RBFHSS
Revista Brasileira de Farmácia Hospitalar e Serviços de Saúde

Original Paper

Open Access

Use of potentially inappropriate medication by older adults in a southern municipality of Minas Gerais: prevalence study

Liliana Batista VIEIRA[1], Simone Maria SILVA[1], Tiago Marques REIS[1], Lívia Nascimento SANTANA[1], Camila Campos DUTRA[1], Adriano Max REIS[1]

[1]Faculdade de Ciências Farmacêuticas, Universidade Federal de Alfenas, Alfenas, MG; Universidade Federal de Alfenas, Alfenas, MG; Faculdade de Farmácia, Universidade Federal de Minas Gerais, Belo Horizonte, MG

Corresponding author: Vieira LB, liliana.vieira@unifal-mg.edu.br

Submitted: 07-06-2022 Resubmitted: 14-04-2023 Accepted: 24-05-2023

Double blind peer review

Abstract

Objectives: to analyze the frequency of use of potentially inappropriate medications by the older adults in primary care in a municipality in the south of Minas Gerais and to determine the associated factors. **Methods:** cross-sectional observational study carried out in primary health care units in a city in the south of Minas Gerais. Potentially inappropriate medications for the older adults were classified according to the American Geriatric Society/ Beers 2019 Criteria. Descriptive analysis was performed with determination of absolute and relative frequency and dispersion measures. The association between the use of potentially inappropriate medications by the older adults and the independent variables was verified using Pearson's chi-square test. Variables that were associated with the use of potentially inappropriate medications by the older adults with p<0.20 were included in the initial multiple logistic regression model. The selection of variables to be included in the final model was defined by the Backward method The magnitude of the association was estimated by the Odds Ratio. The adequacy of the final models was evaluated using the Hosmer-Lemeshow test. **Results:** A total of 436 elderly patients aged 60 years and over were included in the study. The frequency of potentially inappropriate medications by the older adults use was 47.7%. The most use potentially inappropriate medications by the older adults classes were proton pump inhibitors; long-acting benzodiazepines, including clonazepam and diazepam; and the antidepressants amitriptyline, clomipramine, imipramine and nortriptyline. Logistic regression showed a positive association of potentially inappropriate medications by the older adults use with polypharmacy, absence of a partner, presence in two or more consultations in the last six months. Regarding the presence of potentially inappropriate drugs for the older adults in the Municipal List of Drugs in the city of this study, 48 drugs were identified, which corresponds to 43.6% of the total number of standardized drugs in the city. **Conclusions:** The frequency of potentially inappropriate medications by the older adults use in primary care in the city investigated was high. This study can help health professionals that work in primary care in decision-making, helping to ensure the medication safety for the older adults.

Key words: potentially inappropriate medication list, inappropriate prescribing, polypharmacy, aged, primary health care.

Uso de medicamentos potencialmente inapropriados para idosos em um município do sul de Minas Gerais: estudo de prevalência

Resumo

Objetivos: analisar a frequência de utilização de medicamentos potencialmente inapropriados por idosos da atenção primária de um município do sul de Minas Gerais e determinar os fatores associados. **Métodos:** estudo observacional, delineamento transversal, realizado nas unidades de atenção primária à saúde de um município do sul de Minas Gerais. Os medicamentos potencialmente inapropriados por idosos foram classificados segundo os critérios American Geriatric Society /Beers 2019. Realizou-se análise descritiva compreendendo determinação de frequência absoluta e relativa e medidas de dispersão. A associação entre o uso de medicamentos potencialmente inapropriados por idosos e as variáveis independentes foi verificada por meio do Teste Qui-Quadrado de *Pearson*. As variáveis que se associaram ao uso medicamentos potencialmente inapropriados por idosos com valor de p<0,20 foram incluídas no modelo inicial de regressão logística múltipla. A seleção das variáveis a serem incluídas no modelo final foi definido pelo método *Backward.* No modelo final permaneceram as variáveis com valor de p<0,05. A magnitude da associação foi estimada pelo *Odds Ratio.* A adequação dos modelos finais foi avaliada pelo teste de *Hosmer-Lemeshow.* **Resultados:** Um total de 436 pacientes idosos, com 60 anos ou mais, foram incluídos no estudo. A frequência de uso de medicamentos potencialmente inapropriados por idosos foi 47,7%. As classes de medicamentos potencialmente inapropriados por idosos mais utilizadas foram os inibidores da bomba de prótons; os benzodiazepínicos de longa ação, entre eles o clonazepam e o diazepam; e os antidepressivos amitriptilina, clomipramina, imipramina e nortriptilina. A regressão logística evidenciou associação positiva do uso de medicamentos potencialmente inapropriados por idosos por com polifarmácia, ausência de companheiro, presença em duas ou mais consultas nos últimos seis meses. Em relação à presença de medicamentos potencialmente inapropriados para idosos na Relação Municipal de Medicamentos da cidade desse estudo, foram identificados 48 medicamentos, o que corresponde a 43,6% do total de medicamentos selecionados no município. **Conclusões**: A frequência de utilização de medicamentos potencialmente inapropriados por idosos na atenção primária do município investigado foi elevada. O estudo pode auxiliar os profissionais de saúde de atenção primária nas tomadas de decisões, ajudando a garantir o uso seguro de medicamentos pelos idosos.

