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Sedative-hypnotic drug use and risk of falls and fractures in elderly patients: a cross-sectional study

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Abstract

Background Falls are a leading cause of injury, hospitalization, and mortality among older adults. Sedative-hypnotic medications, especially benzodiazepines and Z-drugs, have been implicated as potential contributors to fall risk and fracture. This study investigated the prevalence of sedative-hypnotic drug use in elderly patients with falls and its association with fracture outcomes.

Methods A cross-sectional study was conducted on 200 patients aged ≥ 60 years presenting with falls to Rasool Akram Hospital, Tehran (2023–2024). Demographics, comorbidities, and medication history were extracted from medical records. Sedative-hypnotic use was recorded, and outcomes included fracture occurrence confirmed by imaging. Statistical analyses included chi-square tests and multivariate logistic regression.

Results Among 200 patients (mean age 73 ± 8 years; 65.5% female), 55.5% sustained a fracture. Sedative-hypnotic use was identified in 15.5% ($n = 31$). Fracture prevalence was higher in sedative users compared to non-users (74% vs. 52%), but the difference was not statistically significant ($p = 0.08$). Benzodiazepines were the most commonly used class (15.5%). Losartan use was more frequent in fracture patients (29.7% vs. 12.4%) and showed a significant association in logistic regression (OR 3.28; 95% CI: 1.48–7.26; $p = 0.003$).

Conclusions Sedative-hypnotic use was common among elderly patients presenting with falls; although fracture risk was higher in users, the association did not reach statistical significance, likely due to limited sample size. The observed link between losartan and fractures should be interpreted cautiously and warrants further investigation. Medication review remains a critical component of fall-prevention strategies in geriatric care.

Keywords Sedative-hypnotics, Benzodiazepines, Falls, Fractures, Elderly, Polypharmacy

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Introduction

Falls in older adults are a major global health concern. According to the World Health Organization, falls are the second leading cause of accidental injury deaths worldwide, with adults over 60 years being at the highest risk [1]. In the United States alone, more than one in four people aged 65 years or older fall each year, and falls are the most common cause of injury-related hospitalizations in this age group [2]. Falls often lead to injury; around 20% of such incidents result in serious trauma (e.g. fractures or head injuries) that require medical attention [3]. Consequently, falls are a leading cause of emergency department visits and hospitalizations among the elderly [4]. Globally, as populations age, the absolute number of fall-related injuries is growing—by 2030, one in six people in the world will be aged ≥ 60 [5]. This trend makes fall prevention in older adults increasingly important.

Multiple risk factors for falls have been identified, including age-related declines in balance and vision, chronic illnesses (such as Parkinson's disease or cognitive impairment), and environmental hazards [6]. Medication use is a particularly modifiable risk factor. In particular, sedative and psychotropic drugs are known to adversely affect balance and cognition, thereby increasing fall risk [7–9]. Benzodiazepines (BZDs) and related sedative-hypnotics (so-called "Z-drugs" like zolpidem) are of special concern [10, 11]. These medications are commonly prescribed to older adults for anxiety and insomnia, despite guidelines advising caution. The American Geriatrics Society's Beers Criteria lists benzodiazepines and non-benzodiazepine hypnotics as potentially inappropriate for older patients due to their association with confusion, falls, and fractures [12]. Studies and meta-analyses have demonstrated that BZD use in the elderly confers a significant increase in fall and fracture risk [13, 14]. For example, a 2019 meta-analysis of 33 studies found benzodiazepine use associated with a ~ 34% higher risk of hip fracture compared to non-use [13]. Similarly, "Z-drug" sleeping pills have been linked to a 1.6-fold increase in fractures in older adults [11]. The mechanism is thought to relate to drug-induced sedation, impaired reflexes, and postural instability [6].Despite these risks, sedative-hypnotic medications remain widely used by older adults. In the United States, an estimated 8.7% of adults ≥ 65 fill a BZD prescription each year [15], and in some countries this prevalence may exceed 10–15% [16, 17]. In many regions, there is a cultural tendency to treat insomnia and anxiety pharmacologically, which may lead to high rates of hypnotic drug use in the geriatric population. Polypharmacy in general is common in older patients and contributes to fall risk as well [3]. However, there is a paucity of local data quantifying how frequently elderly fall patients are on sedatives, and whether this correlates with their injury outcomes.

This study aimed to determine the prevalence of sedative-hypnotic drug use among elderly patients presenting with falls and to examine its association with the occurrence of fall-related fractures in a hospital-based cohort in Tehran, Iran.

Materials and methods

Study design

This cross-sectional, observational study was conducted between March 21, 2023, and March 19, 2024, at Rasool Akram Hospital, a tertiary referral center in Tehran, Iran. The study focused on elderly patients presenting to the emergency department following a ground-level fall. The study protocol was approved by the institutional ethics committee, and all patient data were handled with strict confidentiality.

Inclusion and exclusion criteria

We included patients aged 60 years and older who presented to the emergency department with a primary complaint of a ground-level fall or other low-energy trauma. Patients whose falls were due to high-energy trauma (e.g., motor vehicle accidents), those with incomplete medical records, or repeated admissions for the same incident were excluded.

