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Evaluation of the Potentially Inappropriate Cardiovascular Medication Prescription in Elderly: A Nationwide Study in Turkey

ABSTRACT

Background: Elderly comprises a specific group due to possible alterations in the effects of drugs and comorbidities. We aimed to identify for the first time the characteristics and rates regarding the inappropriate prescriptions of cardiovascular system medications in the geriatric age group in Turkey.

Methods: Cardiovascular system medications prescribed electronically by family physicians to patients aged 65 and over, in the years 2015 and 2016, were obtained through Prescription Information System administered by the Ministry of Health. Evaluation of potentially inappropriate prescriptions was done according to the "Beers Criteria 2015 update." Prescription rates for each group were evaluated under sub-breakdowns for the specialty of family physicians, gender, age groups, and "Nomenclature of Territorial Units for Statistics" regions.

Results: Approximately 65 million prescriptions were evaluated. The rate of potentially inappropriate cardiovascular medication prescribing was 0.33%. This raised to 11.56% when "drugs to be used with caution" were included. It was observed that potentially inappropriate drugs have been prescribed more by specialist family physicians. The most frequently prescribed potentially inappropriate drugs were doxazosin in the diagnosis of hypertension and methyldopa regardless of indication. Diclofenac-warfarin was the most commonly prescribed concomitant drug use in the potentially clinically important drug–drug interactions group. The rate of potentially inappropriate drug prescribing was higher in males and in aged 80 years and older.

Conclusions: This pharmacoepidemiological study draws attention to potentially inappropriate cardiovascular system drugs prescribed in primary care settings to the elderly. The rate of potentially inappropriate cardiovascular system drug prescribed was found to be very low in Turkey.

Keywords: Geriatrics, potentially inappropriate medication list, cardiovascular agents, drug prescriptions

ORIGINAL INVESTIGATION

Mehmet Tevfik Kitapçı[1,2]
Osman Karakuş[3]
Fatma İşli[4]
Mesil Aksoy[4]
Muhammed Cihan Güvel[5]
Canan Uluoğlu[5]

[1]*Department of Nuclear Medicine, Faculty of Medicine, Gazi University, Ankara, Turkey*
[2]*Integra Medical Imaging Center, Ankara, Turkey*
[3]*Department of Medical Pharmacology, Başakşehir Cam and Sakura City Hospital, İstanbul, Turkey*
[4]*Turkish Medicines and Medical Devices Agency, Ankara, Turkey*
[5]*Department of Medical Pharmacology, Faculty of Medicine, Gazi University, Ankara, Turkey*

Corresponding author:
Canan Uluoğlu
✉ culuoglu@yahoo.com

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INTRODUCTION

Aging is defined as a chronic process of the loss of regenerative and bioprotective mechanisms in an organism.[1] The World Health Organization (WHO) defines 65 years and over as old and 85 years and over as very old.[2]

According to the 2021 data from the Turkish Statistical Institute (TURKSTAT), the ratio of the population aged 65 and over in the total population has increased to 9.7%. This rate was reported as 8.3% in 2016, 8.2% in 2015, and 7.5% in 2012.[3-6]

The increase in the prevalence of diseases such as coronary heart disease, hypertension, chronic heart failure, and chronic atrial fibrillation (AF) with age causes cardiovascular system (CVS) medicines to be used more frequently in elderly patients.[7-10]

The term "potentially inappropriate medications" has been introduced to prevent practices that ignore the fact that the elderly constitute a distinct group. The rates of "potentially inappropriate drug use" in the elderly vary widely between countries, ranging from 8.6% to 81%.[11]

To overcome this issue, criteria lists have been developed to guide healthcare professionals. The first of these lists is the Beers Criteria published in 1991. This list was updated in partnership with the American Geriatrics Society in 1997, 2003, 2015, and 2019.[12,13]

In our study, potentially inappropriate use of CVS drugs in the geriatric population was investigated based on the 2015 update of the Beers Criteria. The 2019 update of the Beers Criteria was published after the research data were collected and analyzed. But there was no difference between the 2 versions regarding cardiovascular medications.

METHODS

This study was carried out in collaboration with the Ministry of Health (MH) Rational Drug Use Department. Evaluation of CVS medications prescribed electronically by family physicians to patients aged 65 and over was carried out from the data obtained through the "Prescription Information System (PIS)" under the administration of MH.[14] All prescriptions written electronically by family physicians to patients aged 65 and over in Turkey in 2015-2016 were counted by the utilization of PIS database. The evaluation of the CVS-related prescriptions in the database in terms of "inappropriateness" was carried out according to the "Beers Criteria 2015 update." Anatomical Therapeutic Chemical Classification codes of potentially inappropriate medications (PIM) and International Classification of Diseases (ICD-10) diagnosis codes for related indications were determined and data were drawn from the prescription pool accordingly. Inappropriate medication use in the elderly is grouped under 5 topics according to the Beers Criteria:

Potentially Inappropriate Medication Use by Organ System and Therapeutic Category

Drugs in this category are classified according to the organ system or therapeutic category in which they show their effects. Within the scope of our research, centrally acting alpha-blockers (clonidine, guanabenz, guanfacine, methyldopa, reserprine), dronedarone, nifedipine (rapid release), and disopyramide were included in the analysis. Only nifedipine (rapid release), methyldopa, and reserpine under the first topic were found to be prescribed to the elderly in 2015-2016. This group will be referred to as "Potentially Inappropriate Medications (PIM)" in the study.