Palavras-chave: lista de medicamentos potencialmente inapropriados, prescrição inadequada, polimedicação, idoso, atenção primária à saúde.

CC BY NC ND

Introduction

The ongoing demographic transition in Brazil during recent decades has led to a significant growth in the number of people aged over 60 years old, which has resulted in epidemiological changes characterized by the predominance of chronic non-communicable diseases[1]. In older adults, these diseases can frequently contribute to impairment of their functional capacity, making it difficult or preventing performance of their daily activities and interfering with their participation in society and their autonomy, with a significant impact on quality of life[2].

Due to the increase in chronic diseases, this age group is more predisposed to resorting to polypharmacy, defined as the joint use of five or more medications[3-6]. The cultural understanding that medication is the sole option for managing chronic diseases, to the detriment of non-pharmacological strategies, also enhances the polypharmacy practice and, with that, the risks it can impose on aged people's health and quality of life[7].

From a public health perspective, polypharmacy is a relevant problem because the more medications prescribed, the higher the risk of inappropriate medication use, drug interactions, adverse drug events and other negative health outcomes[8].

Potentially Inappropriate Medications (PIMs) for older adults have a low risk-benefit ratio and, therefore, they should present more effective and safer therapeutic alternatives[9-10]. The prescription of PIMs in the aged population should be avoided due to the association with negative outcomes such as falls and increased health-related costs[11].

Since 2012, the American Geriatrics Society (AGS) has published the AGS/Beers Criteria that introduce medications classified as PIMs[12]. The most recent version of the AGS/Beers criteria dates back from 2019[12]. In the context of older adults' care, the AGS/Beers criteria are a framework widely used by clinicians, researchers, managers and educators to guide health planning and clinical decision-making[13].

PIM use deserves attention from health professionals and systems, as a number of studies show that they can reduce functional capacity and increase hospital admissions and the risk of death, compromising aged patients' safety[14-16].

Primary Health Care (PHC) is the care level at which most drug prescriptions occur and, therefore, it is relevant to investigate PIM use by older adults at this level. The PIM use frequency among older adults in Primary Care varied from 34.5% to 53.7% in previous studies conducted in Brazil[17-22]. The PIM use level in Primary Care draws the attention to the need to expand knowledge about factors that contribute to their use by older adults at this health care level.

Given the above, the study objectives were to analyze the PIM use frequency among aged people in Primary Care in a municipality from southern Minas Gerais and to determine the associated factors.

Methods

An observational study with a cross-sectional design conducted in Alfenas, southern Minas Gerais. The municipality has an estimated population of 80,494 inhabitants, with 9,113 older adults[23]. The city has a Medications Distribution Center (*Central de Distribuição de Medicamentos*, CDM) located downtown, nine outpatient centers, fourteen urban Family Health Programs (*Programas Saúde da Família*, PSFs), one PSF in the countryside, one Psychosocial Care Center (*Centro de Atenção Psicossocial*, CAPS) and the Testing and Counseling Center (*Centro de Testagem e Aconselhamento*, CTA).

The *Strengthening the Reporting of Observational Studies in Epidemiology Statement* (STROBE) checklist was used for the reporting stage of this study[24].

The target population of this study consisted of older adults aged at least 60 years old, treated in the CDM and in eleven PSFs from the urban region of Alfenas.

Sample calculation was performed considering the number of older adults in the scope area of the CDM and of eleven urban PSFs. The number of individuals for the calculated sample was 436 older adults, considering a 5% sampling error and a 95% confidence level.

The selection criteria corresponded to individuals aged at least 60 years old, of both genders, who routinely used the Alfenas basic health units and fetched their medications at the pharmacies from the municipal health network. The patients excluded were those that presented some type of cognitive deficit that precluded their participation in the interview. The patients were recruited to take part in the study from June to December 2019. The interviews were conducted on the same day as recruitment.

The researchers randomly interviewed the older adults arriving at the Primary Health Care units from the municipality to fetch their medications in the pharmacies. Each older adult was approached after being served in the Primary Care unit pharmacy and invited to participate in the research. The interviews were conducted after accepting and signing the Free and Informed Consent Form. Interviews were carried out until reaching the sample calculated for the study. The interviews were conducted using a structured questionnaire covering questions about demographic (gender, age, skin color and marital status), socioeconomic (economic and schooling levels) and health (health services and medications used) characteristics. The questions contemplated in the questionnaire were selected based on demographic, socioeconomic and health variables, included in studies that investigated medication use by older adults[1,3,6-8]. When the patients did not know how to answer, complementary information (dates of the last medical consultations and information on the medications dispensed in the pharmacies from the municipal health network) was collected from the computerized system of the Alfenas Municipal Health Department.

