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Polypharmacy prevalence among older adults based on the survey of health, ageing and retirement in Europe

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ABSTRACT

Polypharmacy, a common condition among the elderly, is associated with adverse outcomes, including increased healthcare costs, due to higher mortality, falls and hospitalizations rates, adverse drug reactions, drug–drug reactions and medication nonadherence. This study aims to evaluate the prevalence and factors related to polypharmacy in older adults across 17 European countries, plus Israel.

In this cross-sectional analysis, we used data from participants aged 65 or more years from Wave 6 of the Survey of Health, Ageing, and Retirement in Europe (SHARE) database. Polypharmacy was defined as the concurrent use of five or more medications. Age, gender, education, physical inactivity, number of limitations with activities of daily living, network satisfaction, quality of life, depression, number of chronic diseases and difficulty taking medication variables were found to be associated with polypharmacy.

Our results showed a prevalence of polypharmacy ranging from 26.3 to 39.9%. Switzerland, Croatia and Slovenia were the countries with the lowest prevalence, whereas Portugal, Israel and the Czech Republic were the countries where the prevalence of polypharmacy was the highest. Age, gender, number of limitations with activities of daily living, number of chronic diseases, quality of life, depression, physical inactivity, network satisfaction, difficulty in taking medications, years of education and shortage of money were significant variables associated with polypharmacy.

Polypharmacy is a highly prevalent condition in the elderly population. Identification of variables associated with polypharmacy, such as those identified in this study, is important to identify and monitor elderly groups, which are most vulnerable to polypharmacy.

1. Introduction

One of the biggest achievements of mankind during the last century was the increase in average life expectancy. Along with this increase, changes in the demographic pyramid occurred (Mirkin & Weinberger, 2001). In 2010, about 524 million people were 65 years of age or older, representing 8% of the total population and it is estimated that this number will reach 1.5 billion in 2050, comprising 16% of the total population (World Health Organization, 2011). This is driven mainly by a decline in fertility and mortality rates but also due to advances in public health, technology and medicine (McLean & Le Couteur, 2004a). The use of medicines either for treatment or as preventive therapy was, in fact, a critical point for this rise of life expectancy (Kline & Flavin, 2009).

With increasing survival into old age, the likelihood of developing multiple chronic diseases also increases. Indeed, the presence of two or more diseases reaches approximately 40% for individuals aged 65 or more years, and this prevalence is even higher with increasing age (Fabbri & Rabe, 2007; Fulop et al., 2010; Leslie, 2012). The presence of multiple chronic diseases makes the therapeutics difficult not only for the healthcare professional but also for the patient, which may have a negative impact on health outcomes (Maher, Hanlon, & Hajjar, 2014). The use of medicines is the most common approach to treat and prevent chronic diseases, therefore the elderly are more susceptible to polypharmacy (Marengoni et al., 2016). The use of multiple medicines, commonly referred to as polypharmacy, is common in the older population with comorbidities, as one or more medicines may be used to treat each condition. There are several definitions for polypharmacy.

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Although there is no general agreement on the number of medicines to be considered the threshold of polypharmacy, the most widely accepted definition is from Bjerrum et al., who define "polypharmacy" as taking five or more medications per day (Bjerrum, Rosholm, Hallas, & Kragstrup, 1997).

Polypharmacy is associated with adverse outcomes, including increased healthcare costs, due to higher mortality, falls and hospitalizations rates, adverse drug reactions, drug–drug reactions and medication nonadherence (Salazar, Poon, & Nair, 2007). Although polypharmacy is often considered as a well-defined, specific and homogeneous entity, emerging evidence suggests that it may have different prevalence and characteristics in different country settings (Feng et al., 2017). Therefore, the aim of this study was to evaluate the prevalence of, and variables associated with, polypharmacy in older adults, across 17 European countries and Israel.

2. Materials and methods

In this work, we used data from the SHARE (Survey of Health, Ageing and Retirement in Europe) project, Wave 6. SHARE is a multidisciplinary and international database of data on health, social and economic status and social and family networks of representative samples of community-based populations from 17 European countries (Austria, Belgium, Croatia, the Czech Republic, Denmark, Estonia, France, Germany, Greece, Italy, Luxembourg, Poland, Portugal, Spain, Sweden, Switzerland and Slovenia) and Israel. This project became a pillar of European research on ageing. Wave 6 of this survey collected data from 68,231 individuals, with ages between 24 and 106 years.

