Int J Clin Pharm (2012) 34:626–632
DOI 10.1007/s11096-012-9656-9

RESEARCH ARTICLE

Factors associated with potentially inappropriate medication use by the elderly in the Brazilian primary care setting

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Received: 9 October 2011 / Accepted: 15 May 2012 / Published online: 13 June 2012

Abstract *Background* The exposure of elderly patients to potentially inappropriate medication (PIM) is associated with the increased use of health care services. *Objective* To evaluate both the prevalence of and the factors associated with the use of PIM by elderly patients who are being treated in primary healthcare facilities. *Setting* Family Health Programme centres in northeastern Brazil. *Method* A prospective survey of the medications used by elderly patients was performed. A total of 142 participants were randomly selected via systematic sampling. Beers criteria were applied to assess the use of PIM among the investigated sample. All of the medications included in these criteria were assessed for their availability in Brazil. The prevalence of inappropriate medications was chosen as an occurrence measure and was compared among the exposure groups using the prevalence ratio (PR) as a measure of association. *Main outcome measure* Prevalence and various factors associated with the use of PIM. *Results* The prevalence of PIM usage was 34.5 %. The factors that exhibited associations included the following: illiteracy (PR = 1.51; 95 % CI = 1.02–2.24); black skin colour (PR = 1.80; 95 % CI = 1.40–2.32); the use of ≥4 drugs per day (PR = 2.36; 95 % CI = 1.79–3.11); the use of medications prescribed by a doctor (PR = 2.52; 95 % CI = 1.12–5.69), and the use of medications supplied by the Brazilian government (PR = 1.42; 95 % CI = 1.10–1.81). The most frequently prescribed PIM included short-acting nifedipine (34.5 %) and methyldopa (9.1 %). *Conclusion* The data collected in this study indicated a high prevalence of the use of PIM. The factors that contributed the most to this prevalence included medical prescriptions, polypharmacy, medications supplied by the Brazilian National Health System, and black skin colour (specifically, being of African descent).

Keywords Beers criteria · Brazil · Elderly · Inappropriate drug use · Potentially inappropriate medication

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Impact of these findings on practice

- The use of potentially inappropriate medication (PIM) by elderly patients in the Brazilian primary healthcare setting might be associated with availability of such medicines within the national health system.
- Polypharmacy is associated with the use of PIM in the primary healthcare setting.
- Despite widespread accounts in the literature of the risks associated with the use of PIM by the elderly, the data indicated that these drugs are still commonly prescribed.

Introduction

In Brazil, the elderly population grew from 4.9 % in 1970 to approximately 10 % in 2010 [1]. The national health

system of Brazil is the Unified Health System (SUS—Sistema Único de Saúde). The SUS focuses its efforts along the following two major lines: the Family Health Programme, which provides primary healthcare to 5,295 counties, and secondary and tertiary healthcare services, which are supplied by a network of public or sub-contracted hospitals and medical centres across the country [2]. The Family Health Programme was established by the Brazilian Health Ministry in 1994 and plays a strategic role in public health policy [3]. In Brazil, the population aged ≥60 years is considered elderly [5], and most community-dwelling elderly patients are treated by general practitioners [4].

The Brazilian Elderly Health policy was approved in 1999. Since then, the Family Health Programme has been a link between the elderly population and the healthcare system [6]. Healthcare managers have been concerned with this segment of the Brazilian population because of the high incidence of hospitalisations due to preventable causes (which reached 16 % in 1996) and the 11 % polypharmacy prevalence among the elderly [6]. Previous surveys indicated that a significant fraction of elderly patients under the care of the Family Health Programme are supplied medications by the Brazilian government [7] and that some of these medications can be rated as potentially inappropriate medications (PIMs) according to Beers criteria [8, 9]. Moreover, several generic drugs marketed in Brazil were also rated as PIMs according to these same criteria [10], which were defined by a consensus panel to assess treatment appropriateness in elderly patients and have been widely used for two decades [11–13]. Although this issue has been the subject of on-going international debate, few studies have assessed the use of PIM by elderly patients in Brazil [5, 14].

