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Polypharmacy in Nursing Home in Europe: Results From the SHELTER Study

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Background. This study assesses prevalence and patients characteristics related to polypharmacy in a sample of nursing home residents.

Methods. We conducted a cross-sectional analysis on 4,023 nursing home residents participating to the Services and Health for Elderly in Long TERm care (SHELTER) project, a study collecting information on residents admitted to 57 nursing home in 8 countries. Data were collected using the interRAI instrument for long-term care facilities. Polypharmacy status was categorized in 3 groups: non-polypharmacy (0–4 drugs), polypharmacy (5–9 drugs) and excessive polypharmacy (≥10 drugs).

Results. Polypharmacy was observed in 2,000 (49.7%) residents and excessive polypharmacy in 979 (24.3%) residents. As compared with non-polypharmacy, excessive polypharmacy was directly associated not only with presence of chronic diseases but also with depression (odds ratio [OR] 1.81; 95% confidence interval [CI] 1.38–2.37), pain (OR 2.31; 95% CI 1.80–2.97), dyspnoea (OR 2.29; 95% CI 1.61–3.27), and gastrointestinal symptoms (OR 1.73; 95% CI 1.35–2.21). An inverse association with excessive polypharmacy was shown for age (OR for 10 years increment 0.85; 95% CI 0.74–0.96), activities of daily living disability (OR for assistance required vs independent 0.90; 95% CI 0.64–1.26; OR for dependent vs independent 0.59; 95% CI 0.40–0.86), and cognitive impairment (OR for mild or moderate vs intact 0.64; 95% CI 0.47–0.88; OR for severe vs intact 0.39; 95% CI 0.26–0.57).

Conclusions. Polypharmacy and excessive polypharmacy are common among nursing home residents in Europe. Determinants of polypharmacy status include not only comorbidity but also specific symptoms, age, functional, and cognitive status.

Key Words: Polypharmacy—Nursing home—Older adults.

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THE aging process is characterized by a high level of complexity, which makes the care of older adults particularly challenging. Typically, older adults show the co-occurrence of multiple chronic diseases (comorbidity) and conditions that cannot be ascribed to a specific organ system pathology and have multiple causes (the so-called geriatric syndromes) (1). This high degree of complexity is further complicated by the presence of cognitive and functional impairment, which are common in this population (2,3). Nursing home (NH) residents represent the paradigm of this complexity because they are usually 'frail' and present with multiple chronic diseases and with a high rate of functional and cognitive impairment. Pharmacological treatment of this complex patient represents a challenge for prescribing physicians, as confirmed by the high prevalence of polypharmacy, defined as the concomitant use of multiple drug therapies, and resulting iatrogenic illness observed in this population (4,5): national surveys in the United States and Canada have suggested that prevalence of polypharmacy in the long-term setting ranges between 15% and 40% (6,7).

In addition, application of recommendation of disease-specific guidelines to complex elderly participants is not straightforward as they are difficult to generalize to "the

complex patient" in NH and rarely provide recommendations for treatment of older adults with these characteristics (8–10). A recent survey conducted among prescribing physicians in the United States showed that they used a variety of strategies to balance the benefits and harms of complex drug regimens and identified a number of barriers to care for complex patients and lack of data for outcomes most important for the patients, including pain and specific symptoms (11).

The purpose of this study is to explore prescribing physicians' approach to pharmacological treatment of complex older adults in NH in Europe. In particular, the present study assesses "the prevalence of and patient characteristics" related to the use of multiple medications in a sample of NH residents in eight countries participating to the Services and Health for Elderly in Long TERm care (SHELTER) project.

Methods

Sample and Study Setting

The study sample consisted of 4,156 NH residents in 57 facilities of 7 European Union (EU) countries (Czech Republic, England, Finland, France, Germany, Italy, and The Netherlands) and 1 non-EU country (Israel), participating to the SHELTER study, a project funded by the Seventh Framework Programme of the EU (12). The SHELTER study is aimed at validating the interRAI instrument for long-term care facilities (interRAI LTCF), a comprehensive standardized instrument, as an tool to assess the care needs and provision of care to residents of NH in Europe.