HIGHLIGHTS

- This is the first nationwide study that evaluates potentially inappropriate cardiovascular drugs prescribed (approximately 65 million prescriptions) by family physicians for the elderly in Turkey according to the Beers Criteria.
- The rate of potentially inappropriate medications was 0.33%, and it raised to 11.56% when "drugs to be used with caution" were included.
- The most frequently prescribed potentially inappropriate drugs were doxazosin in the diagnosis of hypertension and methyldopa regardless of indication.

Potentially Inappropriate Medication Use Due to Drug–Disease or Drug–Syndrome Interactions

Diseases specified under the second topic are "Hypertension," "Heart Failure," and "Syncope." Drugs in this category include drug classes that cause increased severity in certain diseases according to the Beers Criteria. However, in our study, this group was classified as potentially inappropriate drugs while used with specific indications. In our study, among the drugs specified under this topic, terazosin and doxazosin in hypertension; cilostazol, diclofenac, diflunisal, diltiazem, etodolac, ibuprofen, indomethacin, ketoprofen, mefenamic acid, meloxicam, naproxen, oxaprozin, pioglitazone, piroxicam, and verapamil in heart failure; and cilazapril, perindopril, and olanzapine in syncope were found to be prescribed to geriatric patients 2015-2016. This group will be referred as "Drug–Disease" in the study.

Drugs to be Used with Caution

In this group, prescriptions containing aspirin, digoxin, and amiodarone were evaluated. Digoxin is not recommended as a first-line drug in AF and heart failure in the elderly population and is above 0.125 mg/day of dose in any indication. Amiodarone is not recommended as first-line therapy for AF unless there is heart failure or significant left ventricular hypertrophy. Since it is not possible to reach detailed clinical information on whether digoxin and amiodarone are used as the first-line drugs from the data obtained, these 2 drugs are included in the category of "drugs to be used with caution."

Potentially Clinically Important Drug–Drug Interactions That Should Be Avoided

Potentially inappropriate drug combinations include angiotensin-converting enzyme inhibitors (ACEI)-amiloride, ACEI-triamterene, loop diuretics-lithium, loop diuretics-peripheral alpha-1 blockers, warfarin-amiodarone, and warfarin-nonsteroidal anti-inflammatory drugs (NSAID). In the study, the following drugs related to this title were found to be co-prescribed: warfarin with diclofenac, diflunisal, etodolac, ibuprofen, indomethacin, ketoprofen, mefenamic acid, meloxicam, naproxen, oxaprozin, piroxicam, tolmetin, amiodarone; lithium with loop diuretics and ACEI; and peripheral alpha-blockers with loop diuretics. This group will be referred to as "Drug–Drug" in the study.

Medications That Should Be Avoided or Have Their Dosage Reduced With Varying Levels of Kidney Function

Information about kidney functions of the patients is needed to make evaluation regarding this topic. In our study, we could not reach detailed clinical information via PIS, so evaluation could not be made on this topic.

The "PIM," "Drug–Disease," and "Drug–Drug" groups were evaluated together as "Total Potentially Inappropriate Medication use" and were referred to as Total PIM (TPIM) in the study.

Potentially inappropriate drugs discussed were also evaluated for the NUTS (Nomenclature of Territorial Units for Statistics) regions where prescriptions have been written, whether the prescribing family physician was a specialist or a practitioner, for the gender of the patients, and for the age

groups of the patients. Family physicians working in primary healthcare settings were stated as specialists if they have completed three years of family medicine residency training and as practitioners if they did not.

Residential locations of patients were obtained from the "2018 Address Based Population Registration System."[15,16]

Evaluations were carried out based on the ratios of potentially inappropriate CVS medication-containing prescriptions to the total number of prescriptions in the geriatric population. However, a potentially inappropriate drug may have been prescribed to the same patient more than once in the respective years. Besides, a single prescription may contain more than one potentially inappropriate drug. In this case, the electronic database analyzes each medication as separate prescriptions. Nevertheless, we already aimed to find out how many potentially inappropriate drugs are used by patients.

Statistical Analysis

Descriptive statistics were expressed as frequencies and percentages for categorical variables. Analyses were made using the Statistical Package for Social Sciences 23.0 package software. *P* value of .05 was accepted as the significance level. Differences between the groups were compared with the Chi-square test using the Yates continuity correction method.

RESULTS

Number and Distribution of Prescriptions

By family physicians, a total of 65 249 804 prescriptions were written to individuals aged 65 and over in relevant years, of which 33 161 386 prescriptions were written in 2015 and 32 088 418 prescriptions were written in 2016. Thus, it can be estimated that approximately 5 prescriptions were written per person per year. Of which, 93.19% of the prescriptions were written by practitioner family physicians and the remaining were written by specialist family physicians; 58.48% of the prescriptions were written to women. It was observed that a higher ratio of prescriptions was written in TR2 (West Marmara), TR3 (Aegean), TR4 (Eastern Marmara), TR5 (Western Anatolia), and TR6 (Mediterranean) regions than the actual population. Yet, in the TRB (Middle East Anatolia) region, the ratio of prescriptions written was less than half of the ratio of the population. The TPIM rate was found to be high in Istanbul, West Anatolia, and Black Sea regions (Figure 1).