Sampling method and sample size

The sample size was determined based on an expected prevalence of sedative-hypnotic use of approximately 15% among elderly patients with falls, as reported in previous studies [9]. Using a single population proportion formula with a 95% confidence interval, 5% margin of error, and an expected prevalence (p) of 0.15, the required sample size was estimated at 196 patients. To account for potential missing data, we enrolled 200 patients.

A total of 200 eligible patients were selected using convenience sampling from the hospital's emergency department registry. Patient selection continued throughout the study period until the desired sample size was achieved. Sample size was determined to ensure adequate representation of sedative-hypnotic medication use among elderly fall patients, based on expected prevalence estimates from prior literature.

Data collection

Patient data were extracted retrospectively from electronic medical records using a standardized and structured checklist. Extracted variables included demographic data (age, sex), residential status, clinical history (e.g., diabetes mellitus, osteoporosis, prior falls or fractures), and medication profiles. Specific attention was given to the use of sedative-hypnotic drugs, including benzodiazepines (such as diazepam, alprazolam, clonazepam, lorazepam, and chlordiazepoxide) and Z-drugs

(such as zolpidem). Both regular and as-needed use of these agents were recorded. Additional medications were documented to evaluate polypharmacy, defined as the concurrent use of five or more drugs. Use of dietary supplements such as vitamin D and calcium was also noted. Polypharmacy was defined as the concurrent use of five or more prescription medications, in accordance with widely accepted criteria for geriatric populations [6].

Outcomes

The primary outcome was the occurrence of any fall-related fracture confirmed through radiographic imaging. Secondary outcomes included the anatomical site of the fracture (with particular emphasis on hip fractures), hospitalization following the fall, and the requirement for surgical intervention. Functional limitations and post-fall complications were also documented where available in follow-up records.

Table 1 Descriptive characteristics of elderly patients presenting with falls from the same level or from a height

Variable	Category	Frequency	Percentage (%)
Gender	Male	69	34.5
	Female	131	65.5
Current Occupation	Full-time job	20	10.0
	Part-time job	20	10.0
	Retired	55	27.5
	Unemployed	105	52.5
Education Level	Illiterate	31	15.5
	Primary education	76	38.0
	Secondary education	39	19.5
	Higher education	54	27.0
Marital Status	Single	16	8.0
	Married	113	56.5
	Other (widowed/divorced)	71	35.5
Place of Birth	Tehran	54	27.0
	Other cities	146	73.0
Housing Type	Rented	9	4.5
	Mortgaged	12	6.0
	Owned	164	82.0
	Living with relatives	1	0.5
	Elderly care home	14	7.0
Living Arrangement	Alone	12	6.0
	With spouse only	48	24.0
	With spouse and unmarried children	65	32.5
	Without spouse, with unmarried children	13	6.5
	Without spouse, with married children	23	11.5
	With relatives	9	4.5
	With others (nurse/friend, etc.)	30	15.0
	Total	200	100.0

Statistical analysis

Descriptive statistics were used to summarize the baseline characteristics of the cohort. Categorical variables were expressed as frequencies and percentages, while continuous variables were described using means and standard deviations. Descriptive statistics were applied to qualitative variables (reported as frequency and relative frequency) and quantitative variables (reported as mean and standard deviation).

For analytical comparisons, the Kolmogorov–Smirnov test was used to assess the normality of the distribution of quantitative variables. If normal distribution was confirmed, independent sample t-tests were used for comparing means. In cases where the assumption of normality was not met, the Mann–Whitney U test was applied. For categorical variables, comparisons between groups (e.g., patients with vs. without fractures) were conducted using the chi-square test or Fisher's exact test where appropriate. The relationship between sedative-hypnotic use and fracture occurrence was specifically evaluated. Multivariate analysis was done through logistic regression analysis with Enter method. A p-value of <0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics software, version 26.

Ethical considerations

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. The study protocol received ethical approval from the Ethics Committee of Shiraz University of Medical Sciences (Approval Code: IR.IUMS.FMD.REC.1401.600). All data were anonymized, and patient confidentiality was maintained throughout the study. Clinical trial number: not applicable.

Results

Descriptive characteristics of the patients

This study aimed to investigate the association between the prevalence of hypnotic drug use and fall-related fractures in elderly patients presenting to the emergency department of Rasool Akram Hospital in 2023. A total of 200 elderly patients who presented with complaints of falls were evaluated. The mean age of the participants was estimated to be approximately 73 ± 8 years, as all individuals included in the study were aged 60 years or older The mean ± standard deviation of the patients' weight and height were 69.58 ± 10.51 kg and 166.36 ± 7.76 cm, respectively. Table 1 presents the descriptive characteristics of the 200 elderly patients who experienced a fall either from the same level or from a height.

Fall circumstances and characteristics

Table 2 shows the characteristics of the falls. All patients (100%) experienced a fall either from the same level or from a height. Of them, 89% had experienced a single fall prior to their visit, and 99.5% sought medical care on the same day. Among those who responded, 99.2% reported movement limitations following the fall. Additionally, 55.5% suffered fractures due to the fall, 53.5% were hospitalized, and 20% underwent surgery.

Fall location

59% of falls occurred at home, most frequently in the living room (20%). Falls outside the home accounted for 35% of cases, with the street being the most common location (14.5%).