The study was conducted from 2009 to 2011. In each country, study partners identified a sample of NH willing to participate to the study. "The sample was not randomly selected and it was not intended to be representative of all NH in each country." Overall 57 NH participated to the study (Czech Republic: 10, England: 9, Finland: 4, France: 4, Germany: 9, Israel: 7, Italy: 10, The Netherlands: 4). Older adults residing in participating NH at the beginning of the study and those admitted in the 3 months enrollment period following the initiation of the study were assessed using the interRAI LTCF. "No exclusion criteria was adopted." Residents were invited to take part in the study and were free to decline participation. Ethical approval for the study was obtained in all countries according to local regulations.

Data Sources

The interRAI LTCF contains over 350 data elements including socio-demographic variables, numerous clinical items about both physical and cognitive status, as well as all clinical diagnoses (13,14). The interRAI LTCF also includes information about an extensive array of signs, symptoms, syndromes, and treatments being provided. The SHELTER study showed that the interRAI LTCF is a reliable instrument that enables the creation of databases that can be used to assess and compare characteristics of NH residents across countries, languages, and cultures (12).

Study researchers responsible for data collection were trained following a previously validated procedure (15). In each country, courses were organized to teach study researchers how to perform the assessment using the interRAI LTCF, including the specific forms and appropriate response codes, and to develop care planning. Study researchers were trained to use a variety of information sources, such as direct observation, interviews with the person under care, family, friends, or formal service providers, and review clinical records, both medical and nursing.

Outcome Measure

As part of the InterRAI LTCF assessment, study researchers collected information on all the drugs patients had been taking in the 3 days prior to the assessment. They were instructed to derive drug data from different information sources, including physician order sheets and medication administration record. Drug information included nonproprietary and proprietary name, Anatomical Therapeutic and Chemical code of the WHO Collaborating Centre for Drug Statistics Methodology, (16) formulation, dosage, frequency (number of times per day, week or month the medication is taken), and route of administration. Drugs with no ingredients that are absorbed systemically (i.e. topical treatments) and drugs ordered as needed and assumed in the 3 days prior to the assessment were also recorded. In line with previous publications, polypharmacy status was categorized in 3 groups: non-polypharmacy (concurrent use of 0–4 drugs), polypharmacy (concurrent use of 5–9 drugs), and excessive polypharmacy (concurrent use of ≥10 drugs) (17–20).

Independent Variables

The demographic variables included age and gender. The Cognitive Performance scale (CPS) was used to assess cognitive status. The Cognitive Performance scale combines information on memory impairment, level of consciousness, and executive function, with scores ranging from 0 (intact) to 6 (very severe impairment) (21,22). Cognitive impairment was categorized as follows: moderate (Cognitive Performance scale score 2–4) and severe (Cognitive Performance scale score ≥ 5) (21). To evaluate functional status, the seven-point MDS Activities of Daily Living (ADL) Hierarchy scale was used (23). The ADL Hierarchy scale ranges from 0 (no impairment) to 6 (total dependence). ADL disability was categorized as follows: assistance required (ADL Hierarchy scale score 2–4) and dependence (ADL Hierarchy scale score ≥ 5). The MDS Depression Rating scale was used to assess the presence of depressive symptoms and a score ≥ 3 was used to diagnose depression