Number and Distribution of Prescriptions Containing Potentially Inappropriate Medications

The ratio of drugs prescribed as TPIM was found to be 0.33% of the total prescriptions. When the breakdown of this ratio is evaluated, 0.01% of TPIM included "PIM," 0.18% "Drug–Disease," and 0.14% "Drug–Drug" type inappropriateness. Drugs to be used with caution constitute 11.23% of the total (Figure 2). When the TPIM were evaluated within themselves, 3.50% of the inappropriateness were in the "PIM" group, 53.50% were in the "Drug–Disease" group, and 43% were in the "Drug–Drug" group (Figure 3).

While 6.81% of the total prescriptions were written by specialist family physicians, the rate of potentially inappropriate drugs prescribed by specialists was found to be significantly higher in all groups (8.09% in TPIM, 9.57% in PIM, 8.94% in Drug–Disease, and 6.91% in Drug–Drug) (Figure 4A).

Despite 56.2% of individuals aged 65 and over were females according to demographic data, 58.48% of the total prescriptions were written to women. In contrast, 55.10% of prescriptions containing TPIM were written to males and this rate is significantly higher than the ratio of total prescriptions written to males. However, when the PIM group alone was evaluated, it was observed that 67.9% of these drugs were observed to be prescribed to women (Figure 4B, Table 1).

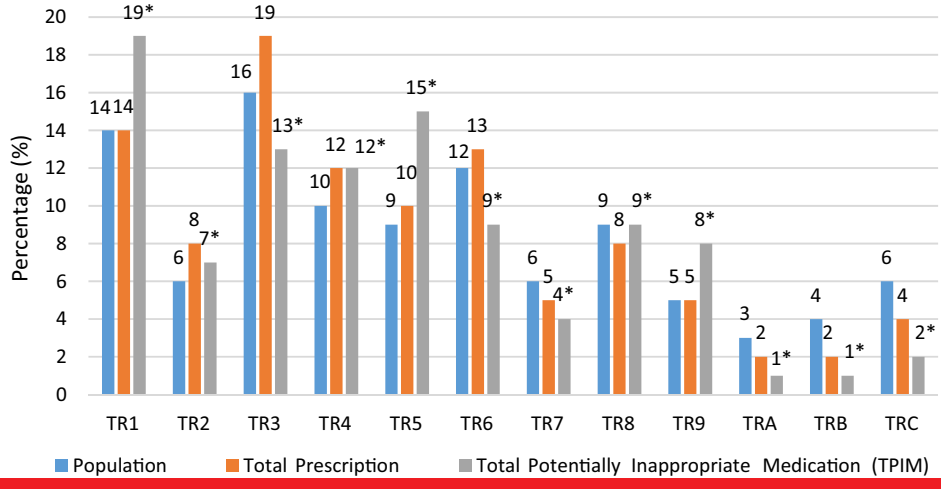

Figure 1. Percent distribution of population, total prescriptions, and total potentially inappropriate medication (TPIM) use by NUTS (Nomenclature of Territorial Units for Statistics) regions (TR1 Istanbul, TR2 West Marmara, TR3 Aegean, TR4 East Marmara, TR5 West Anatolia, TR6 Mediterranean, TR7 Central Anatolia, TR8 West Black Sea, TR9 East Black Sea, TRA Northeast Anatolia, TRB Middle East Anatolia, TRC Southeast Anatolia). (*$P < .001$, different from "Total Prescriptions" group, Chi-square).