Prevalence of comorbidities

Table 3 presents the distribution of comorbidities among the elderly patients. Of the 200 patients who presented with falls, 25.5% had a history of diabetes, 38% had osteoporosis, and 67.5% had a previous history of fractures, with 25.5% having experienced a hip fracture. Among patients aware of their parents' medical history, 16.93% reported maternal fractures and 8.6% reported paternal fractures.

When comparing patients who experienced fractures with those who did not, the prevalence of diabetes was 27% vs. 23.6%, rheumatoid disease 1.8% vs. 0%, osteoporosis 44.1% vs. 30.3%, and prior fractures 100% vs. 27%.

- 3.3.1. Diabetes and Fracture: No statistically significant association was observed between diabetes and fall-related fractures ($P = 0.555$).
- 3.3.2. Osteoporosis and Fracture: No statistically significant association was found ($P = 0.052$).
- 3.3.3. Rheumatoid Disease and Fracture: No significant association was observed ($P = 0.203$).
- 3.3.4. History of Previous Fractures and Fall-Related Fracture: A statistically significant association was found ($P < 0.001$).
- 3.3.5. History of Hip Fracture and Fall-Related Fracture: No significant association ($P = 0.884$).
- 3.3.6. Maternal History of Fracture:No significant association ($P = 0.485$).

Table 2 Characteristics of the fall and its consequences

Variable	Frequency	Valid Percent (%)
One fall before ER visit	178	89.0
Two falls	12	6.0
Three falls	8	4.0
Four falls	2	1.0
Fall without medical causes	20	10.0
ER visit on same day as fall	199	99.5
Fracture due to fall	111	55.5
Movement limitation post-fall	131	99.2
Hospitalization due to fall	107	53.5
Wound or scratch at fall time	107	53.5
Fear of falling – Somewhat	58	29.0
Fear of falling – Very much	134	67.0
Fear of falling – No fear	8	4.0
Reduced activity due to fear of falling	160	85.1
Balance when walking – Balanced	113	57.0
Balance when walking – Low	56	28.3
Balance when walking – None	29	14.6
Balance when standing – Balanced	127	63.5
Balance when standing – Low	49	24.5
Balance when standing – None	24	12.0
Balance rising from floor – Balanced	114	57.0
Balance rising – Low	59	29.5
Balance rising – None	27	13.5
Surgery after fall	40	20.0

- 3.3.7. Paternal History of Fracture: No significant association ($P = 0.432$).

Supplement use

70.5% of patients who fell, 72.1% of those who experienced fractures, and 68.5% of those without fractures reported supplement use. Vitamin D was the most commonly used supplement among both fractured (34%) and non-fractured (28.5%) groups, whereas calcium was most frequently used among those without fractures (31.5%). There was no statistically significant association between supplement use and the occurrence of fractures ($P > 0.05$).

Medication use

Table 4 summarizes the use of medications. Among the 200 elderly patients with falls, 77% had a history of at least one medication use, and this proportion increased to 83.8% among those with fractures. Losartan was the

Table 3 Comorbidities and fracture status

Variable	Frequency (All)	% (All)	Frequency (Fracture)	% (Fracture)	Frequency (No Fracture)	%(No Fracture)	*P*-Value
Diabetes	51	25.5	30	27.0	21	23.6	0.555
Rheumatoid Disease	2	1.0	2	1.8	0	0.0	0.203
Osteoporosis	76	38.0	49	44.1	27	30.3	0.052
Previous Fracture	135	67.5	111	100.0	24	27.0	0.000
Previous Hip Fracture	51	25.5	28	25.2	23	25.8	0.884
Maternal Fracture History	32	16.93	18	17.5	14	16.3	0.485
Paternal Fracture History	16	8.6	8	7.9	8	9.4	0.432

Table 4 Comparison of medication use among elderly patients who experienced a fall, based on the presence or absence of a fracture. Frequencies, percentages, and P-values are reported

Medication	Frequency (All)	Percentage (All)	Frequency (Fracture)	Percentage (Fracture)	Frequency (No Fracture)	Percentage (No Fracture)	*P*-Value
Used ≥ 1 medication	154	77.0	93	83.8	61	68.5	—
Lorazepam	2	1.0	2	1.8	Missing Data	Missing Data	0.203
Chlordiazepoxide	9	4.5	6	5.4	3.0	4.3	0.49
Aspirin	41	20.5	21	18.9	20	22.5	0.536
Memantine	5	2.5	2	1.8	3.0	4.3	0.48
Tramadol + Acetaminophen	2	1.0	1	0.9	1.0	1.1	0.875
Diazepam	2	1.0	1	0.9	1.0	1.1	0.875
Alprazolam	12	6.0	8	7.2	4.0	4.5	0.422
Zolpidem	1	0.5	1	0.9	Missing Data	Missing Data	0.369
Melatonin	4	2.0	4	3.6	Missing Data	Missing Data	0.07
Diazepam	1	0.5	1	0.9	Missing Data	Missing Data	0.369
Clonazepam	9	4.5	5	4.5	4.0	4.5	0.997
Sertraline	6	3.0	3	2.7	3.0	4.3	0.783
Fluoxetine	5	2.5	4	3.6	1.0	1.1	0.264
Olanzapine	4	2.0	2	1.8	2.0	2.2	0.823
Nortriptyline	1	0.5	1	0.9	Missing Data	Missing Data	0.369
Atorvastatin	43	21.5	28	28.2	15.0	16.9	0.152
Rosuvastatin	3	1.5	3	2.7	Missing Data	Missing Data	0.118
Metformin	35	17.5	21	18.9	14.0	15.7	0.555
Amlodipine	16	8.0	10	9	6.0	6.7	0.557
Gliclazide	4	2.0	2	1.8	2.0	2.2	0.823
Hydrochlorothiazide	5	2.5	4	3.6	1.0	1.1	0.264
Valsartan	10	5.0	5	4.5	5.0	5.6	0.72
Losartan	44	22.0	33	29.7	11.0	12.4	0.03
Metoprolol	14	7.0	11	9.9	3.0	3.4	0.072
Propranolol	4	2.0	4	3.6	Missing Data	Missing Data	0.07