Aim of the study

To assess both the prevalence of and the factors associated with the use of PIM by elderly patients under the care of the Brazilian Family Health Programme.

Method

This study is part of the project "Multidimensional Assessment Study of Elderly Patients Cared for at Family Health Centres". The goal of this cross-sectional study was to perform a multidimensional assessment of elderly patients who were registered at three family health centres in a county in northeastern Brazil. Each patient under the care of the Family Health Programme registers for follow-up care from a team comprising physicians, nurses, and dentists. Each Family Health Programme centre comprises one or more teams. The patients included in the study sample had registered at one of the three family health centres, were 60 years old or older, were found at their homes when visited, and agreed to participate by signing an informed consent form. Patients were excluded if the interview could not be performed after three attempts. For the analysis in this study, individuals who were not using drugs at the time of the interview were excluded.

The sample size was calculated from the estimated elderly population in the area covered by the three health centres (9.7 %) after allowing for a 5 % maximum error between the sample proportion and the actual population proportion at a 5 % significance level. The calculated sample size (142 participants) was proportionally distributed as a function of the percentage of elderly patients registered by the family health teams at the centres.

These 142 participants were randomly selected via systematic sampling from a mixed-gender list of elderly patients registered with the family health teams. The participants were grouped by demographic area to facilitate the interviews performed by the study team.

Data were collected through two interviews that were conducted at the participants' homes. When the participants were unable to answer questions, the assistance of a caregiver or relative was requested as a proxy.

The questionnaire that was used in this study was derived from the instrument used in another project: Health, Well-being, and Aging in Latin America and the Caribbean (SABE) [15]. This questionnaire consists of variables associated with prescribed medications, the availability of drugs, and demographic and elderly health-related data. The questionnaire was subjected to pretesting among a sample of elderly patients who were not included in the study sample.

Individuals were queried about their age, race, sex, education (number of years of schooling completed), and number of people in the household. Medical and medication histories included patient self-reports of medical conditions and current medications, including prescription, over-the-counter, and alternative/complementary medications. Drug-related information was also obtained by asking interviewees to present the packages, package inserts, and prescriptions of any medication used during the interview. When the subject was not able to respond to the questionnaire, information was obtained from the caregiver or relatives. In the case of uncertainty, the interviewer marked the option "do not know" on the questionnaire, and the variable was considered missing in the analysis. To complement the clinical variables (diagnosis), a review of each elderly patient's medical records was conducted.

The 2003 version of the Beers criteria were applied to assess the use of PIM by the study sample independent of prescription, over-the-counter, or alternative/complementary

medications. These criteria include two lists of drugs. One of the lists describes drugs or classes of drugs that are rated potentially inappropriate independent of diagnosis or clinical condition as a function of their high risks of side effects and the availability of safer drug alternatives. The second list describes drugs or classes of drugs that must be avoided in particular clinical conditions [13]. The Beers criteria were chosen to identify PIMs due to their applicability to the Brazilian context. The three previous studies that examined the availability of PIMs in the Brazilian market also utilised the Beers criteria [8–10]. The last of these studies showed that 20.8 % of drugs available in the primary healthcare setting may be considered PIMs [9].

All of the drugs included in the Beers criteria were assessed according to their availability in Brazil. To perform this assessment, registrations at the Brazilian drug regulation agency (ANVISA) website were surveyed. Data were analysed per specific drug or class of drugs.

The prevalence of inappropriate medications was chosen as the occurrence measure and was compared among the exposure groups using the prevalence ratio (PR) as the measure of association [16]. In this study, polypharmacy was defined as the use of ≥4 medications. Bivariate analysis via a Poisson regression technique was applied to assess the investigated association, as the analysed outcome is not rare. The confidence level to accept the hypothesis of association was established at 95 %.

As a function of the characteristics of the original study performed with elderly patients registered at these three family health centres (cluster-sampled), all of the bivariate models were adjusted using randomised intercepts at the team level, after adjusting for the standard error of the intragroup correlation. The statistical package Epi Info (Windows version) was used to enter the data, and the data analysis was performed using STATA (9.0 version) software.

