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Potential drug-drug interactions among geriatric oncology patients: a retrospective study in Saudi Arabia

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Abstract

Background Drug–drug interactions (DDIs) are significant causes of adverse drug reactions among patients with cancer. We aimed to identify the prevalence, severity, and predictors of potential DDIs among geriatric oncology patients.

Methods A cross-sectional, retrospective study was conducted at two tertiary medical centers. Geriatric patients (≥ 65 years) who were diagnosed with solid tumors and received outpatient prescriptions with a minimum of two drugs between January 2018 and December 2022 were included in the study. Patients' medications were screened for DDIs using Lexi-Interact. Univariate and multivariable logistic regression models were used to explore factors associated with DDIs.

Results The study included 247 geriatric patients with a mean age of 74.0 ± 7.3 years, and 48.6% of the patients were female. The most common type of cancer was gastrointestinal cancer (35.6%), followed by genitourinary cancer (20.6%), and 50.6% of the patients had metastasized tumors. Approximately one-half of the patients (49.0%) received anticancer therapy, and hormonal therapy (21.9%) or chemotherapy (16.6%) was the most common therapy. The mean number of medications used per patient was 6.9 ± 3.5. The majority of patients (79.4%) had at least one DDI, with a mean of 5.6 ± 5.3 DDIs per patient. Most of the interactions were classified as moderate (58.9%), and only 19.3% were classified as major. Multiple logistic regression revealed that females were more vulnerable to DDIs than their male counterparts were (adjusted odds ratio (AOR) = 37.4; 95% CI 4.13–338.3). The number of medications used was significantly associated with the risk of DDIs (AOR = 4.07; 95% CI 2.53–6.54). Compared with patients with gastrointestinal cancers, patients with breast or gynecologic cancers had lower odds of experiencing DDI (AOR = 0.02; 95% CI < 0.01–0.24 and AOR = 0.04; 95% CI < 0.01–0.29, respectively).

Conclusion This study revealed a high prevalence of DDIs among geriatric oncology patients, with most interactions classified as moderate. Female patients and patients taking multiple medications had a greater risk of experiencing DDIs. Routine screening for potential DDIs is essential for this vulnerable population, and the factors identified in this study should be carefully considered.

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Keywords Drug–Drug interaction, Safety, Geriatric, Oncology, Tumor, Cancer

Introduction

Aging is a unique and complex process that results in a gradual decline in the functional capacities of various organs and systems. This decline reduces the body's ability to endure physical, emotional, or social stressors, necessitating an increase in the use of daily medications [1]. In many countries, elderly individuals are defined as individuals who are 65 years or older [2]. Approximately 60% of cancers occur at this age [3], and managing cancer in this population presents unique challenges and is often complicated by the existence of multiple comorbidities and polypharmacy [4].

Polypharmacy is a condition in which patients take five or more medications simultaneously and has emerged as a significant health concern among older patients [5]. Notably, polypharmacy presents a greater challenge among elderly patients with cancer receiving chemotherapy than among those without cancer. This is because of the increased risk of drug–drug interactions (DDIs), hospitalization, treatment toxicity, and mortality among such patients [6, 7].

In addition, DDIs occur when the effect of one drug is altered in the presence of a concomitant drug, which increases the risk of toxicity or reduces the intended effect of the drug [8, 9]. The risk of DDIs is increased among patients treated systemically for cancer, as these patients usually receive numerous medications concurrently, including cytotoxic, hormonal, targeted, and supportive care agents [10]. Although DDIs are significant causes of adverse drug reactions (ADRs), they are mostly predictable and preventable [11, 12]. However, their prevention in clinical practice remains challenging because of the large number of drugs that can interact with each other. It has been reported that 20–30% of all ADRs are caused by DDIs, and approximately 26% of the ADRs that lead to hospitalization are caused by DDIs [13, 14]. Among patients with cancer, DDIs have even been identified as the cause of death in 4% of patients [15].