most frequently used medication (22% in the general fall group; 29.7% in those with fractures). Alprazolam was the most commonly used hypnotic drug (6% in fall patients; 7.2% in fracture group). A significant association was found between Losartan use and fall-related fractures ($P = 0.030$). No other drug, including hypnotics, showed a statistically significant association with fractures

As shown in Fig. 1, medication use was higher among patients with fractures compared to those without. For example, losartan was used by 29.7% of patients with fractures versus 12.4% of those without. A statistically significant association was observed only for losartan ($P = 0.030$), while no significant differences were found for other medications.

Hypnotic drug use

Benzodiazepines were the most frequently used hypnotics in both fall patients (15.5%) and those with fractures (18%). The use of antidepressants, antipsychotics, melatonin, and zolpidem was low and not significantly associated with fractures ($P > 0.05$).

Figure 2 presents the use of hypnotic drug classes in elderly fall patients. Benzodiazepines were the most commonly used hypnotic agents (18% in the fracture group vs. 12.4% in the non-fracture group), although no significant association was observed between any drug class and fracture occurrence ($P > 0.05$).

Polypharmacy

polypharmacy was reported in 1.5% of the entire group, 1.8% of patients with fractures, and 1.1% of those without fractures. No statistically significant association was observed between polypharmacy and fall-related fractures ($P > 0.05$).

Multivariate analysis on medications

The findings from the logistic regression models highlighted the impact of losartan use on an increased fracture rate following falls, with an odds ratio of 3.278 (95% CI: 1.481–7.256, p-value = 0.003). No significant associations were observed with other medications regarding fracture rates, as illustrated in Table 5.

Figure 3 graphically displays the adjusted odds ratios and 95% confidence intervals for each medication from the multivariate logistic regression model. Only losartan