(24). Behavioral symptoms were present if the participant exhibited one or more of the following symptoms in the 3 days prior to assessment: wandering, verbally abusive, physically abusive, socially inappropriate behavior, and active resistance of care. Falls were defined as a sudden loss of balance causing the contact of any part of the body above the feet with the floor occurring in the 90 days before the assessment. Weight loss was defined as loss of 5% or more of body weight in last 30 days or 10% or more in last 180 days. Presence of the following health problems in the 3 days prior to assessment was recorded: pain, dyspnoea, gastrointestinal (GI) symptoms (including acid reflux, constipation, diarrhoea, and vomiting), and dizziness. Data on clinical diagnoses were collected through a list of common or important diseases relevant to care embedded in the InterRAI LTCF. Clinical diagnoses were recorded by study researchers gathering information from the patient, the general practitioner, and after physical examination, careful review of patient clinical documentation and previous medical history. Flare up of a recurrent or chronic problem was defined as presence of an acute health condition (ie a new myocardial infarction, adverse drug reaction, influenza, urinary tract infection) or an exacerbation of a chronic condition (ie new-onset shortness of breath in residents with a history of asthma or increased pedal edema in a person with congestive heart failure), which requires evaluation by a physician and a significant increase in nursing monitoring.

Statistical Analysis

From the initial sample of 4,156 residents, those with missing data on medication used (n = 133; 3.2%) were excluded, leading to a final sample of 4,023 participants. Baseline characteristics of participants according to polypharmacy were compared using analyses of variance for normally distributed variables, nonparametric Mann–Whitney U test for skewed variables, and chi-square analyses for dichotomous variables. Generalized estimating equations were used to estimate the effect of polypharmacy on variables considered (25). This methodology was applied in order to adjust for the potential confounding effect of facility and to take into account the correlation of observations within each facility. Variables entered in this model were age, gender, country and those variables associated with polypharmacy at $p \leq 0.10$. Odds ratios (ORs) and corresponding 95% confidence intervals (CIs) were derived from this model. Analyses were performed using SAS statistical software, version 8 (SAS Institute Inc, Cary, NC).

Results

Mean age of 4,023 residents entering the study was 83.5 (*SD* 9.3) years, 2,945 (73.2%) were women, 3,333 (82.8%) had a length of stay ≥90 days and mean number of drugs used was 7.0 (median 7.0, *SD* 3.6). Polypharmacy (concurrent use of 5–9 drugs) was observed in 2,000 (49.7%) residents and excessive polypharmacy (concurrent use of ≥10 drugs) in 979 (24.3%) residents. Prevalence of polypharmacy and excessive polypharmacy widely varied in study sample. In particular, Italy had the lowest prevalence of excessive polypharmacy (8.8%), followed by Israel (12.9%), Germany (15.7%), England (22.7%), the Netherlands (24.4%), Czech Republic (25.2%), France (30.2%), and Finland (56.7%).

Table 1. Prevalence of Drug Used in 57 European Nursing Homes: The SHELTER Study

Drug Class	All n = 4,023 (%)
Laxatives	1,680 (41.8)
Antiulcer drugs	1,645 (40.9)
Aspirin and antiaggregants	1,518 (37.7)
Benzodiazepines	1,448 (36.0)
Antidepressants	1,431 (35.6)
Diuretics	1,429 (35.5)
Analgesics	1,382 (34.4)
Antipsychotics	1,063 (26.4)
Angiotensine converting enzyme inhibitors	925 (23.0)
Beta blockers	910 (22.6)
Antiosteoporosis drugs (including vitamin D)	753 (18.7)
Calcium channel blockers	674 (16.8)
Statins	595 (14.8)
Antidementia drugs	429 (10.7)
Oral hypoglycemic agents	373 (9.3)
Antiparkinson drugs	310 (7.7)
Digoxin	272 (6.8)
Insulin	256 (6.4)
ARB	241 (6.0)
Antibiotics	211 (5.2)
Vitamin supplements (not including vitamin D)	163 (4.1)
Corticosteroids	144 (3.6)

Note: ARB = Angiotensin Recepter Blockers; SHELTER = Services and Health for Elderly in Long TERm care.