The prevalence of DDIs in elderly patients ranges from 81 to 91% and results from multiple comorbidities and polypharmacy [16–19]. Potential DDIs may become clinically relevant with medications that have a narrow therapeutic index, those with zero-order pharmacokinetics, those that inhibit or induce microsomal enzymes, and those administered to patients with hepatic and/or renal impairment [6]. The incidence of potential DDIs in general clinical practice and the factors contributing to their development have been extensively studied [20–23]. However, only a few studies have investigated possible drug interactions in older patients with cancer. A study conducted in India identified DDIs in 98% of elderly patients with cancer, where 89% had at least one DDI with antineoplastic medications [6]. Another study assessed DDIs among older patients with cancer in the United States and reported more than 700 potential DDIs in 75.4% of the included patients [24].

In Saudi Arabia, there is a paucity of literature assessing DDIs in elderly patients with cancer who have been prescribed anticancer agents, including chemotherapy, biologics, and hormonal therapy. In a study conducted in Saudi Arabia including patients with cancer, with a mean age of 47 years, the prevalence of DDIs was 60% [25]. The identified significant risk factors were the number of medications and type of treatment, such as chemotherapy, as well as the length of hospital stay [25].

Like many other countries, Saudi Arabia is experiencing an aging population, highlighting the need for better medication management in older cancer patients [26]. The objectives of this study were to assess the prevalence and severity of DDIs among elderly oncology patients and explore factors associated with these interactions.

Methods

Study design, patients and settings

A cross-sectional study was conducted to assess the prevalence of DDIs among elderly oncology patients in ambulatory care settings and explore the factors associated with these interactions. The study included patients from two tertiary medical centers in Riyadh, Saudi Arabia: King Saud Medical City (KSMC) and King Abdulaziz Medical City (KAMC). We included elderly patients (≥ 65 years) who had a confirmed diagnosis of active solid tumor and received outpatient prescriptions with a minimum of two drugs between January 2018 and December 2022. Patients were excluded if their electronic medical profile lacked the required information. Study approval was granted by the Institutional Review Board at KSMC (IRB: H1RI-07-Dec22-02) and KAMC (SP23R/019/03). Data were collected retrospectively; therefore, the need for informed consent was waived.

Data collection and variables

The study data were retrospectively extracted from patients' electronic health records and entered into a predesigned data collection sheet in a deidentified manner. The data collected included demographic characteristics [age, sex, height, weight, and body mass index (BMI)], laboratory parameters [creatinine, creatinine clearance calculated using the Cockcroft-Gault Eq. [27], aspartate aminotransferase (AST), alanine aminotransferase (ALT), and gamma-glutamyl transferase (GTT)], medical history [type and stage of tumor, metastasis status, and

number and type of comorbidities], and outpatient prescribed medications.

Medication screening and DDI categorization

Medications were screened for potential DDIs using Lexi-Interact® Online software [28]. Lexi-Interact® categorizes DDIs into five categories on the basis of their risk rating [29]. These categories are summarized in Table 1. Lexi-Interact® was chosen because of its high sensitivity (87–100%) and specificity (80–90%) for different types of DDIs [30–32]. It emphasizes the depth and duplication of drug information, compares multiple sources of drug information, and presents the search results clearly and comprehensibly [7]. Furthermore, the online version of this software is updated on a daily basis [28].

Statistical analysis

Continuous data are presented as means with standard deviations (± SDs), and categorical data are presented as frequencies with percentages. Predictors of DDI occurrence were assessed using both univariate and multivariable logistic regression models, which included age, sex, number of comorbidities, number of medications, type of cancer, metastasis status, and cancer therapy status. The findings of the logistic regression are presented as odds ratios (ORs) with 95% confidence intervals (CIs). A p value of < 0.05 was considered to indicate statistically significant differences between groups of variables included in the logistic regression models. The data were analyzed using SAS® statistical software version 9.4 (SAS® Institute, Cary, NC, USA).