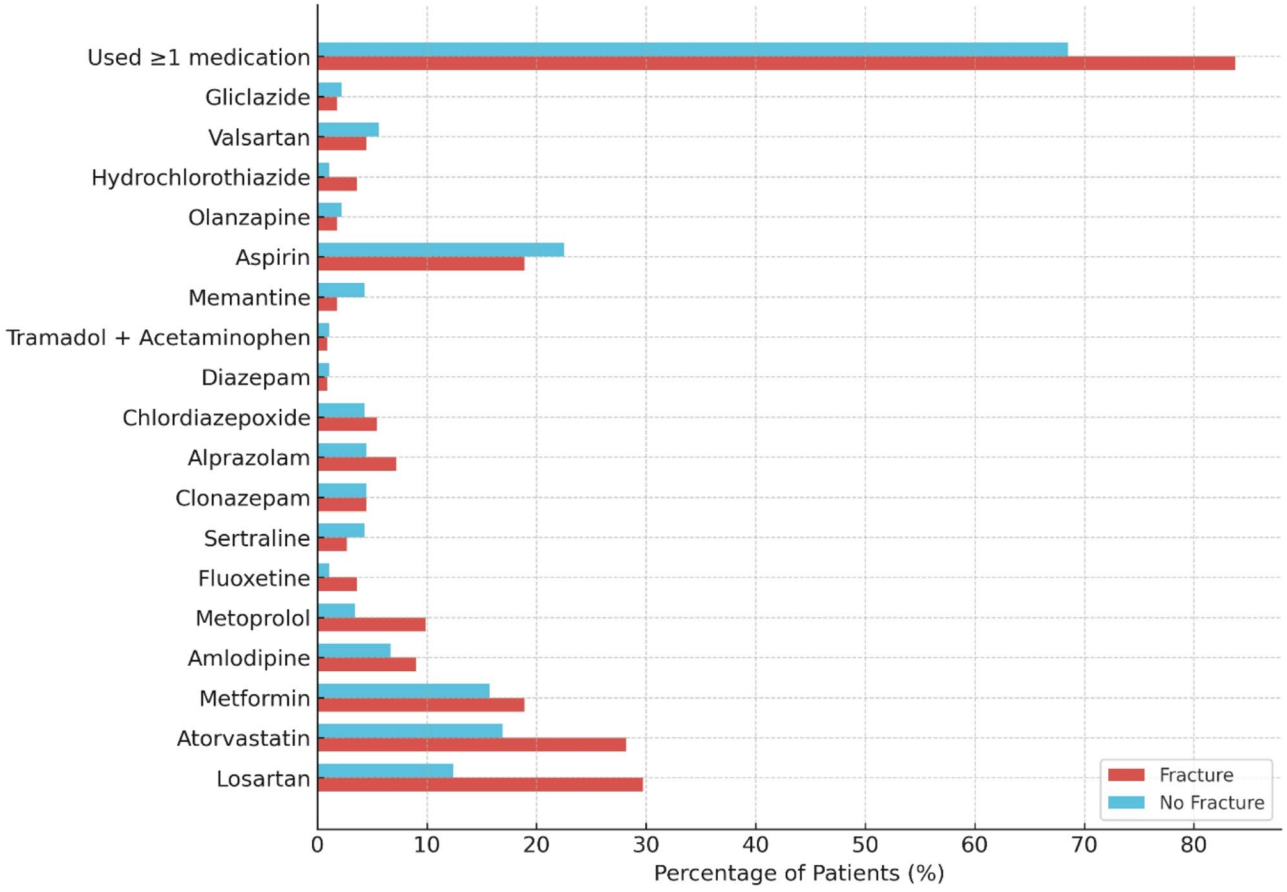

Fig. 1 Medication use among elderly fall patients with and without fractures. The figure highlights higher usage of medications such as losartan, atorvastatin, and alprazolam in the fracture group compared to the non-fracture group

showed a statistically significant association with fracture risk (OR = 3.28, 95% CI = 1.48–7.26).

Discussion

In this study of older adults presenting to a large emergency department with falls, we found a high burden of sedative-hypnotic medication use: about 15.5% of patients were regularly using a benzodiazepine or similar hypnotic. This prevalence is consistent with patterns observed in other settings, though it is on the higher end of the range reported in developed countries (for instance, 9–12% in studies from the US and UK) [17, 18]. The frequent use of alprazolam and other benzodiazepines in our cohort reflects prescribing practices in our region, where these drugs are often readily prescribed for insomnia or anxiety in older patients. From a clinical standpoint, this is concerning because sedative-hypnotics are well known to be fall-risk increasing drugs (FRIDs) [6]. BZDs can cause drowsiness, delayed reaction time, impaired balance, and nocturnal confusion, all of which can precipitate falls [6]. Guidelines worldwide, such as the AGS Beers Criteria and others, urge clinicians to avoid or minimize the use of these medications in the elderly [12]. The clinical relevance of our findings lies in the tension between the relatively high use of these potentially harmful medications and the need to prevent falls in a vulnerable population.

Interestingly, in our dataset the use of sedative-hypnotic medications was not statistically associated with an immediate increase in fracture risk from the index fall. This result is somewhat unexpected given the extensive literature linking such medications to falls and injuries [11, 13]. There are several possible explanations. First, our sample size (especially the subgroup on hypnotics, n = 31) may have limited power to detect a difference – the observed fracture rate was indeed higher in sedative users (74% vs. 52%), but with only 31 users this difference did not reach significance (p = 0.08). The trend suggests that a true effect might exist, aligning with prior studies, but that our study was underpowered to confirm it. A recent meta-analysis found that sedative-hypnotic users have approximately a 30% higher risk of fractures compared to non-users, reinforcing that even modest associations in smaller studies can be clinically relevant [19]. Second, there could be selection bias: patients on chronic sedatives may differ in other ways (e.g. they could be more

