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Prevalence of potentially inappropriate prescribing among older adults: A comparison of the Beers 2012 and Screening Tool of Older Person's Prescriptions criteria version 2

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Aim: To date, there is no study comparing the Beers 2012 and Screening Tool of Older Person's Prescriptions (STOPP) version 2 criteria, nor reporting a comparison of the prevalence of potentially inappropriate Prescribing (PIM) with STOPP version 2. We aimed to evaluate the prescriptions of patients admitted to a geriatric outpatient clinic with these tools, and to document the factors related to PIM use.

Methods: Older patients (aged ≥65 years) admitted to the outpatient clinic of a university hospital were retrospectively evaluated for PIM with Beers 2012 and STOPP version 2 criteria. Age; sex; chronic disease and number of drugs; and functional, depression and nutritional statuses were studied with regression analysis as possible factors related to PIM.

Results: The study included 667 participants (63.1% women, mean age 77.6 ± 6.3 years). The mean number of drugs was 6.1 ± 3.4. PIM prevalence detected by STOPP version 2 was higher than that of the Beers 2012 criteria (39.1% *vs* 33.3%, respectively; $P < 0.001$; $Z = -3.5$) with moderate agreement in between (kappa = 0.44). Antipsychotics, over-the-counter vitamin/supplements, aspirin, selective-serotonin-reuptake-inhibitors and anticholinergics were the leading drug classes for PIM. The extent of polypharmacy ($P < 0.001$, OR 1.29, 95% CI 1.20–1.38) was the most important variable related to PIM, along with the multiple comorbidities ($P = 0.005$, OR 1.16, 95% CI 1.05–1.30). Higher level of functionality was inversely associated with PIM ($P = 0.009$, OR 0.90, 95% CI 0.83–0.97).

Conclusions: Inappropriate prescription prevalence of ~40% by STOPP version 2 was similar to the global worldwide prevalence – yet at the upper end. STOPP version 2 was more successful than Beers 2012 to detect PIM. Patients with multiple drug use, multiple comorbidities and more dependency were more likely to have PIM requiring special attention during prescription. **Geriatr Gerontol Int 2017; 17: 1245–1251.**

Keywords: Beers 2012, comparison, potentially inappropriate prescribing, Screening Tool of Older Person's Prescriptions version 2.

Introduction

Inappropriate medication use (IMU) is a common problem in the aged population.[1,2] The adverse effects of IMU are well-known, commonly causing functional detoriation[3,4] and – in some cases – even death of older adults.[5,6] Consideration of the pharmacokinetic/pharmacodynamic changes related to aging, functional changes in the organ systems and the major drugs related to IMU will decrease its prevalence, hence improving the health and well-being of the older population. Accordingly, some international IMU criteria are suggested worldwide reflecting the local prescription habits. The most widely used and studied criteria are the Beers and the Screening Tool of Older Person's Prescriptions (STOPP) and Screening Tool to Alert Doctors to Right Treatment criteria. These two major criteria have been updated recently, and their relative applicability in practice is a major area of research in the geriatric literature.[7,8] Although some studies suggest that STOPP criteria are more successful for predicting IMU,[9–12] some others suggest superiority of the Beers criteria.[13–15] There is no study from Turkey reporting their relative applicability,

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†In this original study, two authors, namely Gulistan Bahat and Ilker Bay, carried out first author level work. Hence, there are two first authors in this study.

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yet one very recent study reported IMU by using the STOPP/Screening Tool to Alert Doctors to Right Treatment version 1.[16] However, there are many more older adults in the developing regions with more tendency to have IMU or polypharmacy, significantly contributing to global IMU.[17,18] Furthermore, to our knowledge, there is no study as yet comparing the success of the Beers 2012 and STOPP version 2 criteria to detect potentially inappropriate medication (PIM) or reporting PIM prevalence by STOPP version 2 criteria. Here, we aimed to evaluate PIM among patients admitted to the geriatric outpatient clinic of the Istanbul University Hospital, Istanbul, Turkey, with these tools to identify their potential use in this setting. We also studied the factors associated with PIM in this practice.

Methods

The patients admitted to geriatric outpatient clinic of the Istanbul University Hospital, Istanbul, Turkey, were evaluated retrospectively and cross-sectionally by a geriatrician using the patients' records. The sample size was determined assuming a type 1 error of 0.05, a type 2 error of 0.2 and a power of 80%. A minimum sample size of 182 was calculated to detect a proportion difference of 10%. We recruited the study patients randomly among the patients admitted between June 2000 and June 2014. The study protocol was approved by the local ethics committee. Informed consent was obtained from all individual participants included in the study, and those not given consent were excluded. Age; sex; weight; chronic drugs; chronic diseases; functional, nutritional and depression scores; and serum creatinine level were recorded from the patient files.