2.1. Prevalence of polypharmacy

To evaluate the prevalence of polypharmacy, our sample included all individuals from the wave 6 of SHARE project aged 65 years or more who answered to the question: "Do you take at least five different drugs on a typical day? Please include drugs prescribed by your doctor, drugs you buy without a prescription and dietary supplements such as vitamins and minerals." For the purposes of this work, polypharmacy was defined, as previously mentioned, as the concurrent use of five or more medications per day (Gnjidic et al., 2012).

2.2. Explanatory variables

Because SHARE is a project that includes immense data from several areas, it was possible to evaluate many exploratory variables, such as socio-demographics (age and gender) and education, physical inactivity, number of limitations with activities of daily living, network satisfaction, quality of life and well-being, depression, number of chronic diseases, difficulty taking medications and shortage of money.

The "age" was calculated according to the answer to "Year of birth" and for the year of 2015, and three age classes were set (65–74, 75–84 and 85+ years). Gender had "male" or "female" as possible answers. "Education" was assessed through the answer to "How many years have you been in full-time education?" which includes "receiving tuition, engaging in practical work or supervised study or taking examinations."

"Physical inactivity" was assessed with the questions "How often do you engage in 'vigorous physical activity,' such as sports, heavy housework or a job that involves physical labor?" and "How often do you engage in activities that require a moderate level of energy, such as gardening, cleaning the car or doing a walk?" "Physical inactivity" was defined as never or almost never engaging in moderate and/or vigorous physical activity. The variable "Number of limitations in activities of daily living" was a result of the sum of all the answers about difficulties selected in activities of daily living, (difficulties in a) dressing, including shoes and socks; b) walking across a room; c) bathing or showering; d) eating, cutting up food; e) getting in or out of bed; f) using the toilet, including getting up or down; g) using a map in a strange place; h) preparing a hot meal; i) shopping for groceries; j) telephone calls; k) taking medications; l) doing work around the house or garden; m) managing money; n) leaving the house independently/accessing transportation; o) doing personal laundry). The variable "Network satisfaction" was assessed through the question: "Overall, how satisfied are you with the [relationship that you have with the person/relationships that you have with the persons] we have just talked about? Please answer on a scale from 0 to 10, where 0 means completely dissatisfied and 10 means completely satisfied." "Quality of life and well-being" was evaluated through the CASP-12 index. "Depression" was defined as the total score on the EURO-D scale, included in the SHARE database.

The variable "Number of chronic diseases" was based on the number of chronic diseases reported by each individual and was dichotomized as either "less than two chronic diseases," or "two or more chronic diseases". The variable "Difficulties taking medication" was derived from the question "Please tell me if you have any difficulty with these activities because of a physical, mental, emotional or memory problem," being "taking medication" one of the items evaluated, with "yes" or "no" as possible answers. Shortage of money was measured by the question "How often do you think that shortage of money stops you from doing the things you want to do?", with "often", "sometimes", "rarely" and "never" as possible answers.

"Age," "education," "number of limitations in activities of daily living," "network satisfaction," "quality of life and well-being" and "depression" were analyzed as continuous variables, while "sex," "physical inactivity," "number of chronic diseases", "difficulty in taking medication" and "shortage of money" were considered as dichotomic variables.

2.3. Statistical analysis

We performed a descriptive results analysis to estimate the proportion of individuals with polypharmacy in the 18 countries. Age- and gender-standardized prevalence of polypharmacy by country and the 95% confidence intervals (95% CI) were also assessed. All the results related to the prevalence were standardized using the standard European population of 2013 (EUROSTAT, 2013). Given the multilevel structure of data, a multilevel logistic regression was used, with polypharmacy as the dependent variable. Multilevel univariable logistic regression models were made, considering each covariate, to identify potential factors associated with polypharmacy. Significant covariates were included in a multilevel multivariate logistic regression model. Odds ratios (OR) and their 95% CI were reported. Analyses were performed using IBM SPSS (version 24). The significance level of 0.05 was chosen.