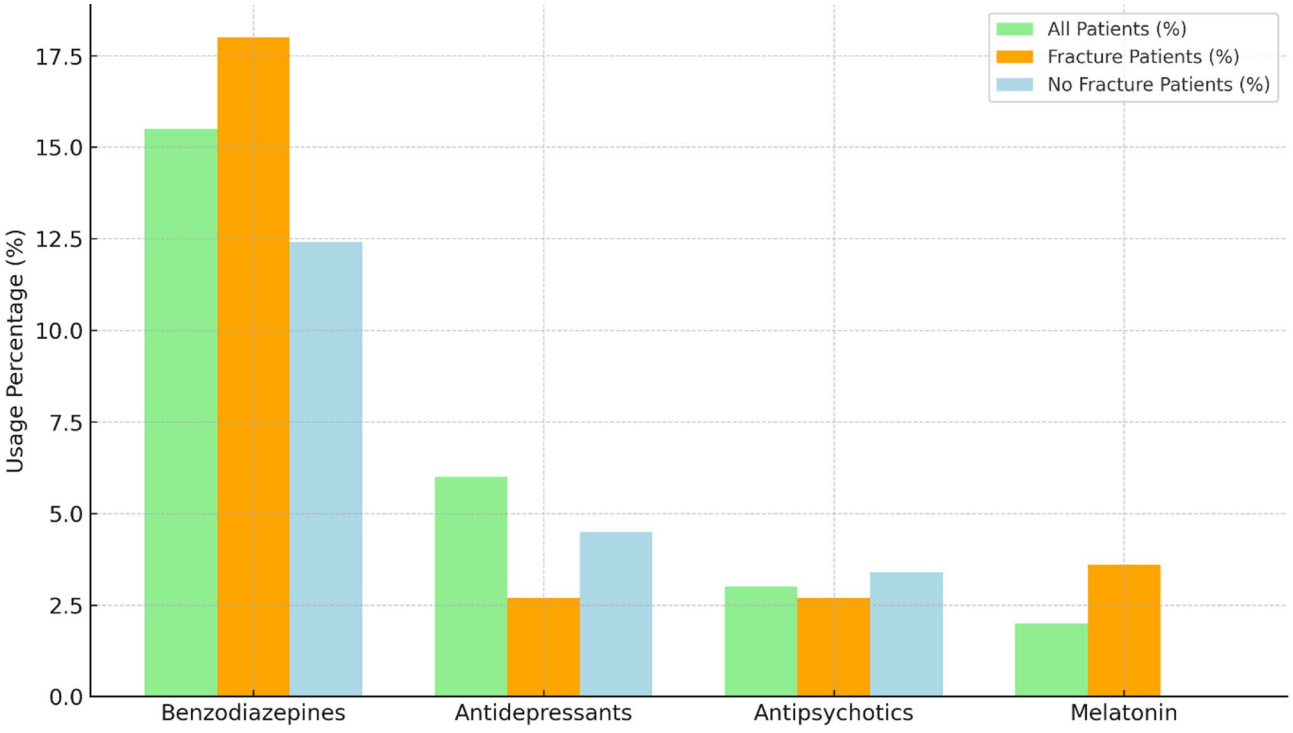

Fig. 2 Comparison of hypnotic drug class use in elderly patients with and without fractures. Benzodiazepines were the most commonly used class, followed by antidepressants. No statistically significant differences were found between groups ($P > 0.05$)

Table 5 Multivariate analysis of medication usage in fracture rates

Medication	β intercept (Standard Error)	Odds Ratio	95% CI for Odds Ratio	*P*-Value
Chlordiazepoxide	0.314 (0.790)	1.368	0.291–6.44	0.692
Aspirin	−0.453 (0.398)	0.636	0.291–1.388	0.255
Memantine	−0.874 (1.321)	0.417	0.031–5.552	0.508
Tramadol + Acetaminophen	0.265 (1.668)	1.303	0.050 – 34.277	0.874
Diazepam	1 (2.208)	2.719	0.036–205.998	0.651
Alprazolam	0.407 (0.708)	1.503	0.375–6.025	0.565
Clonazepam	−0.095 (0.753)	0.909	0.208–3.976	0.899
Sertraline	−0.185 (0.931)	0.831	0.134–5.156	0.842
Fluoxetine	1.413 (1.255)	4.107	0.351–48.038	0.260
Olanzapine	−0.396 (1.178)	0.673	0.067–6.767	0.737
Atorvastatin	0.592 (0.409)	1.807	0.810–4.030	0.148
Metformin	−0.003 (0.499)	0.997	0.413–2.405	0.995
Amlodipine	0.185 (0.588)	1.203	0.380–3.810	0.753
Gliclazide	−0.690 (1.224)	0.501	0.045–5.526	0.573
Hydrochlorothiazide	0.766 (1.192)	2.151	0.208–22.249	0.521
Valsartan	0.139 (0.892)	1.149	0.2–6.601	0.876
Losartan	1.187 (0.405)	3.278	1.481–7.256	**0.003**
Metoprolol	1.021 (0.732)	2.776	0.662–11.651	0.163
Constant	−0.171 (0.211)			0.419

cautious or mostly taking very low doses, or they might have conditions like anxiety that make them stay home more, mitigating some fall risk). Third, almost all our patients – both users and non-users of hypnotics – had very high fall risk due to factors like osteoporosis (38%) and past falls (nearly 90%). This homogeneous high-risk background may have overwhelmed any incremental risk from medications. In other words, when the baseline propensity for fractures is extremely high, the relative contribution of sedative use might be less detectable.

It is informative to compare our findings with those of other studies. Casey et al. (2023) studied older adults