Functionality was evaluated by the six-item Katz activities of daily living (ADL) scores and eight-item Lawton instrumental activities of daily living (IADL) scores.[19,20] The scores for each item were determined as 1, 2, and 3 if the patient was totally dependent, partially dependent and independent for carrying out the related activity, respectively. For ADL, 6, 7–12 and 13–18 points, and for the IADL, 8, 9–16 and 17–24 points correspond to dependency, partial dependency, and independency, respectively. Depression was screened by the 15-item Geriatric Depression Scale Short-Form, and evaluated as normal for points 0–4, mild depression for points 5–8, moderate depression for points 9–11 and severe depression for points 12–15.[21] Nutrition was evaluated by the Mini-Nutritional Assessment Short-Form, which signifies malnutrition with 0–7 points, malnutrition risk with 8–11 points and normal nutrition with >11 points.[22] Glomerular filtration rate was estimated by the Cockroft–Gault Formula. In STOPP version 2 criteria, two new criteria were added as "drug indication criteria," which were use of any drug prescribed without an evidence-based clinical indication and any drug prescribed beyond the recommended duration, where treatment duration is well defined.[8] These two criteria are self-evident, non-specific criteria with absolute global consensus. Thus, in the present study, we analyzed and compared two tools by their statements on specific drugs or drug classes. Nevertheless, we reviewed the data on the drug indication criteria and outlined the related results as well. The drug uses were designated as "PIM due to lack of evidence-based clinical indication" if laboratory-confirmed vitamin B_{12} deficiency, any vitamin B deficiency or any vitamin deficiency either on admission or in the follow up were not present – for the vitamin B_{12} drugs, vitamin B complex drugs and multivitamin drugs; if there was not any predefined clinical indication for proton pump inhibitors (PPI); and any use of gingko biloba extracts or piracetam for gingkobiloba extracts and piracetam, as there is not any guideline consensus on their use for any given indication.

Statistical analysis

All data were entered into a database and verified by a second independent person. Descriptive statistics were generated for all study variables, including the mean and standard deviation for normally distributed continuous variables, the median for abnormally distributed variables and relative frequencies for categorical (qualitative) variables. Two groups were compared with paired Student's *t*-test or Mann–Whitney *U*-tests when necessary. The χ^2-test with Yates correction and Fisher's exact test were used for 2×2 contingency tables when appropriate for non-numerical data. PIM prevalence was compared with the Wilcoxon signed rank test. Kappa statistics were carried out to detect the concordance between the two tools. The kappa value 0.41–0.6, 0.61–0.8, and 0.81–1 were defined as moderate, significant and very significant concordance, respectively. Factors related to PIM were analyzed with logistic regression analysis. The results were evaluated in 95% confidence interval and at $P < 0.05$ level. The statistical analysis was carried out with the statistical package SPSS version 21.0 for Windows (SPSS Inc., Chicago, IL).

Results

Characteristics of the study population

Among the total of 3335 patients admitted to outpatient clinic between June 2000–2014, 667 patient files (421 [63.1%] women, 246 [36.9%] men) were selected as described above. The mean age was 77.6 ± 6.3 years, mean total chronic disease number was 4.8 ± 2.1 (median 5) and mean drug number was 6.1 ± 3.4 (median 6). The characteristics of the study population including the age groups; functional, depression and nutrition statuses; and their most common chronic diseases and drugs of use are given in Table 1 by sex.

From 667 patients, a total of 4051 medication items were reviewed. The prevalence of ≤5 drug use, 6–10 drug

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Table 1 Characteristics of the study population by sex