A pilot test was carried out with 25 aged individuals to ensure good quality of the collection instrument, as well as to avoid ambiguities and other biases that might interfere with the research results. Three women researchers were previously trained to perform the data collection procedure.

The study independent variable was use of PIMs for older adults. The medications were classified as PIMs according to the 2009 AGS/Beers criteria, regardless of diagnosis or clinical condition[12].

The independent variables included were the following: demographic and socioeconomic characteristics – gender (male and female), skin color (white, brown, black), marital status/partner (yes or no), family income (≤1 minimum wage and >1 minimum wage) and schooling ≥4 years (yes or no). The health-related variables were the following: emergency service use (yes or no); prescriber (SUS, Private, SUS and Private); and number of appointments in six months (<2 or ≥2). The pharmacotherapy variables were as follows: access to all medications via the SUS or Popular Pharmacy (yes, no) and polypharmacy.

© Authors

Additionally, the frequency of inappropriate medications was determined regardless of the diagnosis or clinical condition listed in the AGS/Beers 2019 criteria, which were included in the 2019 Alfenas Municipal List of Medications (*Relação Municipal de Medicamentos*, REMUME).

A descriptive analysis was performed encompassing determination of absolute and relative frequencies and dispersion measures (mean and standard deviation [SD], median and interquartile range [IQR]). Normality was assessed by means of the *Shapiro-Wilk* test.

The statistical analyses were performed employing the *Statistical Package for Social Sciences* (SPSS), version 25.0. The association of each nominal independent variable with the dependent variable was analyzed using Pearson's Chi-square test, observing the test premises. The variables that were associated with PIM use at p<0.20 were included in the multiple logistic regression initial model. The numerical independent variables were dichotomized by the median value. Selection of the variables to be included in the final model was defined following the "Backward" method. The criterion for permanence in the final multivariate logistic regression model was that the independent variables should present an association with the response variable at a p-value<0.05. Magnitude of the association was estimated by means of Odds Ratio (OR), with a 95% confidence interval (95%CI). Adequacy of the final model was assessed by means of the *Hosmer-Lemeshow* test. The multicollinearity diagnosis between the independent variables was performed by means of the tolerance and variance inflation factors.

The research was authorized by the Alfenas Municipal Health Department and approved by the Research Ethics Committee of the Federal University of Alfenas (CAAE: 81111817.6.0000.5142). The older adults who agreed to participate in the study signed the Free and Informed Consent Form.

Results

A total of 436 aged individuals were included in the study, with predominance of the female gender (64.2%) and a median age of 68 years old (IQR=10). Almost two-thirds of the sample (59.4%) was comprised by individuals aged between 60 and 69 years old. Most of the participants self-declared as white-skinned (77.8%) with 12.8% reporting themselves as black-skinned. In relation to schooling, it was verified that 31.7% had less than four years of study, with 12.2% illiterate individuals. The monthly income for 71.1% of the interviewees was one minimum wage at the most. Table 1 presents a more detailed description of the population under study.

Of all 436 older adults participating in the study, 47.7% used PIMs. Among them, 30.5% used a single potentially inappropriate medication, 11.2% used two, while 4.6% made use of three and 1.3% used four to five potentially inappropriate medications.

The population under study used a median of 5.0 medications (IQR=3.0) a day, which allows classifying them as on polypharmacy. The participants' prescriptions totaled 2,283 medications, of which 311 (13.6%) were potentially inappropriate medications for older adults. In relation to the place where they purchased the medications, 39.9% did so exclusively at pharmacies from the public health network.

The most used classes of inappropriate medication were proton pump inhibitors; long-acting benzodiazepines, including clonazepam and diazepam; as well as antidepressants amitriptyline, clomipramine, imipramine and nortriptyline (Table 2).

Table 1. Distribution of the sociodemographic and clinical characteristics of the older adults interviewed in the Primary Health Care units from Alfenas, Minas Gerais (n=436).

Características	n (%)
Gender	
Female	280 (64.2)
Male	156 (35.8)
Partner	
Yes	354 (81.2)
No	82 (18.8)
RIncome	
≤1 minimum wage	310 (71.1)
>1 minimum wages	126 (28.9)
Schooling ≥4 years	
Yes	298 (68.3)
No	138 (31.7)
Prescriber	
SUS	421 (96.6)
Private	11 (2.5)
SUS and Private	4 (0.9)
Number of appointments	
<2	247 (56.7)
≥2	189 (43.3)
Use of Emergency Service	
Yes	88 (20.2)
No	348 (79.8)
Pharmacotherapy	
Polifarmácia (⩾ 5 medications)	241 (55.3)
PIM use	208 (47.7)
Number of PIMs per patient	
1	133 (30.5)
2	49 (11.2)
3	20 (4.6)
4	5 (1.1)
5	01 (0.2)
Access to all medications via the SUS or Popular Pharmacy	
Yes	174 (39.9)
No	262 (60.1)

Table 2. Potentially inappropriate medications used by the older adults interviewed in the Primary Health Care units from Alfenas, according to the AGS/Beers criteria (2019), Alfenas, 2019.