A local ethics committee approved this multidimensional assessment study of elderly patients under the care of family health centres.

Results

The study sample comprised 142 elderly participants. Three patients were excluded from the analysis because they were not using medication at the time of the interview. Most of the subjects were female (61.9 %), between 60 and 74 years old (65.5 %), literate (54 %), and had brown skin colour (65 %). The prevalence of the use of PIM was 34.5 %.

Although only 46.8 % of the participants reported being married, questions about their living arrangements revealed that 87.8 % of them lived with other people (Table 1).

Table 1 Sociodemographic characteristics of the sample

Characteristics	N	%
Sex		
Female	86	61.9
Male	53	38.1
Age range (years)		
60–74	91	65.5
≥75	48	34.5
Spouse		
Yes	65	46.8
No	74	53.2
Schooling		
Literate	74	54.0
Illiterate	63	46.0
Living arrangement		
Lives with someone	122	87.8
Lives alone	17	12.2
Skin colour		
White	33	24.1
Brown	89	65.0
Black	15	10.9

The variables Schooling and Skin colour have missing values

Table 2 Data on medications used by the sample of elderly patients

Characteristics	N	%
Use of at least one PIM		
No	91	65.5
Yes	48	34.5
No. of medications used		
<4	49	35.3
≥4	90	64.5
Prescription medication use		
No (over-the-counter)	20	14.4
Yes	119	85.6
Source of medication		
Unified health system	80	63.5
Other	46	36.5

The variable source of medication has missing values

Regarding the use of drugs, more than half of the patients used ≥4 drugs (64.5 %), received their drugs through medical prescriptions (85.6 %), and were supplied the medication by the SUS (63.5 %) (Table 2).

The most frequently prescribed PIMs were short-acting nifedipine (34.5 %) and methyldopa (9.1 %). Most of the medications were rated as PIMs independent of diagnosis or clinical condition, with the exception of Amlodipine, Clonazepam, and Nimesulide (Table 3).

Table 3 Potential inappropriate medications according to Beers criteria, classified by active substances

Active substance	N (%)	Independent from Diagnosis or Condition	Disease or Condition
Short-acting nifedipine	19 (34.5)	Yes	–
Methyldopa	5 (9.1)	Yes	–
Carisoprodol	4 (7.3)	Yes	–
Chorpheniramine	4 (7.3)	Yes	–
Orphenadrine	4 (7.3)	Yes	–
Amiodarone	2 (3.6)	Yes	–
Clonidine	2 (3.6)	Yes	–
Cyclobenzaprine	2 (3.6)	Yes	–
Dexchorpheniramine	2 (3.6)	Yes	–
Fluoxetine	2 (3.6)	Yes	–
Lorazepam (dose greater than 3 mg)	2 (3.6)	Yes	–
Amitriptyline	1 (1.8)	Yes	–
Amlodipine	1 (1.8)	No	Constipation
Clonazepam	1 (1.8)	No	Long-term (benzodiazepine use in depression)
Diazepam	1 (1.8)	Yes	–
Ergot mesyloids	1 (1.8)	Yes	–
Nimesulide	1 (1.8)	No	Blood clotting disorders
Oxybutynin	1 (1.8)	Yes	–
Total	55 (100)		

Table 4 shows the prevalence ratio of the use of PIM by elderly patients with the corresponding confidence interval (95 % CI), according to the investigated variables. Reading level and skin colour exhibited statistically significant associations with the use of PIM. The use of at least one PIM was 51 % higher among the illiterate participants (PR = 1.51; 95 % CI = 1.02–2.24) and 80 % higher among participants with black skin colour (PR = 1.80; 95 % CI = 1.40–2.32). Elderly individuals who took ≥ 4 medications per day exhibited a 2.36-fold increase in the prevalence ratio of the use of at least one PIM relative to participants using <4 medications per day (PR = 2.36; 95 % CI = 1.79–3.11). Regarding the use of medical prescriptions, the use of PIM was 2.52-fold greater relative to only relying on over-the-counter medications (PR = 2.52; 95 % CI = 1.12–5.69). Consequently, the participants who were supplied with their medications by the SUS exhibited a 42 % greater the use of PIM prevalence ratio compared to those who received their medications through other supply sources (PR = 1.42; 95 % CI = 1.10–1.81).