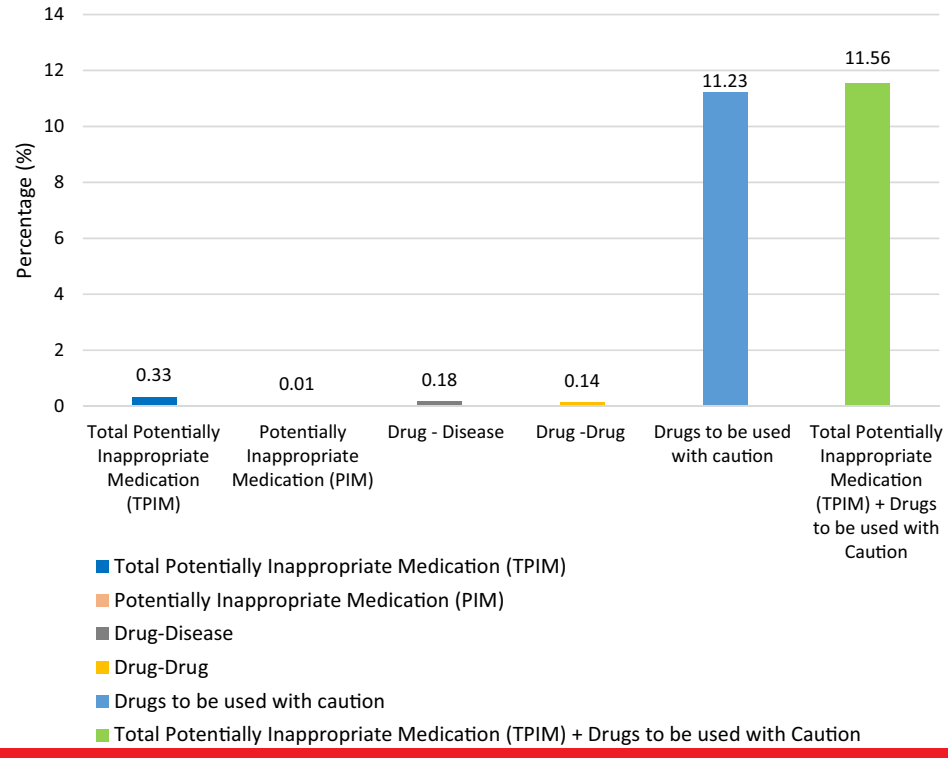

Figure 2. Distribution of the total number of prescriptions containing total potentially inappropriate medication (TPIM) by subgroups when evaluated together with the drugs to be used with caution as a percentage. (PIM: Potentially Inappropriate Medication Use by organ-system, therapeutic category; Disease–Drug: Potentially Inappropriate Medication Use Due to Drug–Disease or Drug–Syndrome Interactions; Drug–Drug: Potentially Clinically Important Drug–Drug Interactions That Should Be Avoided).

According to the TURKSTAT data, it is seen that the rate of 65-79 years old is 79.57%, and the rate of 80 and over is 21.2% in the geriatric population.[17] On the other hand, both rates of total prescriptions (22%) and prescriptions containing TPIM (24%) were found higher for aged 80 and over, compared to 65-79 years old group (Figure 5).

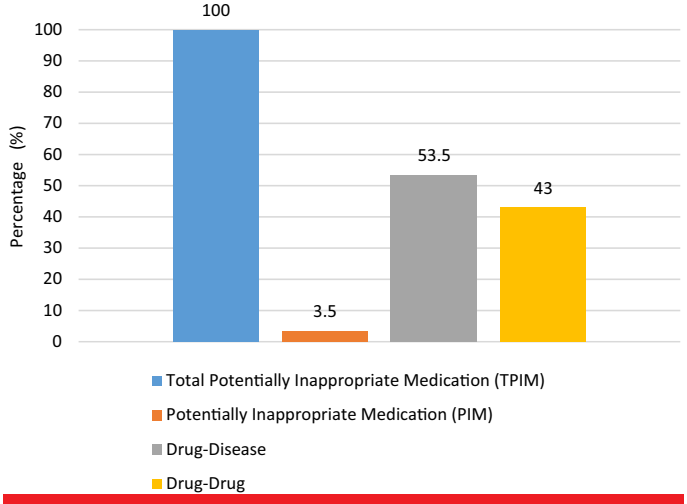

Figure 3. Distribution of the total number of prescriptions containing total potentially inappropriate medication (TPIM) by subgroups as a percentage. (PIM: Potentially Inappropriate Medication Use by organ-system, therapeutic category; Disease–Drug: Potentially Inappropriate Medication Use Due to Drug–Disease or Drug–Syndrome Interactions; Drug–Drug: Potentially Clinically Important Drug–Drug Interactions That Should Be Avoided).

Drugs found to be prescribed in the PIM category were nifedipine (immediate release), methyldopa, and reserpine. Among them, methyldopa was the most written one with a rate of 52% (Figure 6A).

In the Drug–Disease category, among the PIM prescribed for hypertension, doxazosin was the most frequent one with a rate of 97.15% (Figure 6B). In addition, the most prescribed drug among TPIMs was again doxazosin with a rate of 47.63% (Table 2). Among the PIM prescribed for heart failure, diltiazem was the most frequently prescribed drug with a rate of 40.57% (Figure 6c). Potentially inappropriate drugs prescribed in syncope consisted of only 5 prescriptions and were not evaluated.

Diclofenac-warfarin was the most commonly prescribed concomitant drug use in the group of "Potentially Clinically Important Drug–Drug Interactions That Should Be Avoided" with a rate of 33% (Figure 6D).

Of TPIM, 43% consisted of potential inappropriateness of the "Drug–Drug" group (Figure 3). Warfarin accounted for 72% of all "Drug–Drug interactions that should be avoided" (data not shown).

Aspirin, digoxin, and amiodarone were included in the "drugs to be used with caution" group. Aspirin consisted 93.81%,