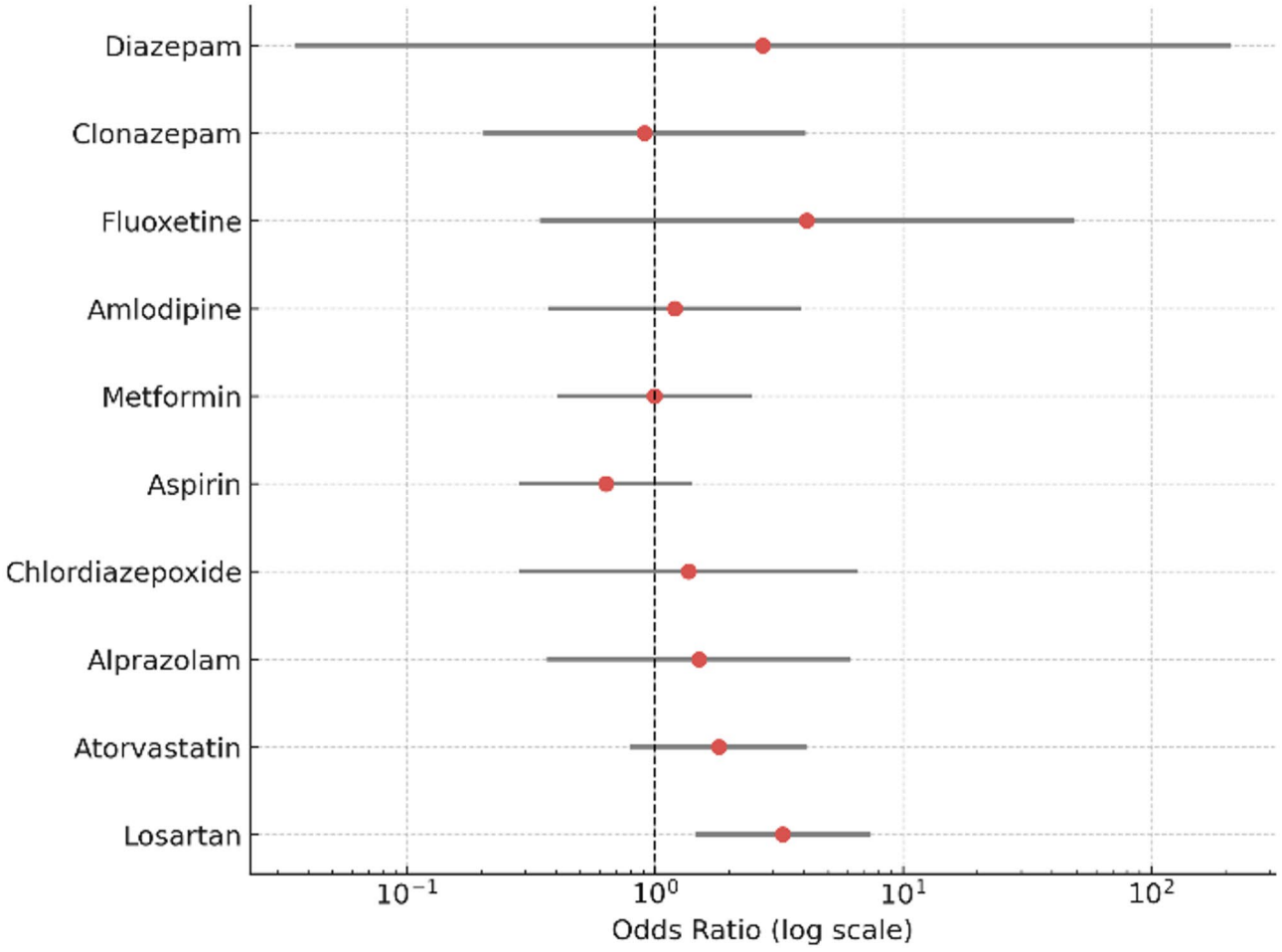

Fig. 3 Forest plot of adjusted odds ratios (95% confidence intervals) for medication use and fracture occurrence. The plot displays the adjusted odds ratios derived from the multivariate logistic regression model. Only losartan demonstrated a statistically significant association with fracture risk (p = 0.003)

who presented to US emergency departments after falls: they found that 46.7% were on at least one FRID and about 9.5% were on benzodiazepines [9]. Our cohort had a slightly higher benzodiazepine use (15.5%), possibly reflecting regional prescribing differences. Casey et al. also noted that the most common FRIDs were antidepressants (27% of patients) and anticonvulsants (18%), with benzodiazepines lower on the list [9]. In our study, antidepressant use was lower (only ~ 6% on SSRIs), so benzodiazepines were the predominant CNS depressant. The lack of a significant link between BZDs and fractures in our data diverges from the bulk of evidence in the literature. Numerous observational studies have demonstrated increased fall and fracture rates in BZD users, especially new users or those on higher doses [13, 14]. Both benzodiazepines and Z-drugs have been significantly associated with increased hip fracture risk in older adults, particularly among new users, suggesting that duration of exposure may modify the risk [19]. Our results should therefore be interpreted with caution; they do not prove absence of harm. In fact, it's notable that the sedative users in our sample had a non-significant trend toward more fractures, and importantly, virtually all were taking short-acting BZDs (like alprazolam) rather than long-acting ones. Some meta-analyses suggest short-acting BZDs carry slightly lower risk than long-acting ones [13], which might have tempered the impact in our group.

Another finding of interest was the significant association between losartan use and fractures. Patients on losartan had nearly a threefold greater representation in the fracture group than in the non-fracture group. This could be a spurious correlation or might indicate that those patients had poorly controlled hypertension or orthostatic hypotension contributing to falls. Antihypertensive medications in general are recognized as potential contributors to falls due to blood pressure lowering and dizziness [6]. In our cohort, losartan was often used in patients with multiple comorbidities (e.g. diabetes and hypertension), so it may be a marker of patients who were inherently frailer or more prone to falls. It is also conceivable that losartan's association could be confounded

by unmeasured variables (for example, perhaps those patients were less likely to use walking aids). Regardless, this finding underscores the multifactorial nature of falls: aside from sedatives, cardiovascular medications and underlying cardiovascular conditions can influence fall risk [6]. With respect to losartan, while our finding of a significant association with fractures is noteworthy, experimental data are mixed: animal studies suggest possible osteoprotective effects, whereas others indicate changes in bone microarchitecture, highlighting that clinical findings should be interpreted with caution [20, 21]. Clinicians should be aware that optimizing blood pressure in older adults is a balance between reducing stroke risk and not causing orthostatic drops that could precipitate falls.