Table 4 Prevalence ratios (PRs) and corresponding confidence intervals (95 % CI) of PIM bivariate associations according to variables studied in the elderly sample

Characteristics	N	At least one inappropriate medication			
		N	%	PR	95 % CI
Sex					
Female	86	31	36.0	1.00	
Male	53	17	32.1	1.12	0.88–1.44
Age range (years)					
60–74	91	30	33.0	1.00	
≥75	48	18	37.5	1.14	0.85–1.52
Spouse					
Yes	65	21	32.3	1.00	
No	74	27	36.5	1.13	0.91–1.40
Schooling					
Literate	74	21	28.4	1.00	
Illiterate	63	27	42.9	1.51	1.02–2.24
Living arrangements					
Lives with someone	122	40	32.8	1.00	
Lives alone	17	08	47.1	0.70	0.31–1.59
Skin colour					
White	33	11	33.3	1.00	
Brown	89	27	30.3	0.91	0.56–1.49
Black	15	09	60.0	1.80	1.40–2.32
No. of used medications					
<4	49	09	18.4	1.00	
≥4	90	39	43.3	2.36	1.79–3.11
Prescription medication use					
No (over-the-counter)	20	03	15.0	1.00	
Yes	119	45	37.8	2.52	1.12–5.69
Source of medications					
Unified health system	80	32	40.0	1.42	1.10–1.81
Others	46	13	28.3	1.00	
Difficulty sleeping					
No	76	24	31.6	1.00	
Yes	62	23	37.1	1.18	0.64–2.16
Falls					
No	63	23	36.5	1.00	
Yes	73	24	32.9	0.90	0.37–2.18

The variables schooling, living arrangements, skin colour, source of medications, difficulty sleeping and falls have missing values

Discussion

The aim of this study was to assess both the prevalence of and the factors associated with the use of PIM by elderly patients in the primary healthcare setting. The prevalence was 34.5 %. Previous studies that applied Beers criteria identified a prevalence of 13.1–40 % [17–26] and 33.5 % after adaptations of these criteria [27].

The most frequently used PIMs contain active ingredients that have been associated with higher incidence of one or more serious adverse effects in elderly patients; thus, these medications have been included on lists of drugs to be avoided [13, 28]. Several studies performed in primary healthcare settings also revealed the use of PIMs that were described in this study, albeit with different prevalence rates [20, 23, 25].

Our data suggest that most of the participants (64.5 %) used multiple medications, a factor that was associated with a higher probability of the use of PIM. An assessment of 143 immobile elderly patients in the primary healthcare setting revealed that 71.3 % of the sample used ≥4 medications [23]. Although other studies [18, 19] have reported an association between polypharmacy and the use of PIM, their definitions do not allow for a direct comparison of the data. Many researchers have criticised the notion of defining polypharmacy exclusively by the number of drugs taken and have discussed the need to also assess the indication and length of use [29, 30]. The assessment of the number of prescribed medications without evaluation of the adequate indications leads to the risk of promoting the sub-utilisation of treatments that might benefit elderly patients.

Two sociodemographic variables exhibited an association with the use of PIM in the studied sample. The association of black skin colour with the use of PIM might be the result of the number of black people utilising the SUS in Brazil. A study conducted in 2003 revealed a relationship between black/brown skin and the use of the SUS (OR = 1.43; 95 % CI = 1.34–1.5) [31].