	Female	Male	Total
n (%)	421 (63.1%)	246 (36.9%)	667 (100%)
Age (years)	77.6 ± 6.4	77.6 ± 6.,1	77.6 ± 6.3
Age groups			
65–74	123 (29.2%)	78 (31.7%)	201 (30.1%)
75–84	243 (57.7%)	139 (56.5%)	382 (57.3%)
85–94	55 (13.1%)	29 (11.8%)	84 (12.5%)
Functionality (ADL/IADL)			
0–4 (normal)			
ADL (*n* = 655)			
0–6 (Dependent)	7 (1.7%)	5 (2.1%)	12 (1.8%)
7–12 (Partially dependent)	42 (10.2%)	18 (7.4%)	60 (9.2%)
13–18 (Independent)	364 (88.1%)	219 (90.5%)	583 (89%)
IADL (*n* = 655)			
0–8 (Dependent)	38 (9.2%)	17 (7%)	55 (8.4%)
9–16 (Partially dependent)	134 (32.4%)	60 (24.8%)	194 (29.6%)
17–24 (Independent)	241 (58.4%)	165 (68.2%)	406 (62%)
Depression, GDS (*n* = 584)			
0–4 (Normal)	223 (60.9%)	160 (73.4%)	383 (65.6%)
5–8 (Mild depression)	87 (23.8%)	40 (18.3%)	127 (21.7%)
9–11 (Moderate depression)	33 (9%)	11 (5%)	44 (7.5%)
12–15 (Severe depression)	23 (6.3%)	7 (3.2%)	30 (5.1%)
Nutrition, MNA (*n* = 620)			
0–7 (Malnutrition)	73 (18.4%)	34 (15.2%)	107 (17.3%)
8–11 (Malnutrition risk)	116 (29.3%)	66 (29.5%)	182 (29.4%)
>11 (Normal)	207 (52.3%)	124 (55.4%)	331 (53.4%)
Chronic diseases			
Hypertension	335 (79.6%)	169 (68.7%)	504 (75.6%)
Chronic renal failure	153 (36.3%)	11 (45.1%)	264 (39.6%)
Diabetes mellitus	128 (30.4%)	77 (31.3%)	205 (30.7%)
Clinical depression	132 (31.4%)	55 (22.4%)	187 (28%)
Osteoporosis	153 (36.3%)	30 (12.2%)	183 (27.4%)
Chronic drugs			
Aspirin	161 (38.2%)	112 (44.5%)	273 (40.9%)
Proton pump inhibitors	129 (30.6%)	68 (27.6%)	197 (29.5%)
Beta-blockers	124 (29.5%)	72 (29.3%)	196 (29.4%)
ARB	130 (30.9%)	51 (20.7%)	181 (27.1%)
ACEI	118 (28%)	62 (25.2%)	180 (27%)

ACEI, angiotensin converting enzyme inhibitor; ADL, activities of daily living; ARB, Angiotensin II Receptor Blocker; GDS, Geriatrics Depression Scale; IADL, instrumental activities of daily living; MNA, Mini-Nutritional Assessment.

use, and >10 drug use (advanced polypharmacy) were 47.5%, 41.7% and 10.8%, respectively. There was not any statistically significant difference between the sexes and age groups in terms of chronic drug numbers ($P > 0.05$).

Comparison of the Beers 2012 and STOPP version 2

PIM prevalence

STOPP version 2 criteria detected 452 PIM in 261 (39.1%) patients with one PIM in 147 (22%) patients, two PIM in 71 (10.7%) patients, three PIM in 23 (3.5%) patients and four PIM in 14 (2.1%) patients, whereas the Beers 2012 detected 374 PIM in 222 (33.3%) patients with one PIM in 143 21.4% patients, two PIM in 37 (5.6%) patients, three PIM in 21 (3.2%) patients and four PIM in 15 (2.3%) patients ($P < 0.001$, $Z = -3.5$). Kappa analysis showed a moderate concordance between the tools (kappa = 0.44, $P < 0.001$; Table 2).

Both tools detected PIM in 155 (23.2%) patients, only STOPP detected PIM in 106 (15.9%) and only Beers detected PIM in 67 (10.1%) patients. In 339 (50.8%) patients, there was not any PIM detected by any of the tools.

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Table 2 Comparison of Screening Tool of Older Person's Prescriptions version 2 and Beers 2012

PIM no.	STOPP version 2	Beers 2012	
0	406 (60.9%)	445 (66.7%)	
1	147 (22%)	143 (21.4%)	
2	71 (10.7%)	37 (%)	
3	23 (3.5%)	21 (3.2%)	
4	14 (2.1%)	15 (2.3%)	
5-6-7-8-9	2-2-1-0-1 (number)	4-1-0-1-0 (number)	
Total PIM	261 (39.1%)	222 (33.3%)	$P < 0.001$*
			$Z = -3.5$
			kappa = 0.44
Common drugs			
	Aspirin (67, 14.8%)	Antipsychotics (110, 29.4%)	
	Antipsychotics (63, 13.9%)	SSRI (54, 14.4%)	
	Anticholinergics (59, 13%)	NSAIDs (35, 9.3%)	
	Loop diuretics (43, 9.5%)	Alpha-blockers (30, 8%)	
	Diltiazem/verapamil (19, 4.2%)	Digoxin (20, 5.3%)	

*Valid/same for χ^2-test, Wilcoxon and kappa analyses, NSAIDs, non-steroidal anti-inflammatory drugs; PIM, potentially inappropriate medication; SSRI, selective serotonin reuptake inhibitor; STOPP, Screening Tool of Older Person's Prescriptions.