Table 1 presents patterns of drug use. Laxatives were the most commonly used drugs (41.8%), followed by antiulcer drugs (40.9%) and *aspirin* and antiaggregants (37.7%). The use of psychotropic drugs was common in this sample with more than one third of participating residents receiving benzodiazepines (36.0%) and antidepressants (35.6%) and more than one fourth of residents receiving antipsychotics (26.4%). Also cardiovascular drugs were commonly used in this sample, with 35.5% of residents using diuretics, 23.0% "angiotensin-converting enzyme inhibitors," 22.6% beta-blockers, 16.8% calcium channel blockers, and 14.8% statins. Analgesics (which included acetaminophen, nonsteroidal anti-inflammatory drugs, and opioids) were used by more than one third of study sample, while uncommon was the use of vitamin supplements (only 4.1% of study sample).

Characteristics of the study sample according to polypharmacy status are summarized in Table 2. Residents on polypharmacy and excessive polypharmacy, when compared with those not on polypharmacy, had a less severe level of disability and cognitive impairment, a reduced rate of behavioral symptoms and a higher prevalence of depression, falls, pain, dyspnoea, GI symptoms, dizziness, and

Table 2. Characteristics of Residents in 57 European Nursing Homes According to Polypharmacy Status: The SHELTER Study

	All n = 4,023 (%)	Non-polypharmacy (<5 drugs), n = 1,044 (%)	Polypharmacy (5–9 drugs), n = 2,000 (%)	Excessive Polypharmacy (≥10 drugs), n = 979 (%)	p
Demographics					
Age, years (mean ± *SD*)	83.5 ± 9.4	83.4 ± 10.3	83.7 ± 9.1	83.3 ± 8.8	.45
Female gender	2945 (73.2)	767 (73.5)	1476 (73.8)	702 (71.7)	.47
Geriatric conditions					
ADL disability*					<.001
Assistance required	1661 (41.4)	379 (36.5)	829 (41.6)	453 (46.3)	
Dependent	1607 (40.1)	486 (46.8)	795 (39.8)	326 (33.3)	
Cognitive status†					<.001
Mild/moderate impairment	1510 (38.1)	324 (32.1)	749 (37.8)	437 (45.0)	
Severe impairment	1234 (31.1)	408 (40.4)	630 (31.8)	196 (20.2)	
Depression‡	1268 (32.0)	245 (24.3)	623 (31.5)	400 (41.2)	<.001
Behavioral symptoms	1605 (40.5)	453 (44.9)	780 (39.3)	372 (38.4)	.004
Falls	373 (9.4)	79 (7.7)	192 (9.7)	102 (10.5)	.07
Weight loss	380 (9.5)	95 (9.2)	200 (10.0)	85 (8.7)	.49
Symptoms					
Pain	1448 (36.1)	231 (23.2)	698 (35.0)	519 (53.1)	<.001
Dyspnoea	524 (13.1)	84 (8.1)	235 (11.8)	205 (21.0)	<.001
GI symptoms	1555 (39.0)	349 (33.7)	762 (38.3)	444 (46.0)	<.001
Dizziness	607 (15.1)	127 (12.2)	309 (15.5)	171 (17.6)	.003
Comorbidity					
Number of diseases (mean ± *SD*)	2.3 ± 1.5	2.0 ± 1.5	2.4 ± 1.4	2.8 ± 1.5	<.001
Ischemic heart disease	1050 (26.3)	177 (17.1)	543 (27.2)	330 (34.2)	<.001
Heart failure	708 (17.7)	98 (9.5)	360 (18.0)	250 (25.8)	<.001
Parkinson disease	394 (9.8)	73 (7.0)	200 (10.0)	121 (12.4)	<.001
Stroke	886 (22.1)	196 (18.9)	456 (22.9)	234 (24.0)	.01
Fracture in the last 30 days	153 (3.8)	37 (3.6)	69 (3.5)	47 (4.8)	.17
Diabetes	866 (21.7)	152 (14.7)	429 (21.5)	285 (29.5)	<.001
Cancer	435 (10.9)	74 (7.1)	230 (11.5)	131 (13.4)	<.001
Flare up of a recurrent or chronic problem	263 (6.6)	52 (5.0)	127 (6.4)	84 (8.6)	.004

Notes: ADL = activities of daily living; CPS = Cognitive Performance scale; GI = gastrointestinal; SHELTER = Services and Health for Elderly in Long TERm care.