Regarding literacy, patients with low literacy may have difficulty accessing healthcare, following instructions from a physician, reading and understanding discharge instructions, education materials, medication labels and taking medication properly [32, 33]. Patients with high education may have greater access to drug information; thus, they may therefore be more active in patient–physician communication, influence the prescription of medication and even recognise the prescription of a PIM. A Brazilian study reported that a lower educational level may be associated with polypharmacy [34], and a study in Sweden showed that elderly individuals with low education had a higher probability of polypharmacy and potential inappropriate drug use [35]. Thus, inadequate literacy might contribute to the use of PIM, both for prescription and over-the-counter medications.

Other factors that were associated with the use of PIM in this study included medical prescriptions and receiving medication supplied by the SUS. In a study performed in a primary healthcare setting in Spain, 75 % of PIMs were prescribed by primary care doctors, 22.7 % by specialists, and 1.5 % were self-prescribed [23]. A recent study in Italy found unsatisfactory prescribing knowledge among primary care physicians [36]. Another study conducted in northeastern Brazil indicated an association between the use of prescription medication and PIMs (OR = 1.25, $p < 0.001$) [14].

Most elderly patients in the Brazilian primary healthcare setting are provided with free medications by the SUS [7]. An earlier study determined that 20.8 % of drugs that were available in the primary healthcare setting and that 9.4 % of drugs described on the Brazilian list of essential medications were PIMs for the elderly [9]. Other studies indicated similar data regarding generic drugs marketed in Brazil [10] and a special programme to supply free medications funded by the wealthiest state in the country [8]. Therefore, it is believed that the causes of the high PIM prevalence identified in this study stem from administrative considerations rather than from clinical factors. In other words, the higher PIM prevalence for medications prescribed by doctors compared to over-the-counter medications might have been influenced by the lack of availability of safer therapeutic alternatives at the SUS. However, primary care physicians' unsatisfactory knowledge of which medications are appropriate for the elderly must also be taken into account. Several studies have shown that PIM prevalence varies as a function of patient population, local drug availability, specialisation field of the prescribing physicians and assessment instruments used [37].

One of the limitations of this study is the use of the Beers 2003 updated criteria to define PIMs [13], which were utilised due to the lack of national criteria. The Beers criteria do not include several drugs that are marketed in Brazil; therefore, it is possible that some PIMs were not identified. Nonsteroidal anti-inflammatory drugs (NSAIDs) constitute an example of such a PIM. According to Beers criteria, the only NSAIDs that have been described as potential causes of gastrointestinal (GI) bleeding, kidney failure, high blood pressure, and heart failure are naproxen, oxaprozin, and piroxicam [13]. However, the risks associated with these drugs are known to be similar for other NSAIDs, such as diclofenac, ketoprofen, and nimesulide [38, 39].

Although Beers criteria have been rated as the gold-standard for assessment of PIMs in the elderly, several authors have formulated new explicit and implicit criteria that have been adapted for a specific country [40], such as the Inappropriate Prescribing in the Elderly Tool (IPET) [41], the Medication Appropriateness Index [42] and the Screening Tool of Older Persons' Potentially Inappropriate Prescriptions (STOPP) [28]. Moreover, Beers criteria have also been criticised for measuring only the "pharmacological appropriateness" of prescription, as they are not intended to replace careful clinical decision-making [40].

Nevertheless, Beers criteria allow for a relative assessment of drug use risk in the elderly and might also be used

as a screening tool to identify potential drug-related problems when other information sources are lacking [20]. New Beers criteria were published following the development of this manuscript [43].

Conclusion

The data collected revealed a high prevalence of the use of PIM. The factors associated with the use of PIMs were drugs prescribed by doctors, polypharmacy (≥4 medications), the use of government-supplied drugs, and having black skin colour. Taking into account the increases in the Brazilian elderly population and the importance of the Family Health Programme for the care of this population, Brazilian healthcare managers must make heavier investments into providing information to primary healthcare professionals and choosing drugs that are safer for the elderly to compose the national list of essential medications.

Acknowledgments We would like to acknowledge the full team of the Multidimensional Assessment Study of Elderly Patients Cared for at Family Health Centres.

Funding This study was partially funded by the Education Programme for Work in Health, Ministry of Education and Culture/Ministry of Health (MEC/MS).

Conflicts of interest None declared.

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