Results

Patient characteristics, cancer type, and treatment

A total of 247 patients were included in the study. The mean age was 74.0 ± 7.3 years, and 127 patients were (51.4%) male. On average, patients had 2.5 ± 1.6 comorbidities, with hypertension (66.8%) and diabetes (50.6%) being the most common, followed by liver disease (18.2%). The baseline characteristics of the patients and the prevalence of potential DDIs according to different patient categories are presented in Table 2.

In terms of cancer type, gastrointestinal cancers (35.6%), followed by genitourinary cancers (20.6%), were the most prevalent, and 125 patients (50.6%) had metastasized tumors. Approximately one-half of the patients (49.0%) used at least one anticancer therapy. Moreover, hormonal therapy (21.9%) and chemotherapy (16.6%) were the most common treatment strategies. The use of monoclonal antibodies (2.8%), tyrosine-kinase inhibitors (2.4%), or combination therapy (5.3%) was less common. Patients used an average of 6.9 ± 3.5 medications. The mean number of prescribed anticancer agents was 1.5 ± 0.6, the number of supportive care medications used was 1.0 ± 1.2, and the number of medications used for comorbidities was 5.2 ± 3.5 (Table 2).

Prevalence and classification of potential DDIs

Among the 247 patients, 196 patients (79.4%) had potential DDIs, including pharmacotherapy for both cancer and nonneoplastic diseases. Patients had an average of 5.6 ± 5.3 DDIs, with a maximum of 30 DDIs in one patient. In terms of severity, out of 1101 DDIs, 649 (58.9%) were "moderate (C)", and 212 (19.3%) were classified as "major (D or X)". Table 3 provides detailed information about all interactions detected in the patients studied.

Predictors of potential drug interactions

Predictors of potential DDIs were assessed with logistic regression modeling. In the univariable model, the numbers of comorbidities (OR 1.49; 95% CI 1.19–1.88) and medications (OR 3.08; 95% CI 2.16–4.40) were associated with increased odds of experiencing DDIs. In contrast, having genitourinary cancer (OR 0.29; 95% CI 0.12–0.69) or gynecologic cancer (OR 0.3, 95% CI 0.12–0.74) was associated with lower odds of experiencing DDIs than having gastrointestinal cancers. In the multivariable analysis, female sex (AOR 37.4; 95% CI 4.13–338.3) and the number of medications (AOR 4.07; 95% CI 2.53–6.54) were associated with increased odds of experiencing DDIs. On the other hand, having breast cancer (AOR 0.02; 95% CI < 0.01–0.24) or gynecologic cancer (AOR 0.04; 95% CI < 0.01–0.29) was associated with lower odds of experiencing DDIs than having gastrointestinal

Table 1 Drug interaction classifications based on Lexi-Interact® software [29]

Category	Description
A	Data have not demonstrated either pharmacodynamic or pharmacokinetic interactions between the specified medications
B	The specified medications may interact with each other, but there is little to no evidence of clinical concern resulting from their concomitant use
C	The medications agents may interact with each other in a clinically significant manner, but the benefits of concomitant use of these two medications usually outweigh the risks
D	The two medications may interact with each other in a clinically significant manner, a patient-specific assessment must be conducted to determine whether the benefits of concomitant therapy outweigh the risks
X	The specified medications may interact with each other in a clinically significant manner, but the risks associated with concomitant use of these medications usually outweigh the benefits. Generally, avoid combination of these medications

Table 2 Baseline characteristics ($n = 247$ patients)