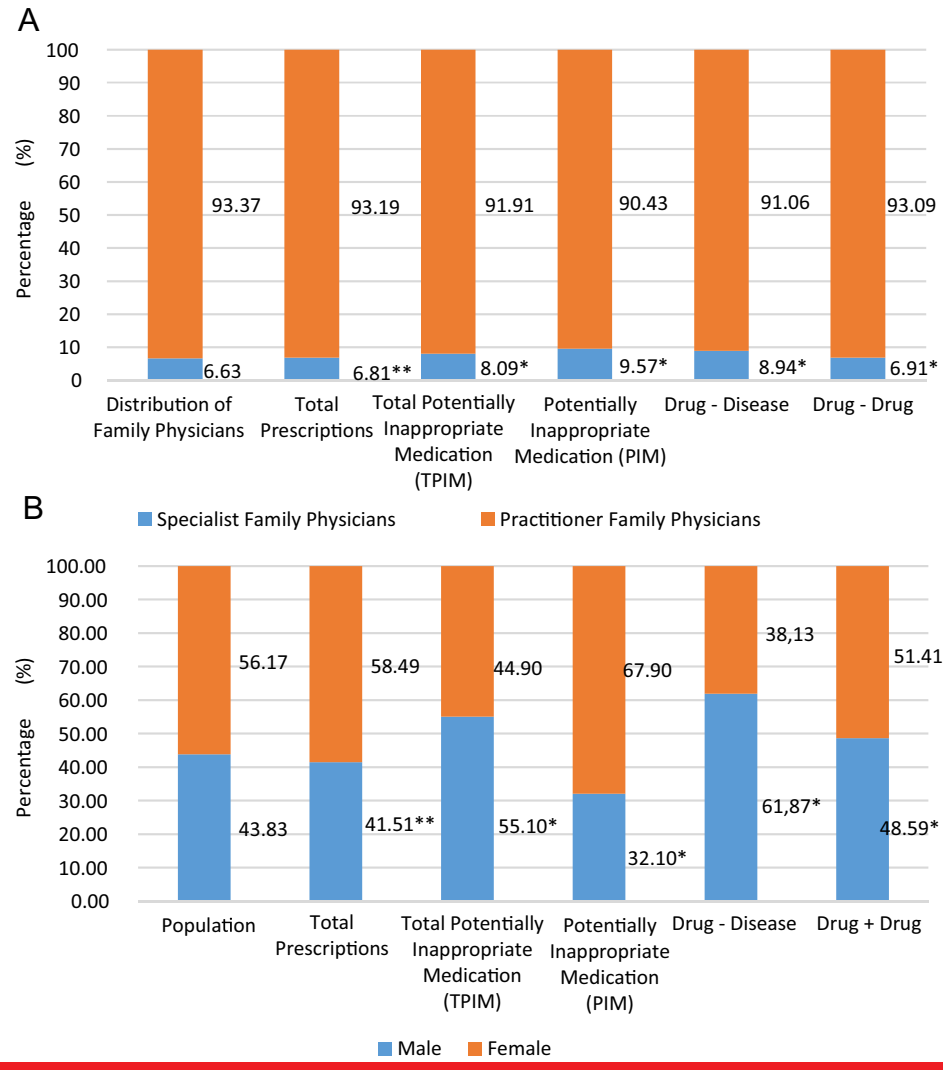

Figure 4. (A) Prescription rates written by specialist and practitioner family physicians are shown in the figure (*P <.001 different from "Total Prescription" group, **P <.001 different from "Distribution of Family Physicians" group, Chi-square). The distribution of family physicians bar is showing the percentages of practitioners and specialists among the total family physician population. (B) Prescription rates for male and female patients aged 65 and over are shown in the figure (*P <.001 different from "Total Prescriptions" group, **P <.001 different from "Population" group, Chi-square). Population bar is showing the percentages of male and female individuals among the whole geriatric population.

digoxin consisted 4.47%, and amiodarone consisted 1.72% of this group. The rate of digoxin prescription was 37.58% in men and 62.42% in women.

DISCUSSION

The rate of TPIM prescriptions written by family physicians in terms of CVS medications was found to be 0.33%, which is very low. This raised to 11.56% when "drugs to be used with caution" were included. Potentially inappropriate drugs were evaluated with the Beers Criteria in 2 studies published in 2015 and 2016.[18,19] Hwang et al[18] evaluated 529 patients with 34 selected PIM from the Beers 2012 update. Potentially inappropriate drug use was found to be 58.2% in general, while this rate was reported to be 10.8% for cardiovascular drugs.[18] In another study published by Nam et al[19] in 2016, health insurance data of 523 811 patients were analyzed retrospectively. In this study, the general rate of potentially inappropriate drug use was found to be 80.96% which was constituted especially of benzodiazepines, anticholinergics, and antianalgesics. In the cardiovascular medication group, the rate of potentially inappropriate drug use was reported to be 9.21%, regardless of the diagnosis. While the rate of potentially inappropriate drug use in heart failure was 55.40% in itself, it was found 22.21% in syncope patients in this study.[19] There are similarities between the results reported in the literature and our study.

It was observed that 93.19% of prescriptions evaluated were written by practitioner family physicians. It is estimated that approximately 85% of the family physicians in Turkey are practitioner doctors.[20] In our study, specialist family physicians were observed to prescribe potentially inappropriate drugs at a higher rate than practitioners. This group among family physicians, who has received residency training, might

Table 1. Prescription rates for male and female patients aged 65 and over

	Total Prescriptions		Total Potentially Inappropriate Medication (TPIM)		Potentially Inappropriate Medication (TPIM)		Drug-disease		Drug-Drug		Drugs to be Used with Caution	
	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
Total Number	38.161.035	27.088.008	97.582	119.768	5.267	67,90	44.288	38,13	48.027	51,41	3.931.402	54,89
Percentage	58,49	41,51	44,90	55,10	2.490	32.10	71.876	61,87	45.401	48,59	3.230.926	45,11
P-value	< .001		< .001		< .001		< .001		< .001		< .001	

be taking more risks leading to the prescription of related drugs. It may be useful to provide up-to-date prescription algorithms and clinical decision-making software to family physicians to avoid the prescription of potentially inappropriate drugs.

Although more than half of the prescriptions were written for women, TPIM were prescribed more for men in our study. The higher number of cardiovascular TPIM prescriptions for men may be associated with the higher prevalence of heart diseases in men.[21,22] On the other hand, it is seen that drugs in the PIM group were prescribed to women more than twice as much. In this group, less nifedipine (rapid release) and higher numbers of methyldopa and reserpine were seen to be prescribed. Methyldopa is recommended for gestational hypertension. However, since our age range is not suitable for any possible pregnancy, this subject is worth investigating.