3. Results

3.1. Prevalence study

For this study, from all the participants of wave 6 of SHARE, we selected participants that answered questions related to age, gender and polypharmacy, were aged 65 or more years, yielding a total of 34,232 participants (Fig. 1). Of these, the mean age was 75.1 ± 7.2 years (mean ± SD 7), and 19,544 (57.1%) were female. The geographical distribution of polypharmacy was assessed for the different countries (Fig. 2 and Table 1), ranging from 26.3 to 39.9%. Switzerland, Croatia and Slovenia were the countries with the lowest prevalence of polypharmacy, while Portugal, Israel and the Czech Republic were the countries where the prevalence of polypharmacy was the highest (Fig. 2 and Table 2).

3.2. Correlations of polypharmacy with explanatory variables

To evaluate the association of polypharmacy with the explanatory

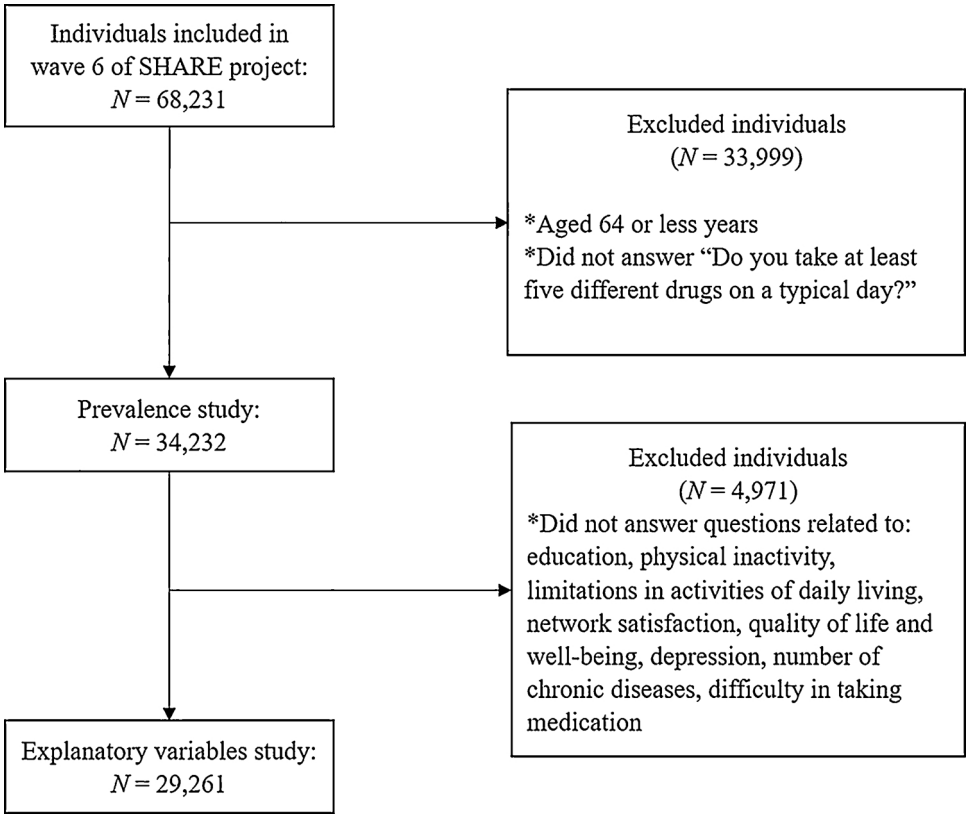

Fig. 1. Flow diagram of the individuals' selection for the prevalence and explanatory variables studies.

