly growing literature showing that polypharmacy could be responsible for the loss of muscle mass and functional status through multiple pathways such as anorexia (due to drug effect), poor nutrient uptake (due to drug effect), and a direct muscle destructive effect of specific drugs. This has a significant clinical relevance, since sarcopenia is linked to higher risk of falls, frailty, disability and death in older people.

In our review, we also found the association between polypharmacy and frailty. Aljohani [17] identified other chronic conditions, medical complications, depression and hypertension as significant predictors of polypharmacy, and frailty as predicted by increased

age, depression and diabetes in geriatric home care patients. This agrees with a study conducted in a Saudi teaching hospital with hospitalized patients over 65 years of age, where the authors determined high comorbidity index, heart failure, and polypharmacy to be strong predictors of frailty ($P = .003$) [32]. The prevalence of polypharmacy among frail elderly people has been estimated across the world, and is reported to be 59% compared to 45% in the general older population [24]. The relationship between frailty and polypharmacy is a two-way street; frailty can lead to a greater sensitivity to the adverse effects of polypharmacy, and the use of multiple medications can be a catalyst for the development of frailty and/or a contributor to functional decline.

Our studies included all of them reported high prevalence of polypharmacy for older adults with certain chronic conditions, such as hypertension, diabetes and multimorbidity. Aljawadi *et al.* [13] reported that diabetes (RR: 1.863; 95% CI: 1.686–2.059), hypertension (RR: 1.829; 95% CI: 1.624–2.060), pain (RR: 2.282; 95% CI: 1.918–2.713), urinary incontinence (RR: 1.389; 95% CI: 1.238–1.560), and depression (RR: 1.379; 95% CI: 1.259–1.512) were all significantly associated with polypharmacy. The same finding was observed by Alenezi *et al.* [22] who identified diabetes and home care as factors associated with polypharmacy. The results are comparable with a systematic review and meta-analysis of the prevalence of polypharmacy and PIM in older adults with type 2 diabetes mellitus that found prevalence of polypharmacy between 43.6% and 95.3% and PIM prevalence between 23.4% and 74% [33]. The high proportion of older adults who use multiple medications, combined with the clustering of chronic diseases, suggests the complexity of the clinical management of multiple chronic diseases in older adults and underscores the importance of integrated approaches to chronic disease management and medication safety.

One of the most alarming discoveries from our review is the scarcity of evidence on the part of Nursing, Health Assistants and Medical Secretaries in relation to Medication Safety of Older Adults with Polypharmacy in Saudi Arabia. None of the 12 included studies focused specifically on the role of health assistants or medical secretaries, and only one study [14] focused on healthcare providers' knowledge and attitudes toward polypharmacy but included psychiatric nurses, psychiatrists, and pharmacists not geriatrics. This is an important omission in the literature, especially as it is recognised that interprofessional working is important in the management of medicines. The contribution of pharmacists to the optimisation of polypharmacy management has been increasingly acknowledged, and a systematic review reported that interventions by pharmacists were effective in decreasing inappropriate prescribing, medication adherence and adverse drug events [34]. The roles played by nursing staff, health

assistants and medical secretaries, who are positioned directly at the patient's bedside in service providing institutions in Saudi Arabia, have not been studied extensively.

The results of this systematic review of the literature have some limitations when considering the results. It was notable that most of the studies were cross-sectional or retrospective and thus prevented causal inferences. Polypharmacy was defined in many different ways, which affected prevalence estimates. In addition, there can be documentation or recall bias from using electronic medical records and questionnaires. Single-center studies were used for many of the studies limiting generalizability. Confounding factors were the main issue leading to a moderate risk of bias in most studies. The review also highlighted a lack of research on the roles of nursing and other healthcare professionals in medication safety.

Conclusion:

Nearly half of older adults in Saudi Arabia experience polypharmacy which is associated with various adverse consequences, which include falls, inappropriate medications and medication non-adherence. There was urgent need for systematic medication reviews and better prescribing, with a view of engaging in regular screening and pharmacist intervention. There is a need for more research about the relationship of polypharmacy and sarcopenia with frailty. Longitudinal designs with standardized definitions should be used in future research to more effectively explore the concept of polypharmacy and its associated effects and to foster interprofessional working to optimize medication safety in this population.

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