Characteristic	Overall	Occurrence of Drug-Drug Interaction	
		No	Yes
Number of patients	247 (100.0)	51 (20.6)	196 (79.4)
Age (years)	74.0 ± 7.3	74.5 ± 7.7	74.0 ± 7.5
Center			
NGHA	61 (24.7)	12 (23.5)	49 (25.0)
KSMC	186 (75.3)	39 (76.5)	147 (75.0)
Gender			
Male	127 (51.4)	29 (56.9)	98 (50.0)
Female	120 (48.6)	22 (43.1)	98 (50.0)
BMI	26.9 ± 6.6	26.8 ± 4.9	26.9 ± 7.0
Comorbidities, mean total number of comorbidities	2.5 ± 1.6	1.8 ± 1.4	2.7 ± 1.6
Hypertension	165 (66.8)	24 (47.1)	141 (71.9)
Diabetes	125 (50.6)	20 (39.2)	105 (53.6)
Liver disease	45 (18.2)	8 (15.7)	37 (18.9)
Stroke	24 (9.7)	5 (9.8)	19 (9.7)
Ischemic heart disease	32 (13.0)	3 (5.9)	29 (14.8)
Dyslipidemia	41 (16.6)	3 (5.9)	38 (19.4)
Chronic kidney disease	15 (6.1)	1 (2.0)	14 (7.1)
Heart failure	8 (3.2)	0 (0.0)	8 (4.1)
Cancer type			
Gastrointestinal	88 (35.6)	13 (25.5)	75 (38.3)
Genitourinary	51 (20.6)	17 (33.3)	34 (17.3)
Breast	45 (18.2)	14 (27.5)	31 (15.8)
Gynecologic	28 (11.3)	4 (7.8)	24 (12.2)
Lung	18 (7.3)	1 (2.0)	17 (8.7)
Nasolabial melanoma	4 (1.6)	0 (0.0)	4 (2.0)
Thyroid	3 (1.2)	0 (0.0)	3 (1.5)
Soft-tissue sarcoma	2 (0.8)	1 (2.0)	1 (0.5)
Skin cancer	2 (0.8)	0 (0.0)	2 (1.0)
Head and neck	2 (0.8)	1 (2.0)	1 (0.5)
CNS tumor	1 (0.4)	0 (0.0)	1 (0.5)
Not documented	3 (1.2)	0 (0.0)	3 (1.5)
Metastasis			
Absent	100 (40.5)	22 (43.1)	78 (39.8)
Present	125 (50.6)	27 (52.9)	98 (50.0)
Not documented	22 (8.9)	2 (3.9)	20 (10.2)
Cancer medication used			
No anticancer therapy	126 (51.0)	25 (49.0)	101 (51.5)
At least one anticancer therapy	121 (49.0)	26 (51.0)	95 (48.5)
Hormonal therapy	54 (21.9)	17 (33.3)	37 (18.9)
Chemotherapy	41 (16.6)	6 (11.8)	35 (17.9)
Monoclonal antibody	7 (2.8)	2 (3.9)	5 (2.6)
Tyrosine kinase inhibitor	6 (2.4)	0 (0.0)	6 (3.1)
Combination between different classes	13 (5.3)	1 (2.0)	12 (6.1)
Number of medications used per patient	6.9 ± 3.5	3.3 ± 1.1	7.9 ± 3.3
Anticancer agents	1.5 ± 0.6	1.2 ± 0.4	1.6 ± 0.6
Supportive care medications	1.0 ± 1.2	0.4 ± 0.7	1.2 ± 1.2
Medications for comorbidities	5.2 ± 3.5	2.3 ± 1.3	5.9 ± 3.6
Laboratory values			
Serum creatinine, mmol/L	87.1 ± 64.8	79.9 ± 31.1	88.8 ± 70.7
Aspartate aminotransferase, U/L	39.0 ± 57.9	27.7 ± 20.0	41.7 ± 63.5
Alanine aminotransferase, U/L	25.5 ± 36.6	20.1 ± 20.5	26.9 ± 39.4
Total Bilirubin, umol/L	17.5 ± 34.0	12.3 ± 30.5	18.8 ± 34.7

Table 2 (continued)

Characteristic	Overall	Occurrence of Drug-Drug Interaction	
		No	Yes
International Normalized Ratio (INR)	1.2 ± 0.5	1.1 ± 0.2	1.2 ± 0.5
Gamma-glutamyl Transferase	97.4 ± 114.8	133.3 ± 147	91.2 ± 109.2