From a public health perspective, our study highlights a critical issue: many older patients presenting with falls are on medications that could be deprescribed or substituted to potentially reduce further fall risk. While our data did not show a significant immediate effect of hypnotics on fractures, the weight of evidence externally indicates these drugs do contribute to falls and fractures [11, 13]. Therefore, the lack of significance in our study should not be taken as reassurance but rather as a prompt for further investigation. It may also point to an opportunity: because a high proportion of our fall patients were on sedatives, any efforts to reduce inappropriate sedative prescribing in the community could have meaningful impact. Clinical guidelines recommend non-pharmacological treatments (like cognitive-behavioral therapy for insomnia) as first-line for older adults [22], reserving hypnotics for short-term or severe cases. In practice, however, access to such therapies can be limited, and prescribing a pill is often the quicker solution.

Conclusion

Sedative-hypnotic medications, particularly benzodiazepines, were commonly used among elderly patients presenting with falls. Although fracture rates were higher among sedative users compared with non-users, the association did not reach statistical significance, likely due to limited sample size. This finding should not be interpreted as evidence of safety; rather, it highlights the need for larger studies to clarify the risk.Losartan use was associated with a higher likelihood of fracture, but this observation may represent a chance finding and requires confirmation in future research. Overall, our results emphasize the importance of comprehensive medication review in older adults as part of fall-prevention strategies. Careful deprescribing of high-risk medications, alongside management of osteoporosis and balance problems, remains a key approach to reducing fall-related injuries in this vulnerable population.

Implications for practice

Our findings support the need for regular medication reviews in older patients – particularly those with a history of falls. Even though we did not find a direct cause-effect in this small sample, deprescribing initiatives remain important. A systematic review by Palumbo et al. (2019) found that while the relationship between polypharmacy and falls is complex, reducing the number of medications can modestly lower fall risk [6]. Another study estimated that 5% of injurious falls could be avoided by eliminating polypharmacy (≥ 4 meds) if causality were assumed [6]. In our sample, polypharmacy rate was low, but many were on at least one FRID. Programs like the CDC's STEADI (Stopping Elderly Accidents, Deaths & Injuries) emphasize assessing medications as a key step in fall prevention [4]. Clinicians should consider tapering unnecessary sedatives in older patients, or switching to safer alternatives (e.g. prescribing melatonin or low-dose trazodone if a hypnotic is absolutely needed, since those may have a better safety profile). Importantly, any deprescribing must be done carefully to avoid withdrawal effects; for benzodiazepines, a slow taper is recommended [23].

Strengths and limitations

Sedative-hypnotic medications, particularly benzodiazepines, were commonly used among elderly patients presenting with falls. Although fracture rates were higher among sedative users compared with non-users, the association did not reach statistical significance, likely due to limited sample size. This finding should not be interpreted as evidence of safety; rather, it highlights the need for larger studies to clarify the risk.

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Future Directions

Given that we observed a high sedative use prevalence but could not conclusively link it to fractures in this study, a larger prospective study would be valuable. Enrolling a greater number of fall patients and tracking their medication changes and subsequent falls could clarify the impact of deprescribing. Additionally, exploring interventions in our hospital or community – such as a falls clinic that includes medication review – could help determine if reducing sedatives leads to fewer falls over time. Public health initiatives should also address patient and provider

education: many older patients are not aware that their "sleeping pill" or "nerve pill" might increase fall risk, and many prescribers continue them out of habit. Highlighting our finding that 1 in 6 fall patients were on a potentially inappropriate sedative can support calls for more judicious prescribing in geriatric care.

In conclusion, this study underlines that sedative-hypnotic medications are commonly used among older adults who fall, even though such drugs are known to contribute to instability. We did not find a statistically significant association between hypnotic use and acute fracture outcomes in this hospital-based sample, likely due to limited power and the uniformly high fall risk of our patients. Nevertheless, given extensive external evidence of harm, it remains clinically prudent to minimize the use of benzodiazepines and similar CNS depressants in the elderly. Our findings reinforce the need for integrated approaches to fall prevention: managing osteoporosis (38% of our patients had it), ensuring adequate vitamin D (despite 70% on supplements, falls still occurred), and critically, reviewing medications. Reducing unnecessary sedatives and other FRIDs is an actionable strategy that healthcare providers can undertake as part of comprehensive fall prevention in aging populations [3]. As populations worldwide continue to age, addressing medication-related fall risk is an important component of improving older adult health and maintaining their independence [1]. The high prevalence of hypnotic use observed should prompt reflection on prescribing practices and encourage healthcare systems to provide support for deprescribing and alternative therapies for insomnia and anxiety in the elderly. By doing so, we may reduce falls, fractures, and the associated morbidity in this growing segment of our population.

Supplementary Information

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Supplementary Material 1.

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Authors' contributions
All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Data availability
The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study was approved by the Research Ethics Committee of Iran University of Medical Sciences (Approval ID: IR.IUMS.FMD.REC.1401.600). Written informed consent was obtained from all participants or their legal guardians in accordance with the Declaration of Helsinki.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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