*Assistance required is defined by ADL hierarchical scale score 2–4, dependent by ADL hierarchical scale score 5–6.

†Mild/moderate cognitive impairment is defined by CPS 2–4, severe impairment by CPS 5–6.

‡Depression Rating scale score ≥ 3.

flare up of a recurrent or chronic problem. Finally, residents on polypharmacy and excessive polypharmacy presented a higher number of concomitant diseases and, in particular, ischemic heart disease, heart failure, Parkinson disease, stroke, diabetes, and cancer were more common in these groups as compared with the non-polypharmacy group.

Table 3 reports results of the multivariate analysis, identifying variables independently associated with polypharmacy and excessive polypharmacy. As compared with non-polypharmacy, excessive polypharmacy was directly associated with depression (OR 1.81; 95% CI 1.38–2.37), pain (OR 2.31; 95% CI 1.80–2.97), dyspnoea (OR 2.29; 95% CI 1.61–3.27), GI symptoms (OR 1.73; 95% CI 1.35–2.21), and specific diseases including ischemic heart disease (OR 2.93; 95% CI 2.06–4.16), heart failure (OR 2.06; 95% CI 1.43–2.99), Parkinson disease (OR 2.82; 95% CI 1.68–4.27), stroke (OR 1.49; 95% CI 1.05–2.12), and diabetes (OR 3.19; 95% CI 2.28–4.45), while an inverse association was shown for age (OR for 10 years increment 0.85; 95% CI 0.74–0.96) ADL disability (OR for assistance required vs independent 0.90; 95% CI 0.64–1.26; OR for dependent vs independent 0.59; 95% CI 0.40–0.86) and cognitive impairment (OR for mild or moderate vs intact 0.64; 95% CI 0.47–0.88; OR for severe vs intact 0.39; 95% CI 0.26–0.57). Similarly, polypharmacy was directly associated with depression (OR 1.43; 95% CI 1.17–1.75), pain (OR 1.61; 95% CI 1.33–1.95), ischemic heart disease (OR 1.65; 95% CI 1.28–2.13), heart failure (OR 1.62; 95% CI 1.22–2.15), and diabetes (OR 1.51; 95% CI 1.19–1.91). Presence of behavioral symptoms presented an inverse and significant association with polypharmacy (OR 0.80; 95% CI 0.67–0.97), but not with excessive polypharmacy.

Discussion

The present study examines prevalence and factors related to polypharmacy and excessive polypharmacy in a sample of NH residents in Europe. Results of this study suggest that excessive polypharmacy is common in NH residents in Europe, with almost one out of four older adults in the SHELTER sample receiving 10 or more drugs and that not only comorbidity but also presence of specific symptoms (including GI symptoms, pain and dyspnoea) is

Table 3. Factors Associated With Polypharmacy Among Residents of 57 European Nursing Homes (reference category: non polypharmacy): The SHELTER Study