Numbers are presented as mean ± standard deviation or frequency with (percentage)

Table 3 Prevalence, classification, and of potential drug interactions among patients with cancer

Variable	Mean ± SD and/or Frequency (%)
Total number of drug-drug interactions in all patients	1101
Number of patients with drug-drug interactions	196 (79.4)
Mean number of drug-drug interactions per patient	5.6 ± 5.3
Max number of drug-drug interactions in one patient	30
Severity	
Minor (B)	240 (21.8)
Moderate (C)	649 (58.9)
Major (D or X)	212 (19.3)
Major (D)	190 (89.6)
Major (X)	22 (10.4)

Numbers are presented as mean ± standard deviation or frequency with (percentage)

cancers. The detailed results from these univariate and multivariable logistic regressions are presented in Table 4.

Discussion

In our cross-sectional study, we aimed to assess the prevalence and severity of DDIs among elderly oncology patients treated in ambulatory settings. We also investigated the risk factors associated with these interactions. We believe that the outcomes of our study will improve the knowledge of medication management practices and the related risks among older patients with cancer.

In our study, the prevalence of potential DDIs was 79.4% among older patients with cancer. Previous studies conducted exclusively in older patients with cancer have demonstrated substantial variability in the reported prevalence of such DDIs, with rates ranging from 16 to 98%

Table 4 Analyses of risk factors for the occurrence of potential drug interactions

Variable	No DDI	Having DDI	Unadjusted OR (95% CI)*	Adjusted OR (95% CI)**
Age	74.5 ± 7.7	74.0 ± 7.5	1.01 (0.96–1.05)	---
Gender				
Male	29 (56.9)	98 (50.0)	Ref	Ref
Female	22 (43.1)	98 (50.0)	1.32 (0.70–2.50)	**37.4 (4.13–338.3)**
Number of comorbidities	1.8 ± 1.4	2.7 ± 1.6	**1.49 (1.19–1.88)**	---
Number of medications	3.3 ± 1.1	7.9 ± 3.3	**3.08 (2.16–4.40)**	**4.07 (2.53–6.54)**
Cancer type				
Gastrointestinal	13 (25.5)	75 (38.3)	Ref	Ref
Genitourinary	17 (33.3)	34 (17.3)	**0.29 (0.12–0.69)**	0.68 (0.14–3.42)
Breast	14 (27.5)	31 (15.8)	0.92 (0.27–3.16)	**0.02 (< 0.01–0.24)**
Gynecologic	4 (7.8)	24 (12.2)	**0.30 (0.12–0.74)**	**0.04 (< 0.01–0.29)**
Lung	1 (2.0)	17 (8.7)	2.55 (0.31–21.2)	12.3 (0.77–198.6)
Nasolabial melanoma	0 (0.0)	4 (2.0)	NAE	NAE
Thyroid	0 (0.0)	3 (1.5)	0.16 (0.01–2.74)	0.44 (0.02–10.17)
Soft-tissue sarcoma	1 (2.0)	1 (0.5)	NAE	NAE
Skin cancer	0 (0.0)	2 (1.0)	NAE	NAE
Head and neck	1 (2.0)	1 (0.5)	NAE	NAE
CNS tumor	0 (0.0)	1 (0.5)	NAE	NAE
Metastasis				
Absent	100 (40.5)	22 (43.1)	Ref	Ref
Present	125 (50.6)	27 (52.9)	1.04 (0.55–1.96)	0.41 (0.12–1.33)
Cancer Therapy				
No anticancer therapy	25 (49.0)	101 (51.5)	Ref	---
Any anticancer therapy	26 (51.0)	95 (48.5)	0.92 (0.49–1.73)	---

Numbers are presented as mean ± standard deviation or frequency with (percentage). Numbers in bold indicates significant results. Abbreviations: NAE: Not able to provide accurate estimate, due to insufficient number of events; OR: Odds Ratio