Therapeutic class/Medication	n (%)
Proton pump inhibitors: omeprazole, pantoprazole	82 (26.4)
Long-acting benzodiazepines: clonazepam. diazepam	78 (25.1)
Antidepressives: amitriptyline. clomipramine. imipramine. nortriptyline	38 (12.2)
Sulphonylureas: glibenclamide. glimepiride	20 (6.4)
First- and second-generation antipsychotics: haloperidol. clozapine. levomepromazine. quetiapine. risperidone	18 (5.8)
Non-selective cyclooxygenase NSAIDs: diclofenac. ibuprofen; meloxicam	14 (4.5)
Short- and intermediate-action benzodiazepines: alprazolam. bromazepam. lorazepam	13 (4.2)
Immediate-action nifedipine	10 (3.2)
Amiodarone	7 (2.3)
Musculoskeletal relaxants: carisoprodol. cyclobenzaprine. orphenadrine	7 (2.3)
Barbiturics: Phenobarbital	5 (1.6)
Peripheral alpha-1 blockers: doxazosin	5 (1.6)
"Z" drugs: zolpidem	4 (1.3)
Anticholinergics: chlorpheniramine. hydroxyzine. promethazine	4 (1.3)
Other central alpha-agonists: Methyldopa	2 (0.6)
Digoxin	2 (0.6)
Nitrofurantoin	2 (0.6)
Total	**311 (100)**

Table 3. Univariate and multivariate analyses of the factors associated with the use of Potentially Inappropriate Medications (PIMs) for older adults. Alfenas. 2019.

	General description	Potentially Inappropriate Medications (PIM)		Univariate analysis		Multivariate analysis[1]	
Variáveis	**n(%)**	**Yes n (%)**	**No n (%)**	**OR (IC)**	**Valor p**	**OR (IC)**	**Valor p**
Sex							
Masculine	156 (64.2)	70 (44.9)	86 (55.1)	0.838 (0.565-1.880)	0.782		
Feminine	280 (35.8)	138 (49.3)	142 (50.7)	1			
have a partner							
No	82 (18.8)	56 (68.3)	26 (31.7)	2.862 (1.718-4.769)	0.000	2.955	0.000
Yes	354 (81.2)	152(42.9.)	202(57.1)	1		(1.725-5.061)	
Income							
Até 1 salário mínimo	310 (71.1)	149 (48.1)	161 (51.9)	1.051 (0.694 - 1.591)	0.814		
> 1 salário mínimo	126 (28.9)	59 (46.8)	67 (53.2)	1			
Schooling ≥4 years							
Yes	298 (68.3)	148(49.7)	150(50.3)	1.283 (0.855-1.925)	0.229		
No	138 (31.7)	60(43.5)	784(56.5)	1			
Age ≥ 68 years							
Yes	219 (50.2)	106(48.4)	113(51.6)	1.058 (0.726-1.540)	0.770		
No	217 (49.8)	102(47.0)	115(53.0)	1			
Number of Consultations							
≥ 2	189 (43.3)	103 (54.5)	86 (45.5)	1.620 (1.1062-2.372)	0.013	1.573	0.003
<2	247 (56.7)	105 (42.5)	142 (57.5)	1		(1.045-2.367)	
Use of Emergency Service							
Yes	88(20.2)	47 (53.4)	41 (46.6)	1.331 (0.833 - 2.128)	0.231		
No	348(79.8)	161 (46.3)	187 (53.7)	1			
Medicine access by SUS or Popular Pharmacy							
Yes	174(39.9)	73 (42.0)	101(58.0)	0.682 (0.462 – 1.001)	0.050		
No	262(60.1	135 (51.5)	127 (48.5)	1			
Polypharmacy (5 ≩ drugs)							
Yes	241(53.3)	148(61.4)	93 (38.6)	3.581 (2.401 - 5.340)	0.000	3.432	0.000
No	348(74.7)	60 (30.8)	135 (69.2)	1		(2.277 – 5.173)	

[1]Hosmer-Lemeshow test: Chi-square test: 1.892; Degrees of Freedom: 5. p-value: 0.864

It was identified that 43.3% of the older adults included in the study had more than two medical appointments in a six-month period and that 9.4% attended no consultations during this period. One out of five older adults (20.2%) sought urgency services at least once in the six months preceding the interview. Attending more than two consultations in the last six months, not having a partner and using polypharmacy were factors positively associated with PIM use, according to the multiple logistic regression final model (Table 3). For all the independent variables, the variance inflation factor value was <10 and the one corresponding to the tolerance rate was >0.2, indicating absence of multicollinearity.

The analysis referring to presence of PIMs in the Alfenas REMUME identified 48 PIMs, which corresponds to 43.6% of all medications selected in the municipality of Alfenas. According to the ATC classification, the most prevalent PIMs belonged to the following groups: Central Nervous System (58.7%), Digestive system and metabolism (10.7%) and Cardiovascular system (9.3%) (Table 4).