	Polypharmacy 5–9 drugs	Excessive Polypharmacy ≥10 drugs
	Odds Ratio (95% CI)	
Demographics		
Age (10 years increment)	0.98 (0.90–1.07)	0.85 (0.74–0.96)
Female gender	1.03 (0.85–1.25)	0.96 (0.73–1.27)
Geriatric conditions		
ADL disability*		
Assistance required	1.11 (0.87–1.41)	0.90 (0.64–1.26)
Dependent	0.83 (0.63–1.09)	0.59 (0.40–0.86)
Cognitive status†		
Mild/Moderate impairment	0.98 (0.78–1.24)	0.64 (0.47–0.88)
Severe impairment	0.79 (0.61–1.01)	0.39 (0.26–0.57)
Depression‡	1.43 (1.17–1.75)	1.81 (1.38–2.37)
Behavioral symptoms	0.80 (0.67–0.97)	0.76 (0.59–1.01)
Falls	1.10 (0.82–1.48)	1.29 (0.84–1.99)
Symptoms		
Pain	1.61 (1.33–1.95)	2.31 (1.80–2.97)
Dyspnoea	1.16 (0.87–1.55)	2.29 (1.61–3.27)
GI symptoms	1.12 (0.93–1.34)	1.73 (1.35–2.21)
Dizziness	1.18 (0.91–1.52)	1.20 (0.82–1.74)
Comorbidity		
Number of diseases (one disease increment)	1.09 (0.98–1.21)	1.15 (0.98–1.35)
Ischemic heart disease	1.65 (1.28–2.13)	2.93 (2.06–4.16)
Heart failure	1.62 (1.22–2.15)	2.06 (1.43–2.99)
Parkinson disease	1.44 (1.00–2.09)	2.82 (1.68–4.72)
Stroke	1.23 (0.96–1.57)	1.49 (1.05–2.12)
Diabetes	1.51 (1.19–1.91)	3.19 (2.28–4.45)
Cancer	1.32 (0.97–1.80)	1.41 (0.94–2.11)
Flare up of a recurrent or chronic problem	1.09 (0.75–1.57)	1.40 (0.86–1.26)

Notes: ADL = activities of daily living; CPS = Cognitive Performance scale; CI = confidence interval; GI = gastrointestinal; SHELTER = Services and Health for Elderly in Long TERm care. Analyses are adjusted for country.

*Assistance required is defined by ADL hierarchical scale score 2–4, dependent by ADL hierarchical scale score 5–6.

†Mild/moderate cognitive impairment is defined by CPS score 2–4, severe impairment by CPS 5–6.

‡Depression Rating scale score ≥ 3.

associated with increased rate of excessive polypharmacy, while increasing age, functional, and cognitive impairment were associated with a reduced rate of excessive polypharmacy. Laxatives and antiulcer drugs are the most frequently used drugs, but also psychotropic drugs, including benzodiazepines, antidepressants, and antipsychotics, and cardiovascular drugs are commonly prescribed in the SHELTER sample.

Prevalence of polypharmacy and excessive polypharmacy in the SHELTER population is higher when compared with studies conducted in community dwelling older adults, (17–20,26) but in line with studies assessing NH residents (6,7). Indeed NH residents are usually "frail" and present with multiple chronic diseases, which require multiple pharmacological treatments and increase their susceptibility to adverse medication effects (4,5). The use of multiple drugs together with the elevated probability of drug–drug and drug–disease interaction may explain the high incidence of adverse health outcomes associated with polypharmacy: different studies have highlighted an increased rate of adverse drug reactions, decline in physical and instrumental activities of daily living, increased risk of hospitalization, mortality, and ultimately an increment in medical costs associated with polypharmacy (18,27–29).

In addition, the prevalence of polypharmacy and excessive polypharmacy greatly differs across countries. This finding can be explained by different attitudes of prescribing physicians when facing the challenge of treatment and management of complex patients in NH. Indeed, "given the seemingly contradictory evidence of the harms and benefits of pharmacological treatments for chronic diseases and the lack of clear rules, prescribing physicians may choose different approaches and strategies" (10). Although some physician may believe that that pharmacological treatment as recommended by guidelines for the treatment of chronic conditions would provide the best outcomes, others may be concerned from such an approach and believe that drug treatment may be tailored based on resident's characteristics (11). However, data on characteristics of prescribing physicians potentially related to different prescribing attitudes (ie education, age, etc.) were not collected in the SHELTER study and the relationship between polypharmacy status and prescribing physicians attitudes cannot be explored in this sample.