It was observed that in the eastern regions of Anatolia, excluding the Eastern Black Sea region, the ratio of prescriptions was generally less than the ratio of population. The total ratio of prescriptions in the Middle East Anatolia region was as low as half of the ratio of the population. The reason for this may be the differences in access to family physicians due to climatic and geographical conditions, specific regional circumstances, differences in awareness of health, and differences in the number of physicians according to the regions. On the other hand, the TPIM rate was found to be high in Istanbul, West Anatolia, and Black Sea regions. The reason for this is not clear. It may be recommended to carry out studies on rational and appropriate drug use in the elderly in these regions.

According to the results, more prescriptions were written to the population aged 80 and over than their ratio in the population (22.17% vs. 21.2). At the same time, the rate of TPIM written to this group was found to be higher than the 65-79 age group. The necessity to use medications due to comorbidities may lead to the potential inappropriateness of drugs used in this age group.[23,24] It is important for family physicians to be more attentive to this sensitive population aged 80 and over.

The most commonly prescribed potentially inappropriate drugs for heart failure were diltiazem, diclofenac, verapamil, and ketoprofen, respectively. Verapamil and diltiazem are not suitable for patients with decreased ejection fraction.[25] However, the classification of heart failure could not be determined with the data obtained in our study. For this reason, in patients whose ejection fraction was not decreased, it may have been appropriate to use these drugs. On the other hand, in the presence of heart failure and degenerative arthritis, anti-inflammatory drugs (like diclofenac, ketoprofen) that may be potentially inappropriate according to the Beers Criteria may have been prescribed. In line with the 2022 AHA/ACC/HFSA and 2021 European Society of Cardiology (ESC) Guidelines, it has been stated that the use of nonsteroidal anti-inflammatory drugs will adversely affect heart failure with a low ejection fraction.[26,27] In the 2021 ESC guideline, the use of colchicine is recommended instead of non-steroidal anti-inflammatory drugs (NSAID)

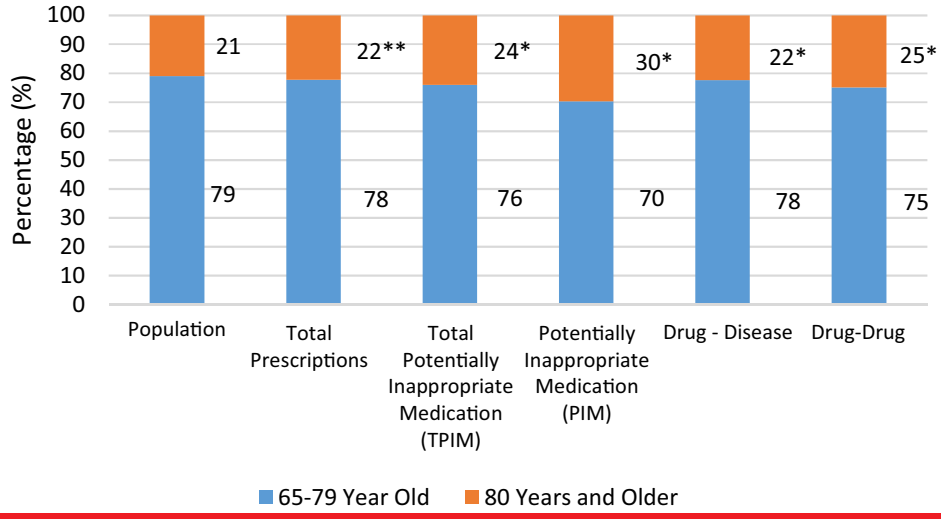

Figure 5. Prescription rates according to age groups are shown in the figure. (*P <.001 different from "Total Prescriptions" group, **P <.001 different from "Population" group, Chi-square).

in gout attacks.[26] Patients using diclofenac and ketoprofen evaluated within our study might have not been benefited sufficiently from other antianalgesics. Besides, the adverse effects of NSAIDs may not be well known to some health-care professionals. Considering the aging world and patient population, it would be helpful for physicians to regularly update their knowledge in the selection of drugs for the geriatric population. In patients with heart failure, selective COX-2 inhibitors are not suitable as they may increase the risk of cardiovascular events, and this is also emphasized in the Beers Criteria.[12,26,27] In our study, we did not observe any patient with heart failure prescribed with a selective COX-2 inhibitor.