Table 4. Classification of the potentially inappropriate medications included in the 2019 Alfenas Municipal List of Essential Medications (REMUME). according to the ATC (Anatomical Therapeutic Chemical Classification) system.

Classe ATC	n (%)
Nervous system	44 (58.7)
Alimentary tract and metabolism	8 (10.7)
Cardiovascular system	7 (9.3)
Respiratory system	4 (5.3)
Musculo-skeletal system	4 (5.3)
Antiinfectives for systemic use	3 (4.0)
Genito urinary system and sex hormones	2 (2.7)
Blood and blood forming organs	2 (2.7)
Sensory organs	1 (1.3)
Total	75 (100)

Discussion

The current research evidenced that the prevalence of PIM use was high among the older adults treated in the Alfenas Primary Health Care network. PIM use presented a positive association with polypharmacy, with not having a partner, and with attending more than two appointments in the last 6 months. To the best of our knowledge, this research is a pioneer in employing the 2019 version of the AGS/Beers criteria in the Primary Care context in Brazil.

The association found with polypharmacy is in line with previous studies in the Primary Care scope that have shown that polypharmacy is one of the most important predictors of PIM use by older adults[17-19].

Currently, the polypharmacy analysis should be performed from the perspective of multimorbidities and of appropriate medication use. In this context, two polypharmacy categories emerge: i) Appropriate: when medication use is prescribed according to scientific evidence, contributing benefits; and ii) Inappropriate:

© Authors

when medications are prescribed improperly and/or the patient does not obtain the desired therapeutic effect[26,27]. Therefore, the main strategy to reduce inappropriate drug prescription is to avoid inadequate polypharmacy, encouraging application of the principles of rational and appropriate prescription in older adults and deprescription of medications that are no longer required[17].

A study conducted in the Primary Care scope and developed in a city from inland Bahia investigated the factors related to the prescribers that determine PIM use. The number of patients seen, the number of prescriptions and time of medical practice <10 years were positively associated with prescription of PIMs[17], factors that can also explain the association between attending more than two consultations in the last six months and PIM use.

Marital status has not been reported as a determinant for PIMs in previous studies. However, it can be inferred that individuals who live without a partner may be more likely to have mood and anxiety disorders, requiring the use of antidepressants and benzodiazepines, frequent PIMs in this study.

Identifying actions to reduce the prescription of inappropriate medications in Primary Care is important, as this practice can have negative consequences for older adults due to the increased risk of adverse reactions, reduced adherence to treatments, increased complexity of therapeutic schemes and increased health system costs[19,28].

The most frequently used potentially inappropriate medications were proton pump inhibitors, long-acting benzodiazepines, antidepressives and sulphonylureas. A similar result was found by Almeida *et al.* in a study that investigated PIMs for older adults at two basic health units from the capital city of Minas Gerais[19]. These results draw the attention to the need to adopt measures targeted at safe medication use and, thus, avoiding health problems in older adults.

When used for more than eight weeks, proton pump inhibitors are potentially contraindicated for use in older adults, regardless of the clinical condition, due to the risks of *Clostridium difficile* infection, bone loss and fractures[22], increased risk of dementia and renal dysfunction with prolonged use[25,29]. With the objective of identifying the deprescription need, pharmacotherapy reviews represent an action for the promotion of rational medication use in older adults[30]. In 2022, the *American Gastroenterological Association* published clinical basis to guide the deprescription of proton pump inhibitors in the clinical practice[25.]

Benzodiazepines have anxiolytic activity, also acting as muscle relaxants and anticonvulsives. In relation to pharmacokinetics, they present fast absorption, high liposolubility, hepatic metabolism and distribution to the Central Nervous System[30-32]. The aging process determines changes in the pharmacokinetics and pharmacodynamics of drugs, mainly as a result of the increase in adipose tissue and the decrease in muscle mass in older adults. Thus, these aged people can more easily present adverse events related to benzodiazepines, and dizziness followed by falls and fractures are important events, as they can compromise older adults' mobility and increase hospitalizations[31,32]. It is worth noting that benzodiazepines can also induce daytime sleepiness, decreased motor coordination, memory impairment, paradoxical reactions and risk of addiction[30-32]. This profile of adverse events can lead to an unfavorable risk-benefit ratio for most older adults.

The prescription of inappropriate medications in aged people is strongly associated with pharmacotherapy-related problems, triggering adverse reactions and hospitalizations and, when associated with the presence of comorbidities and polypharmacy, it exposes older adults to a high risk of mortality[33,34]. The presence of at least one inappropriate medication in the prescription doubles the risk of triggering ADRs, which are responsible for almost 24% of the hospitalizations in this age group and constitute the fifth cause of death among older adults[31,32,35]. Polypharmacy rises from three to four times the chance of ADRs, which can resemble geriatric syndromes or precipitate conditions marked by confusion, incontinence and falls[31,32]. ADRs represent an important reason for hospitalization, especially in older adults, extend the hospitalization period and raise its costs, in addition to leading to death in up to 5% of the cases[36]. Although ADRs constitute an important public health problem, they are frequently not duly valued and identified, which leads to underdiagnosis[36].