* Unadjusted OR are from the univariate logistic regression

** The AORs are the adjusted odds ratio from the backward-stepwise multivariable logistic regression model

[6, 24, 33–36]. This variability may be attributed to differences in study design, patient populations, DDI screening tools, and criteria for defining and classifying potential DDIs. The high prevalence of potential DDIs observed in our study underscores the complexity of managing pharmacotherapy in elderly oncology patients, who often have multiple comorbidities and are prescribed a wide range of medications. Similar to previous findings, our study's mean number of medications per patient was high (6.9 ± 3.5) [24]. Polypharmacy, a well-established risk factor for DDIs [36], not only increases the likelihood of adverse drug reactions but also complicates the clinical management of cancer and its associated conditions [37].

The majority of the DDIs identified in our study (58.9%) were categorized as "moderate" in severity, whereas 19.3% were classified as "major." This distribution aligns with findings from previous studies, which reported a similar pattern of moderate DDIs being the most prevalent ones [6, 38]. However, other studies have highlighted a different pattern, where major interactions were more commonly observed [39]. Notably, major interactions pose the highest clinical risk. The impact of these interactions on treatment efficacy and safety outcomes warrants further investigation. Certain drug interactions may reduce the bioavailability of anticancer agents, potentially compromising therapeutic effectiveness and leading to treatment failure [40]. On the other hand, some interactions may increase toxicity or exacerbate comorbid conditions, necessitating dose modifications or treatment discontinuation to mitigate adverse effects [8, 9]. For example, a study revealed that geriatric patients with advanced cancer who had at least one major potential drug interaction had 59% increased odds of early treatment discontinuation due to toxicity (OR 1.59; 95% CI 1.03–2.46) [7]. Therefore, routine screening and vigilant monitoring of DDIs are essential to optimize treatment outcomes, minimize adverse effects, and ensure safe and effective use of anticancer therapies in high-risk patient populations.

Minimizing the risks associated with DDIs in elderly oncology patients requires structured interventions to improve treatment effectiveness and safety. Pharmacist-led medication reviews have been shown to increase medication safety and optimize pharmacotherapy in oncology settings [41]. A study demonstrated that pharmacists effectively mitigated the majority of potential DDIs through various interventions, including treatment monitoring (44.2%), discontinuation of interacting medications (36.5%), and dose adjustments (17.3%) [42]. Furthermore, the integration of artificial intelligence (AI)-based DDI detection tools into clinical workflows has the potential to enhance real-time identification of potential interactions, enabling proactive interventions to prevent adverse events [43]. These technologies have demonstrated efficacy in detecting complex DDIs and supporting clinical decision-making, particularly in high-volume health care settings where patients often receive complex medication regimens [44].

Our regression analyses identified several predictors for potential DDIs. Among these, the number of medications was a key determinant of DDIs, which is consistent with the findings of previous studies in oncology and other specialties [39]. Similarly, patients with comorbidities were more likely to have DDIs (although this difference was statistically significant only in the univariate analysis). These findings emphasize the importance of a multidisciplinary approach to medication management, particularly in older patients with cancer, to mitigate the risks associated with polypharmacy and comorbidity burden.

Female sex was associated with greater odds of experiencing DDIs (AOR 37.4; 95% CI 4.13–338.3). This contrasts with earlier studies among oncology patients that found no significant association between sex and the risk of experiencing DDIs [39]. Interestingly, one study conducted among patients taking oral anticancer agents reported that males had a greater risk for potential DDIs [45]. Nevertheless, generally, older females tend to utilize more medicines than men do, putting them at increased risk of DDIs [46]. A Brazilian study analyzed DDIs in elderly patients, focusing on age and sex differences. The findings showed that women under 80 years of age used more drugs than men in the same age group did, whereas men over 80 years of age used more drugs than men in other age groups did. Overall, 32.6% of men and 49.2% of women reported at least one DDI [47]. The greater number of medications used in women was attributed to their greater health awareness, earlier health care consultations, and familiarity with medications. They also tend to recognize and report more health issues influenced by sex-related psychosocial factors. Consequently, the higher rate of medication use among women may have contributed to the increased odds of experiencing DDIs among them. However, the particularly large AORs and wide confidence intervals observed in our study warrant further exploration, as they may be influenced by confounding factors. Another potential explanation is the relatively small sample size, which could have resulted in statistical instability and a wider confidence interval.