The most frequently prescribed potentially inappropriate drug for hypertension was doxazosin by far. Apart from

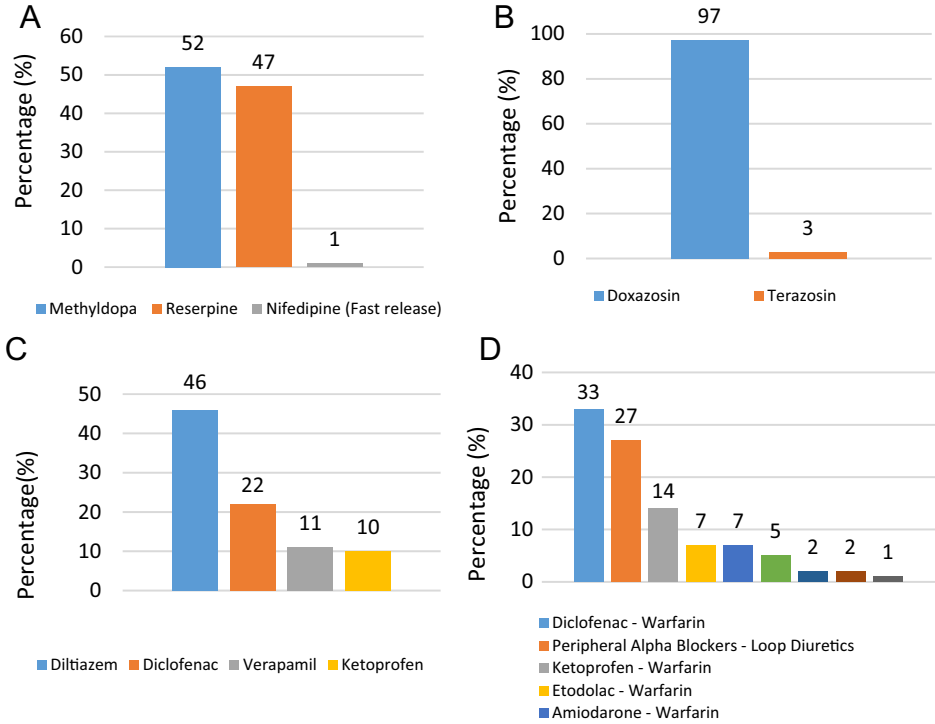

Figure 6. (A) Percent distribution of methyldopa, reserpine, and nifedipine (immediate release) prescribed within the Potentially Inappropriate Medication (PIM) group; (B) Percent distribution of doxazosin and terazosin prescribed in hypertension within the "Drug–Disease" group; (C) Percent distribution of diltiazem, diclofenac, verapamil, and ketoprofen prescribed in heart failure within the "Drug–Disease" group (the most frequently prescribed 4 drugs are included in the figure) (D) Percent distribution of drugs most frequently prescribed within the "Drug–Drug" Group.

Table 2. Distribution of the most commonly prescribed potentially inappropriate medications

The List of Potentially Inappropriate Drugs	Number of Prescriptions	Percentage Among Total Potentially Inappropriate Medications (TPIM)	Percentage of Prescriptions Written by Practitioners	Percentage of Prescriptions Written to Males	Percentage of Prescriptions Written to 65-79 Age Group
Potentially Inappropriate Medication (PIM)					
Reserpine	3.621	1.67	90.39	29.85	64.10
Methyldopa	4.048	1.86	90.49	33.94	75.79
Potentially Inappropriate Medication in Hypertension					
Terazosin	3.039	1.40	89.47	98.22	74.79
Doxazosin	103.514	47.63	90.75	63.18	78.27
Potentially Inappropriate Medication in Heart Failure					
Diclofenac	2.152	0.99	95.21	39.59	63.75
Diltiazem	3.897	1.79	95.07	33.64	65.82
Ketoprofen	931	0.43	94.09	37.59	67.56
Verapamil	1.088	0.50	94.30	31.80	71.05
Potentially Inappropriate Medication in Syncope					
Cilazapril	1	<0.01	100	100	100
Perindopril	3	<0.01	100	66	33
Olanzapine	1	<0.01	100	100	100
Potential Drug-Drug Interaction					
Diclofenac-Warfarin	30.572	14.07	93.86	43.69	77.01
Etodolac-Warfarin	6.705	3.08	93.39	41.25	77.17
Ibuprofen - Warfarin	2.112	0.97	94.08	40.91	74.05
Indomethacin - Warfarin	1.054	0.48	93.07	38.71	74.76
Ketoprofen - Warfarin	13.387	6.16	93.22	42.47	77.96
Meloxicam - Warfarin	1.567	0.72	93.17	39.95	75.05
Naproxen - Warfarin	4.958	2.28	93.04	42.46	78.04
Amiodarone - Warfarin	6.326	2.91	92.32	49.87	82.22
Peripheral Alpha Blockers – Loop Diuretics	25.214	1.,60	92.21	62.56	67.96

lowering blood pressure, doxazosin can also be used for the benign prostatic hypertrophy (BPH) and urinary incontinence.[28,29] Therefore, this drug may have been prescribed by family physicians to male patients with BPH or those with urinary incontinence. However, in the presence of BPH with hypertension, alpha-1 blocker monotherapy is no longer recommended.[30] On the other hand, in a hypertensive patient who was in a stable condition with doxazosin treatment for a long time, it may not have been preferred to increase the number of drugs used by starting a new medication. According to the 2018 ESC/ESH (European Society of Hypertension) and 2020 International Society of Hypertension guidelines, the addition of spironolactone is recommended in resistant hypertension that does not respond to treatment with 3 drugs, at least one of which is a diuretic. In patients who cannot tolerate spironolactone, doxazosin is recommended in the later stages.[26,31] In our study, patients prescribed doxazosin may be resistant to spironolactone. Within the scope of our research, it was not possible to access detailed patient information regarding this point.