It is recommended to adopt strategies such as preferential use of drugs with a safe therapeutic index, use of the smallest possible number of medications in carefully calculated doses and avoiding prescriptions with potential drug interactions to prevent unwanted effects in older adults[36]. The use of explicit methods such as the Beers Criteria can also contribute to a more adequate pharmacotherapy for older adults' specificities, with fewer potential drug interactions and a reduction in the risk of severe ADRs[37].

From the health system perspective, studies on medication use by older adults are recommended as a measure to assess the quality of the health service provided to this age group. Incorporating strategies such as training professionals regarding the prescription and indication of medications for older adults, implementation of a Clinical Pharmacy and Pharmacovigilance and creating decision support systems in the computerized prescription system that guide prescribers to health services, are actions that contribute to promoting the rational medication use in this population segment[13].

Most of the potentially inappropriate medications included in AGS/Beers 2019 and identified in this study require medical prescription. This reinforces the need for precaution while prescribing, which can be encouraged through educational interventions with wide dissemination of the pharmacotherapy aspects related to older adults for health professionals, especially in Primary Health Care. Incorporating the AGS/Beers criteria into the clinical practice to identify problems and adjust medication use can help multidisciplinary health teams, improving care quality[38].

Permanent education of the prescribers is an important strategy to encourage safe and appropriate medication use in older adults. Expanding knowledge about the potential risks of using certain medications in aged people and encouraging the use of non-pharmacological measures are fundamental skills to increase pharmacotherapy rationality in older adults. Adequate qualification of the prescribers is a measure that contributes to the implementation of more efficient and effective therapeutic guidelines for older adults' treatments, in order to improve their quality of life and increase resoluteness of the health services, thus avoiding adverse events and therapeutic ineffectiveness[38-39].

Another measure to avoid the prescription of inappropriate medications is to have adequate therapeutic alternatives available in REMUME. In the REMUME from the municipality under study there was a high proportion of PIMs. Xin Ma *et al.* (2021) analyzed the presence of PIMs in the 21st *Essential Medicines List* published by the World Health Organization in 2019. The survey was conducted using four PIM criteria [AGS/Beers 2019, STOPP/START (version 2), EU(7)-PIM (2015) and FORTA (version 3)] and identified that 26% of the essential medications were included in the PMI lists researched[43]. The authors highlighted the need for a list of essential medications for older adults[43].

© Authors

Monitoring by multiprofessional teams and clarifying family members about the consequences of non-judicious medication use also contributes to rationalization in medication use by older adults. The need to include actions centered on older adults in pharmaceutical assistance is evidenced[40].

Developing integrated pharmacists' actions along with the multidisciplinary team for older adults' care optimizes the results of the assistance provided. By participating in health education programs, pharmacists ensure that the population is instructed in relation to chronic diseases such as hypertension and diabetes, making the population aware of the importance of proper medication use and access to health[41].

Primary Care assumes significant importance in older adults' health care, as it is the coordinating element of the care networks and responsible for developing actions at the individual and collective levels, ranging from health promotion and protection to rehabilitation and maintenance, carried out by means of integrated care[42]. Therefore, measures to qualify medication use by older adults are essential in the Primary Health Care context[18].

The prevalence of PIM use in the municipality under study reinforces the need for a policy to promote proper medication use by older adults, and pharmaceutical services for this subgroup should be a constant concern of health managers[40].

A strength of the current study is that it shows to the Pharmacy and Therapeutics Committee of the municipality researched the existence of gaps in the medication selection process, considering the specificities of the aged population and indicating the need to include safer therapeutic alternatives for older adults, as a measure to avoid PIM prescription.

One of the study limitations was using only 2019 AGS/Beers criteria to classify the PIMs. Another limitation was the fact that it was conducted in a single municipality and restricted to public health units, which precludes generalizations. In addition to that, only the older adults present at the health units to fetch medications were selected for the study. This measure may have led to selection bias with the inclusion of a higher percentage of less vulnerable individuals. And, finally, only the prescribed medications were evaluated; the omission of medications used in self-medication, a frequent practice among older adults, may not have shown the actual use frequency of inappropriate medications. Identifying therapeutic alternatives available for aged people to access is a relevant aspect for future research studies aimed at expanding understanding of medication use by older adults in Primary Care.

Conclusion

The PIM use frequency was high among the older adults treated in the Alfenas Primary Care network. PIM use presented a positive association with polypharmacy, with not having a partner, and with attending more than two appointments in the last six months. This study can assist health professionals in decision-making in Primary Health Care, contributing to the promotion of safe of medication use by older adults.

Funding sources

The research was not funded.

Collaborators

LBV and AMR collaborated in project design and in data analysis and interpretation; SMS and LNS took part in data collection. LBV, AMR, TMR and CCD contributed to writing the article and in the critical review of the intellectual content.