PIM profiles

The most common drugs related to PIM were aspirin in 67 (14.8%), antipsychotics in 63 (13.9%) and anticholinergics in 59 (13%) patients with STOPP criteria, whereas these were antipsychotics in 110 (29.4%), selective serotonin reuptake inhibitors (SSRI) in 54 (14.4%) and NSAIDs in 35 (9.3%) patients with the Beers 2012 criteria (Table 2).

Accordingly, the most common opposed STOPP criteria were "use of >160 mg aspirin" ($n = 53$, 7.9%), followed by "use of loop diuretics in urinary incontinence" ($n = 38$, 5.7%) and "use of antipsychotics in fall risk" (32 [4.8%]); whereas these were "SSRI use in the presence of a fall or fracture" ($n = 54$, 8.1%), "antipsychotic use in dementia without severe behavioral/psychological symptoms and without indication" ($n = 42$, 6.3%) and "oral or parenteral non-selective NSAID use" ($n = 32$, 4.8%) with the Beers criteria.

Among the drug/drug class non-specific statements – as drug indication criteria – of STOPP version 2, there was the use of a variety of drugs prescribed without an evidence-based clinical indication (Table 3). Among these drugs, vitamin B drugs (either as only vitamin B_{12} [$n = 54$, 8.1%] or in complex with other B vitamins [$n = 14$, 2.1%], in total $n = 68$ and 10.2%), PPI ($n = 42$, 6.3%), gingkobiloba extracts ($n = 39$, 5.8%), piracetam ($n = 33$, 4.9%) and multivitamin complexes ($n = 27$, 4%) were the top five drugs/drug classes with ≥4% prevalence (Table 3).

When the data with the tools were combined, the antipsychotics, over-the-counter vitamin/supplement drugs, aspirin, SSRI and anticholinergics were the leading drug classes for inappropriate prescription.

Factors associated with PIM

Factors associated with PIM were analyzed for the STOPP criteria. When patients having PIM and having no PIM were compared, there was no statistically significant difference in terms of sex (38.4% *vs* 40.2% for women and men, respectively) or age (77.6 ± 6.6 years in patients with PIM *vs* 77.6 ± 6 in patients without PIM, $P > 0.05$ for both). However, patients having PIM had a higher rate of chronic drug use (7.8 ± 3.1, median 8 *vs* 4.9 ± 3.1, median 5, $P < 0.001$), a higher number of chronic diseases (5.6 ± 2, median 6 *vs* 4.3 ± 2.1, median 4, $P < 0.001$), more dependence in ADL ($P = 0.049$) with lower ADL scores (15.5 ± 3.2 *vs* 16.5 ± 2.6, $P < 0.001$) and/or IADL ($P = 0.003$) with lower IADL scores (16.9 ± 6 *vs* 19.1 ± 5.6, $P < 0.001$), higher Geriatric Depression Scale scores (4.2 ± 3.8, median 4 *vs* 3.4 ± 3.6, median 2, $P = 0.009$) and lower Mini-Nutritional Assessment Short-Form scores (10.2 ± 3.3 *vs* 11 ± 3.2, $P < 0.001$) compared with patients having no PIM.

Table 3 Potentially inappropriate medication by non-specific drug indication criteria Screening Tool of Older Person's Prescriptions version 2

Lack of evidence-based clinical indication	
Vitamin B drugs	68 (10.2%)
Vitamin B_{12}	$n = 54$ (8.1%)
Vitamin B complexes	$n = 14$ (2.1%)
Proton pump inhibitors	42 (6.3%)
Gingkobiloba extracts	39 (5.8%)
Piracetam	33 (4.9%)
Multivitamin complexes	**27 (4%)**

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In the logistic regression analysis (dependent variable was presence of PIM, and independent variables were chronic drug number, chronic disease number, functional score, Geriatric Depression Scale score, Mini-Nutritional Assessment Short-Form score), chronic drug number (OR 1.29, 95% CI 1.20–1.38, $P < 0.001$), chronic disease number (OR 1.16, 95% CI 1.05–1.30, $P = 0.005$) and ADL score (OR 0.90, 95% CI 0.83–0.97; $P = 0.009$) remained significantly associated with PIM. When the regression analysis was re-performed with the addition of age and sex as independent variables, again the factors associated with PIM emerged as higher drug number, higher chronic disease number and lower functional score (ADL or IADL; results not detailed; Table 4).