Potentially inappropriate Drug–Drug interactions account for 43% of prescriptions among the TPIM group. It was found that the most common interaction was diclofenac-warfarin with a rate of 14.07% in prescriptions containing TPIM (Table 2). Warfarin was found in 72% of potentially inappropriate Drug–Drug interactions. This rate is in accordance with the current medical knowledge.[32,33] The second most commonly prescribed NSAID, along with warfarin, is ketoprofen. These selected NSAIDs may be related to the prescribing habits of Turkish physicians.

It must also be stated that insurance policies in Turkey might have affected the use of certain drugs. Regulatory legislation in Turkey designated by Health Implementation Statement recommends practice in AF is as follows: "After using warfarin for at least 2 months, warfarin can be discontinued and dabigatran or rivaroxaban or apixaban or edoxaban treatment can be started if the target international normalized ratio (INR) value cannot be maintained with warfarin at least three of the last five blood tests performed at least one week apart." The prioritization of warfarin use in AF according to the regulatory legislation may explain the fact that warfarin interaction is the most common medication in the "Drug–Drug" group in this study.[34] However, it should be noted that the Health Implementation

Statement is not a clinical guideline. It is a text that draws the framework of the insurance policy of state health services. Therefore, this information needs to be taken within the stated context.

Aspirin, digoxin, and amiodarone were evaluated in the group of "drugs to be used with caution." It was observed that these drugs were prescribed with a rate of 11.56% in the elderly. The most prescribed drug in this group was aspirin with a rate of 93.81%. In the 2015 version of the Beers Criteria, it was stated that the use of aspirin in the primary prevention of cardiovascular events may not be appropriate for those over 80 years of age and should be used carefully. This age limit is specified as 70 years and above in the Beers 2019 version.[12,13] This information remains up to date. As stated in the "Aspirin Use to Prevent Cardiovascular Disease US Preventive Services Task Force (USPSTF) Recommendation Statement" published in 2022, it is not recommended to start low-dose aspirin therapy for the primary prevention of cardiovascular events in people aged 60 and over. The risks associated with this condition are stated in this guideline as increased risk of gastrointestinal bleeding, increased risk of intracranial bleeding, and increased risk of undergoing hemorrhagic cerebrovascular accident (CVA). It was also emphasized that these risks increase with age and that attention should be paid particularly to the 60-year-old and older group.[35] It has been shown that 36 million US citizens without a history of cardiovascular disease use aspirin.[36] In a meta-analysis, the benefit of aspirin in preventing cardiovascular events and prolonging life was discussed. Again, in this study, it was stated that aspirin may increase the risk of hemorrhage, unexpected deaths, and all-cause deaths.[37]

Since we do not have detailed clinical data of the patients in the scope of our research, it is not known under which conditions digoxin was prescribed for the patients with a diagnosis of AF or heart failure, whether it was the first choice or what the prescription doses were. Therefore, digoxin was considered as a drug that should be used with caution in our study. The remarkable point is that 62.42% of digoxin users were shown to be women. In an observational study using public health data from the United Kingdom, it was reported that the rate of digoxin use did not show any significant change between 1990 and 2007 in men and women diagnosed with chronic heart failure, and was around 25% in both genders.[38] In another comprehensive public health study conducted in Canada, 54% of digoxin users were reported to be women.[39] To the best of our knowledge, there is no recent data published in Turkey regarding the gender breakdown of digoxin users. Therefore, the data in this study showing that the majority of elderly individuals using digoxin in Turkey are women, put forth a topic worth further investigation.

Study Limitations

A limitation of this research is that detailed clinical information of the patients could not be reached via PIS, so it could not be clearly determined whether some criteria were met. With studies to be conducted in a more limited universe, more detailed clinical information can be reached. The Beers Criteria also include some criteria for the list of drugs with anticholinergic effects under the Drug–Drug interactions topic. Cardiovascular system medications that have anticholinergic effects may also be potentially inappropriate for the elderly. However, this was also out of the scope of our study.

The PIS does not include information on whether the prescribed drugs are started with an official specialist report. These reports are regulated under the insurance system and are managed by another institution. For this reason, the prescriptions evaluated within the scope of the study are considered as prescriptions written by family physicians and family physicians can also prescribe these drugs individually.

CONCLUSION

Avoiding inappropriate drug use in the elderly is the simplest, most important, and most effective strategy for preventing many drug-related problems. This cross-sectional pharm acoepidemiological study takes a picture of the Turkish geriatric population while comprising all family physicians and determines which of the potentially inappropriate CVS drugs for geriatric patients were prescribed by family physicians. This study also puts forth regional differences, gender and age differences, and specialist versus general practitioner differences regarding the topic. Strategies to be developed on drug policies to prevent inappropriate drug use are the most important step towards improving the health of the elderly. In the light of the data we presented in our study, evaluation of inappropriate drug use in geriatric patients during routine health controls can be recommended for clinicians. Also these clinical evaluation practices could be included in insurance payment systems. Furthermore, potential inappropriate drug use criteria could be integrated in electronic prescription software (i.e., automated warning algorithms). Thus, more sensitive and rational prescribing practices can be developed with such efforts in the geriatric patient group.

Ethics Committee Approval: Ethics permission was obtained from Gazi University Clinical Research Ethics Committee (Meeting Date: 25.09.2017, Decision No: 432), and the permission for data utilization was obtained from the Ministry of Health.

Informed Consent: There is no need for informed consent as patient data were obtained anonymized from PIS.

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