As expected, in the SHELTER sample, chronic diseases, requiring long-term drug treatment, are among the strongest determinants of polypharmacy and excessive polypharmacy. However, other relevant factors are closely related to these conditions. For example, presence of relevant symptoms, including pain, dyspnoea, and GI symptoms is associated with an elevated rate of polypharmacy and excessive polypharmacy. This finding highlights the fact that symptoms relief in NH residents is considered a priority and that the goal of treatment is most of the time improving quality of life rather than improving survival. This is also confirmed by the high prevalence of use of drugs indicated for the treatment of specific symptoms in this sample (ie laxatives or antiulcer drugs for GI symptoms or analgesics for pain).

Cognitive impairment is associated with a reduced rate of excessive polypharmacy. This may be related to several factors. First, several studies have emphasized the need to avoid drugs that may affect cognition or induce delirium and behavioral symptoms, when treating patients with coexisting cognitive impairment (30,31). This hypothesis is confirmed by the inverse association of behavioral symptoms with polypharmacy status observed in the study sample. Second, memory loss, decline in intellectual function, and impaired judgment and language, commonly seen in patients with cognitive impairment, may cause communication difficulties including decreased ability to report adverse effects (32,33). Third, the oral administration of multiple medications in end-stage dementia patients with feeding problems are additional burdensome consequences of polypharmacy in older adults with cognitive impairment (31). Finally, cognitive impairment is associated with limited life expectancy and therefore limit the efficacy of pharmacological treatments and question the appropriateness of treatment (34).

Finally, increasing age is associated to a reduced prevalence of excessive polypharmacy. This finding may be related to the lack of data on benefits of treatment of chronic diseases in the oldest old (35). In addition, drug prescribing may be guided by weighing the patient's estimated life expectancy against the time required to achieve benefit from the medication treatment and for this reason in the oldest old with a limited life expectancy use of many drugs may be avoided (34).

"Pattern of drug use in the SHELTER sample mirrors the one described in a recent survey conducted among more than 13,000 NH residents in the United States." In this study, the prevalence of use of laxatives (47.5%) and antiulcer drugs (43.3%) is very similar to the one we found in the present study (41.8% and 40.9% respectively) (7). A surprising finding is the extremely elevated rate of use of benzodiazepines in the SHELTER sample, in contrast with the lower rate observed in the United States, where strict government guidelines regulates the use of benzodiazepines in NH and this class of agents is not covered by governmental drug benefits (6,7). These drugs, which are used for the treatment of common conditions observed among older adults, such as insomnia and anxiety, may cause cognitive impairment and increase the rate of falls and hip fracture, and for this reason, their use is often considered inappropriate (36,37).

Some limitations of the present study need to be recognized. First, the cross-sectional design of our research does not allow to establish a cause–effect relationship. Second, "although the InterRAI LTCF is a standardized, comprehensive assessment instrument, the recording of drug data is not its specific focus. In particular, only drugs prescribed in the three days prior to the assessment were recorded in the present study. This could have determined an underestimation of polypharmacy as several drugs may be assumed weekly (ie bisphosphonate), monthly (ie vitamin b-12 injection) or for short periods (ie antibiotics). In addition, we cannot dismiss conclusively the possibility that some drugs ordered by prescribing physicians are not administered and not taken by residents." Third, the definition of polypharmacy status we used included drugs with no ingredients that are absorbed systemically (ie eye drops, dermatological preparations). This approach was chosen in consideration of the fact that previous studies have shown that also topical treatments may increase the risk of iatrogenic illnesses (38,39). Finally, study sample was not meant to be nationally representative and therefore results cannot be generalized to all NH residents in each countries.

In conclusion, this cross-sectional study shows that polypharmacy and excessive polypharmacy are common among NH residents in Europe, but it widely varies across study sites. "This variability may suggest a suboptimal use of drugs because of inappropriate prescribing or nonprescribing in this sample and should stimulate more research aimed at improving prescribing practices for older adults."

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