Discussion

The PIM prevalence were detected as 39.1% and 33.3% by STOPP version 2 and Beers 2012 criteria, respectively. Among patients admitted to a health center, the PIM prevalence varied widely being as low as 18.3% as in primary care by "Beers 2003" from Ireland,[23] 38.6% from Hong-Kong in tertiary care by "Beers 2012"[15] and as high as 87.3% in a tertiary health center by "Beers 2012" from India;[17] whereas by "STOPP version 1", this was much less divergent between 21.4% from Ireland[23] and 35.4% from Spain,[13] both reported in primary care. A very recent study also from Turkey using STOPP version 1 that is about to be published reported PIM prevalence of 41.2% in a very similar setting, but from a different region.[16]

Hence, as compared with the studies documenting PIM by Beers 2012, our prevalence of 33.3% was at the lower end. The PIM prevalence in descending order were reported from India, Brazil, Spain and Hong Kong (87.3%, 51.8%, 44% and 38.6%, respectively).[13–15,17] The detected prevalence of PIM by these criteria depend on the patient characteristics signified by the study setting and local prescription characteristics dependent on i.e. the physician treatment habits and available pharmaceutics.[14,15] Among these studies, tertiary healthcare studies from India and Hong Kong were strikingly different with 87.3% and 38.6% prevalence.[15,17] From primary care centers, PIM were higher in Brazil than Spain, with 51.8% versus 44%.[13,14] The present study was carried out in a university teaching hospital having features of a tertiary health center. However, this outpatient clinic also serves as somewhat a primary care center, enabling direct admission of older people regarding the local health system of government. Hence, we suggest our lower prevalence might be related to health setting. Nevertheless, it was far less common than in Brazil, Spain and India, but very comparable with Hong Kong. The other point related to detected PIM prevalence is the prescription habits that depend on the physician habits and available pharmaceutics. The criteria on the drugs that are not available in Turkey are much more common in the Beers 2012 than the STOPP version 2 criteria.[7,8] Hence, this is a factor for the relative lower PIM prevalence by Beers 2012 in the present study. This point is especially emphasized in European studies comparing STOPP version 1 and Beers 2003 regarding the latter's limitation.[12,23] Although some modifications were carried out in Beers 2012[7] in this aspect, this is still a concern.

Regarding the STOPP criteria, all the former data were evaluated by STOPP 1. In comparison, the STOPP 1-detected PIM prevalence were much more comparable with the 39.1% of the present study; that is, 35.4% from Spain,[13] 33.8% from Brazil,[14] 21.4% from Ireland[23] of primary care and 31.6% from Hong Kong,[15] and 35% from Ireland[12] and 41.2% from another region of Turkey[16] of tertiary centers, yet at the upper side in this case.

These data suggest STOPP version 2 to be more successful for detecting PIM in our region, with a significant difference between detected PIM prevalence by STOPP version 2 and Beers 2012 ($P < 0.001$, $Z = -3.5$). In contrast, as kappa analysis showed a moderate degree of agreement between the two tools (kappa = 0.44, $P < 0.001$), they suggest complementary use, as also suggested by the Spanish study with a reported kappa value of 0.35.[13]

The studies comparing STOPP version 1 and Beers 2003/2012 already scarce and from few countries. Such studies draw much attention, as the criteria have being updated nowadays. In this aspect, some studies suggest STOPP being more successful to predict adverse drug effects;[9,11,12] whereas some others suggest vice versa.[13–15] The studies suggesting STOPP version 1 as a better tool were all from European countries (Ireland and Spain), and were compared with the Beers 2003;[9,11,12] whereas, so far, all the published studies of STOPP version 1 with Beers 2012 reported Beers 2012 as more successful,[13–15] and were from diverse continents of the world, such as Spain, Brazil and Hong Kong. As this is the first study comparing STOPP version 2 with Beers 2012, the results

Table 4 Factors associated with potentially inappropriate medication detected by Screening Tool of Older Person's Prescriptions version 2 by regression analysis