Declaration of conflict of interests

The authors declare that there are no conflicts of interests regarding this article.

References

1. Correr JC, Pontarolo R, Ferreira LC, *et al*. Riscos de problemas relacionados com medicamentos em pacientes de uma instituição geriátrica. Rev Bras Cienc Farm. 2007;43(1):55-62. DOI: 10.1590/S1516-93322007000100007.
2. IBGE. Indicadores Sociodemográficos e de Saúde no Brasil. Brasília, DF, 2009. Available in: http://www.ibge.gov.br/english/estatistica/populacao/indic_sociosaude/2009/indicsaude.pdf. Accessed on: 5 Jul 2020.
3. Gorzoni ML, Fabbri RMA, Pires SL. Medicamentos Potencialmente Inapropriados para Idosos. Rev Assoc Med Bras. 2012;58(4):442-446. DOI: 10.1590/S0104-42302012000400014.
4. Salazar JA, Poon I, Nair M. Clinical consequences of polypharmacy in elderly: expect the unexpected, think the unthinkable. Expert Opnion Drug Safety. 2007; 6(6):695-704. DOI: 10.1517/14740338.6.6.695.
5. Medeiro SP, Neto SLL, Kusano ETL, *et al.* Diagnosis and control of polypharmacy in the elderly. Revista de Saúde Pública. 2007;41(6):1049-1053. DOI: 10.1590/S0034-89102006005000050.
6. Rozenfeld S. Prevalência, fatores associados a mau uso de medicamentos entre idosos: uma revisão. Cadernos de Saúde Pública. 2003;19(3):717-724. DOI: 10.1590/S0102-311X2003000300004.
7. Cojutti P, Arnoldo L, Cattani G, *et al*. Polytherapy and the risk of potentially inappropriate prescriptions (PIPs) among elderly and very elderly patients in three different settings (hospital, community, long-term care facilities) of the Friuli Venezia Giulia region, Italy: are the very elderly at higher risk of PIPs?. Pharmacoepidemiol Drug Saf. 2016; 25:1070-1078. DOI: 10.1002/pds.4026.
8. Laroche ML, Charmes JP, Nouaille Y, *et al.* Is inappropriate medication use a major cause of adverse drug reactions in the elderly? Br J Clin Pharmacol. 2007; 63: 177-186. DOI: 10.1111/j.1365-125.2006.02831.x.
9. Beers MH. Explicit criteria for determining potentially inappropriate medication use by the elderly: an update. Arch Intern Med. 1997;157(14):1531-6.
10. Stockl KM, Le L, Zhang S, *et al*. Clinical and economic outcomes associated with potentially inappropriate prescribing in the elderly. Am J Manag Care. 2010;16(1): e1-10.
11. By the 2019 American Geriatrics Society Beers Criteria® Update Expert Panel. American Geriatrics Society 2019 Updated AGS Beers Criteria® for Potentially Inappropri-

ate Medication Use in Older Adults. J Am Geriatr Soc. 2019;67(4):674-694. DOI: 10.1111/jgs.15767.