Conversely, patients with breast or gynecologic cancers in our study were less likely to have potential DDIs. Few studies have explored the relationship between the type of cancer and the likelihood of experiencing DDIs. For example, a study from Canada identified brain tumor patients as being at significant risk of experiencing DDIs, likely due to the frequent use of anticonvulsants in this population [48]. Additionally, an Iranian study revealed that cancers originating in specific organs, such as the

esophagus, testis, and cervix, were independent predictors of having at least one potential DDI [49]. These findings suggest that the type of cancer, along with its associated treatment protocols and supportive care needs, may influence the risk of DDIs.

Although our study provides valuable insights into the prevalence and predictors of DDIs in elderly patients with cancer, several limitations need to be acknowledged. The retrospective nature of our study limits the ability to evaluate the clinical consequences associated with identified DDIs and to establish causality between DDIs and clinical outcomes. Additionally, the cross-sectional design limits our ability to assess medication changes during cancer treatment and the reasons for these changes. Several potential confounding factors, including medication adherence, differences in prescribing patterns across centers, and variations in clinical decision-making among physicians, may have influenced our findings. However, owing to the limitations of the available data, we were unable to comprehensively account for these intercenter and practice-related differences. Furthermore, the study was conducted in two tertiary hospitals with relatively small sample sizes, which may limit the generalizability of our findings to other health care settings, such as primary care centers. Only one DDI screening database (Lexi-Interact®) was used for the identification of potential DDIs. However, other sources are also available, which may not necessarily yield the same results. Moreover, we were unable to consider other medication variables beyond the medication count, such as the indication, dosage, directions for use, and duration. In addition, details about specific drug classes involved in DDIs were not reported, limiting our ability to identify the most frequently implicated therapeutic categories and assess their potential clinical impact. Last, information on the clinical significance of these potential DDIs is lacking owing to poor documentation of outcomes for these DDIs in electronic health records. While Saudi Arabia has established ADR reporting systems, underreporting and inconsistent documentation practices remain significant challenges. Future large, prospective, multicenter studies are needed to assess the associations between these interactions and adverse outcomes. These studies should incorporate comprehensive medication data, including drug classes, names, dosages, duration of use, and indications. Additionally, improved documentation and access to ADR databases will enhance both the internal and the external validity of the findings.

This is the first study to investigate the prevalence and severity of DDIs in this vulnerable group in Saudi Arabia, and more studies in this area are still needed. Moreover, electronic systems or artificial intelligence tools are needed to detect these DDIs, predict their impact, and monitor the corresponding patients for significant outcomes.

In conclusion, our study highlights the high prevalence of potential DDIs in elderly patients with cancer. In addition, having polypharmacy and being female emerged as key predictors of experiencing DDIs. These results emphasize the importance of thorough medication reviews and enhanced coordination among health care providers to optimize treatment and reduce the risk of adverse drug reactions in this vulnerable group.

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Author contributions
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Data availability
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study was carried out according to the principles of the Declaration of Helsinki, and approval was granted by the supervising institutional review boards (IRB) at KSMC (IRB: H1RI-07-Dec22-02) and KAMC (SP23R/019/03), with the need for written consent waived by the ethical committee due to the retrospective nature of the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Declaration of generative AI and AI-assisted technologies in the writing process
During the preparation of this work the author(s) used ChatGPT 4.0 Mini to paraphrase the text and enhance readability. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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