	P	OR	95% CI
Chronic drug number	0.005*	1.16	1.05–1.30
Chronic drug number	<0.001*	1.29	1.20–1.38
ADL	0.009*	0.90	0.83–0.97
MNA-SF	0.26	0.96	0.90–1.03
GDS	0.52	1.02	0.96–1.07

Dependent variable was presence of potentially inappropriate medication and independent variables were chronic disease number, chronic drug use, functional score, Geriatric Depression Scale score, and Mini-Nutritional Assessment Short-Form (MNA-SF) score. †Addition of age and sex did not modify significances of the associations. *Statistically significant *P*-value. ADL, activities of daily living; CI, confidence interval; GDS, Geriatrics Depression Scale; MNA, Mini-Nutritional Assessment; OR, odds ratio.

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of our data in favor of STOPP version 2 suggest that the current update of STOPP might yield better outcomes in general or specifically in this region. Of course, studies from other countries are required to comment more on the other regions. Most recently, Beers 2012 was also updated as Beers 2015.[24] Compared with the 2012 update, the 2015 update has fewer changes and new medications, likely because of the shorter timespan since the criteria were last revised.[24] However, comparison of Beers 2015 and STOPP version 2 remains as an area of complementary research.

Regarding the PIM profiles, the most common PIM-related drugs were aspirin, antipsychotics and anticholinergics with STOPP; whereas these were antipsychotics, SSRI and NSAID with the Beers criteria. For Turkey, the Beers 2012 has drawn attention for significant PIM practices related to antipsychotic, SSRI and NSAIDs use, and this would be an important contribution regarding local practices. As noted, besides the specific criteria, we also analyzed the drug/drug class non-specific statements with STOPP version 2 separately and detected use of a variety of drugs prescribed without an evidence-based clinical indication (Table 3). As these were non-specific criteria with globally accepted consensus, they were not included in the comparison of specific criteria. Among these drugs, vitamin B drugs (either as only vitamin B_{12} or in complex with other B vitamins), PPI, gingkobiloba extracts, piracetam and multivitamin complexes were the top five drugs/drug classes. When the data with the tools were combined, the antipsychotics, over-the-counter vitamin/supplement drugs, aspirin, SSRI and anticholinergics were the leading drug classes for inappropriate prescription. Accordingly, over-the-counter medication use, especially vitamin use, constitutes a significant contribution to PIM practice. This is the first study evaluating the use of over-the-counter medicines by the explicit drug use criteria, and signifies consideration of over-the-counter medicines in the older population. PPI overuse without a valid indication is another significant yet overviewed problem.

PIM profiles also change significantly between countries. As examples, the study from Ireland had noted PPI, aspirin, benzodiazepine and duplicate drug use with the former STOPP, and benzodiazepine, tricyclics, sympatholytics and doxazosine use with the Beers 2003[11]; the Brazil study had reported aspirin as most common – like ours – followed by clonazepam and diclofenac with STOPP version 1, and short-acting nifedipine and glyburide with the Beers 2012[14]; and the Indian study noted metoclopramide, benzodiazepine, digoxin and diclofenac use with the Beers 2012.[17] Hence, studies from different countries are required to gain a better opinion regarding PIM in the general older population.

The multivariate analysis including a wide range of geriatric syndromes – namely, the presence of polypharmacy, multiple comorbidity, functional dependency, depression and malnutrition – were studied in the present analysis in relation to PIM, which we believe to be another significant contribution of the study. The extent of polypharmacy – as a constant result in the previous reports – was the most important variable related to PIM, along with the higher number of comorbidities and functional dependency.[3,13,25] Age was not an independent factor both in univariate and multivariate analyses. Therefore, we suggest that rather than the age, individual characteristics for drugs, diseases and functionality are important for PIM, and special attention has to be paid in this subgroup of older people.

In conclusion, PIM prevalence of approximately 40% was similar to the global worldwide prevalence, but at the very upper end. STOPP version 2 was more successful than Beers 2012 to detect inappropriate prescribing, but they should be noted as complementary. Antipsychotics, over-the-counter vitamin/supplement drugs, aspirin, SSRI and anticholinergics were the major drug classes accounting for PIM. Patients with multiple comorbidities, drug use and more dependency were more likely to have PIM requiring special attention during prescription. We suggest that these results should have a clinical impact on the older population, and represent major data for worldwide comparison.

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Disclosure statement

The authors declare no conflict of interest.

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