12. Santana DM, Bueno FG, Silva LL. Prescrição de medicamentos potencialmente inapropriados para idosos em um hospital público. J Assist Farmac Farmacoecon. 2016;1(2):320-330.
13. Koyama A, Steinman M, Ensrud K, *et al.* Long-term cognitive and cunctional effects of potentially inappropriate medications in older women. J Gerontol A Biol Sci Med Sci. 2014;69(4):423-9. DOI: 10.1093/gerona/glt192.
14. Price SD, Holman CD, Sanfilippo FM, *et al*. Association between potentially inappropriate medications from the beers criteria and the risk of unplanned hospitalization in elderly patients. Ann Pharmacother. 2014;48(1):6-16. DOI: 10.1177/1060028013504904.
15. Nascimento MMG, Mambrini JVM, Lima-Costa MF, *et al*. Potentially inappropriate medications: predictor for mortality in a cohort of community-dwelling older adults. Eur J Clin Pharmacol. 2017;73(5):615-621. DOI: 10.1007/s00228-017-2202-x.
16. Amorim WW, Passos LC, Gama RS, *et al*. Physician and patient-related factors associated with inappropriate prescribing to older patients within primary care: a cross-sectional study in Brazil. São Paulo Med J. 2021;139(2):107-116. DOI: 10.1590/1516-3180.2020.0411.R1.18112020
17. Farias AD, Lima KC, Oliveira YMDC, *et al*. Prescription of potentially inappropriate medications for the elderly: a study in Primary Health Care. Cien Saude Colet. 2021;26(5):1781-1792. DOI: 10.1590/1413-81232021265.04532021.
18. Almeida TA, Reis AE, Pinto LVI, *et al*. Factors associated with the use of potentially inappropriate medications by older adults in primary health care: An analysis comparing AGS Beers, EU(7)-PIM List , and Brazilian Consensus PIM criteria. Res Social Adm Pharm. 2019;15(4):370-377. DOI: 10.1016/j.sapharm.2018.06.002.
19. Resende ACGD, Costa FBC, Gomes IR, *et al*. Evaluation of drug use in the elderly according to Beers criteria. Revista Médica de Minas Gerais. 2017;27:30-36. doi: 10.5935/2238-3182.20170006.
20. Oliveira MG, Amorim WW, Jesus SR, *et al.* Factors associated with potentially inappropriate medication use by the elderly in the Brazilian primary care setting. International Journal of Clinical Pharmacy. 2012;34: 626-632. DOI:10.1007/s11096-012-9656-9.
21. Oliveira MG, Amorim WW, Jesus SR, *et al*. A comparison of the Beers and STOPP criteria for identifying the use of potentially inappropriate medications among elderly patients in primary care. Journal of Evaluation In Clinical Practice. 2015;21: 320-325. DOI: 10.1111/jep.12319.
22. IBGE. Alfenas-MG - Último censo. Available in: https://cidades.ibge.gov.br/brasil/mg/alfenas/panorama. Accessed on: 5 Apr 2021.
23. Elm VE, Altman DG, Egger M, *et al*. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): diretrizes para relatar estudos observacionais. Ann Intern Med. 2007;147(8):573-577. DOI: 10.7326/0003-4819-147-8-200710160-00010.
24. Targownik LE, Pescadora D, Saini SD. AGA Clinical Practice Update on De-Prescribing of Proton Pump Inhibitors: Expert Review. Gastroenterology. 2022;162(4):1334-1342. DOI: 10.1053/j.gastro.2021.12.24.
25. Cadogan CA, Ryan C, Hughes CM. Appropriate polypharmacy and medicine safety: When many is not too many. Drug Saf. 2016;39(2):109-116. DOI: 10.1007/s40264-015-0378-5.
26. Molokhia M, Majeed A. Current and future perspectives on the management of polypharmacy. BMC Fam Prac. 2017; 18(1):7 DOI: 10.1186/s12875-017-0642-0.
27. Clyne B, Fitzgerald C, Quinlan A, *et al*. Interventions to address potentially inappropriate prescribing in community-dwelling older adults: a systematic review of randomized controlled trials. J Am Geriatr Soc. 2016;64:1210–1222. DOI: 10.1111/jgs.14133.
28. Oliveira MG, Amorim WW, Oliveira CRB, *et al.* Consenso brasileiro de medicamentos potencialmente inapropriados para idosos. Geriatr Gerontol Aging. 2016;10:168–181. DOI:10.5327/z2447-211520161600054.
29. Toth JM, Jadhav S, Holmes HM, *et al*. Prescribing trends of proton pump inhibitors, antipsychotics and benzodiazepines of medicare part d providers. BMC Geriatr. 2022;22(1):306.
30. Praxedes MFS, Telles Filho PCP, Pinheiro MLP. Identificação e análise de prescrições de medicamentos potencialmente inapropriados para idosos em uma Instituição Hospitalar. Cienc Cuid Saúde. 2011;10(2):338-44. DOI: 10.4025/ciencuidsaude.v10i2.10214.
31. Cassoni TCJ, Corona PL, Lieber RSN, *et al*. Uso de medicamentos potencialmente inapropriados por idosos do Município de São Paulo, Brasil: Estudo SABE. Cad Saúde Pública. 2014; (30):1708-1720.
32. Fick DM, Mion CL, Beers HM, *et al*. Health outcomes associated with potentially Inappropriate medication use in older adults. Res Nurs Health. 2008; 31(1): 42-51. DOI: 10.1002/nr.20232.
33. Klarin I, Wimo A, Fastbom J. The association of inappropriate drug use with hospitalisation and mortality: A population-based study of the very old. Drugs & Aging. 2005;22:69–82. DOI: 10.2165/00002512-200522010-00005.
34. Varallo FR, Ambiel ISS, Nanci LO, *et al.* Assessment of pharmacotherapeutic safety of medical prescriptions for elderly residents in a long-term care facility. Braz J Pharm Sci. 2012;48(3):477-85. DOI: 10.1590/S1984-82502012000300015.
35. Passarelli MCG, Jacob-Filho W, Figueras A. Adverse drug reactions in elderly hospilised population: inappropriate prescribing is a leading cause. Drugs & Aging. 2005; 22(9):767-777. DOI: 10.2165/00002512-200522090-00005.
36. Lucchetti G, Lucchetti AL. Inappropriate prescribing in older persons: A systematic review of medications available in different criteria. Arch Gerontol Geriatr. 2017; 68:55-61. DOI: 10.1016/j.archger.2016.09.003.
37. Praxedes MFS, Pereira SCG, Lima MFC, *et al*. Prescrição de medicamentos potencialmente inapropriados para idosos segundo os Critérios de Beers: revisão sistemática. Ciênc Saúde Colet. 2021;26(8). DOI: 10.1590/1413-81232021268.05672020.

© Authors