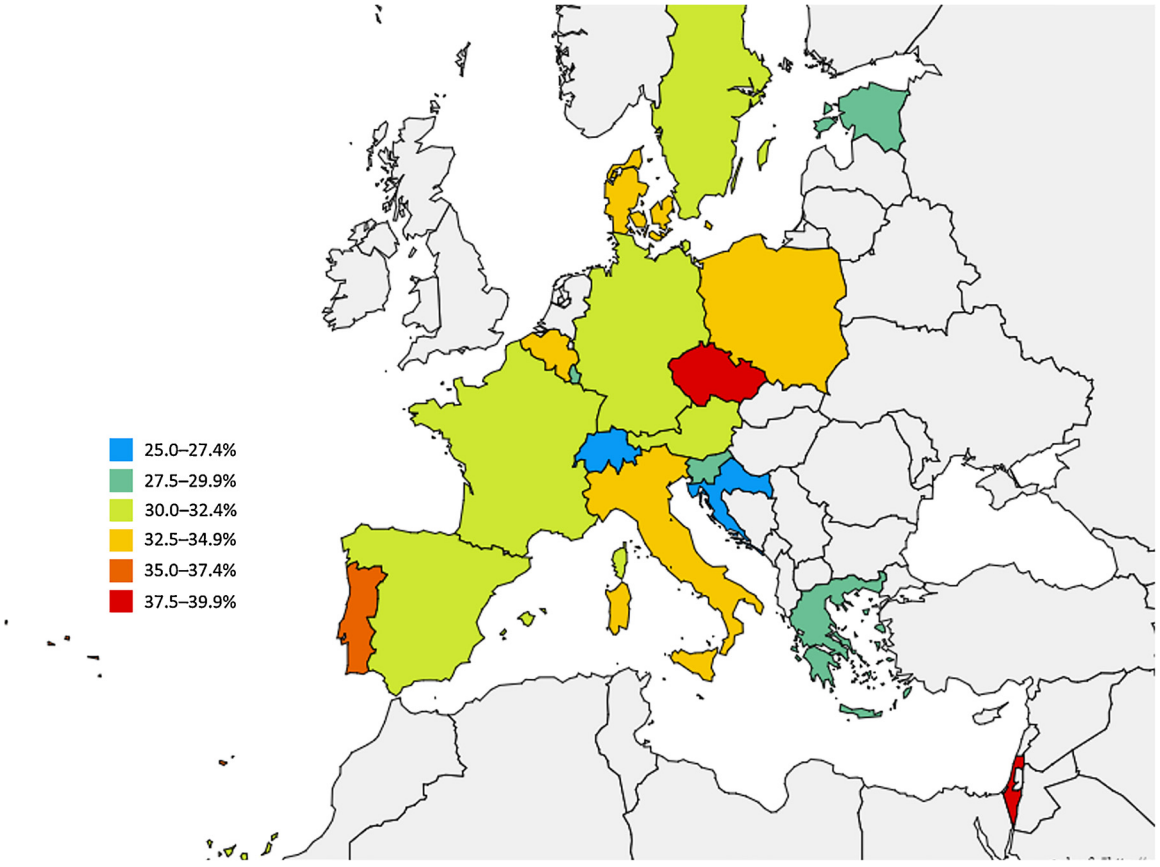

Fig. 2. Prevalence of polypharmacy in elderly (65 years or older) among 17 European countries and Israel.

Table 1
Prevalence (overall and standardized) of polypharmacy according to country, gender and age groups.

	Polypharmacy prevalence (%)													
	Overall					Male					Female			
	Polypharmacy (Total Population)	Overall prevalence (95% CI)	Standardized prevalence rates by age groups (95% CI)			Polypharmacy (*N*)	Overall prevalence (95% CI)	Standardized prevalence rates by age groups (95% CI)			Polypharmacy (*N*)	Overall prevalence (95% CI)	Standardized prevalence rates by age groups (95% CI)		
			65–74	75–84	≥85			65–74	75–84	≥85			65–74	75–84	≥85
Austria	601 (1900)	31.5 (30.9–32.1)	24.5 (23.9–25.2)	36.0 (35.0–37.0)	49.1 (47.2–51.1)	242 (795)	30.8 (30.1-31.6)	25.7 (24.7–26.7)	34.3 (32.9–35.8)	43.6 (41.0–46.3)	359 (1105)	31.8 (31.0–32.6)	23.6 (22.7–24.5)	37.2 (35.7–38.7)	51.9 (49.1–54.8)
Germany	555 (1846)	30.3 (29.8–30.8)	24.3 (23.6–25.0)	34.3 (33.3–35.4)	44.9 (43.1–46.8)	279 (854)	33.3 (32.5–34.1)	28.5 (27.4–29.5)	34.5 (33.1–36.0)	50.6 (47.9–53.5)	276 (992)	27.6 (26.8–28.3)	20.4 (19.6–21.3)	34.2 (32.8–35.6)	40.4 (38.0–43.0)
Sweden	669 (2143)	31.0 (30.5–31.6)	25.7 (25.1–26.4)	35.2 (34.1–36.2)	42.3 (40.5–44.1)	301 (951)	31.5 (30.7–32.3)	27.9 (26.9–28.9)	35.3 (33.9–36.8)	37.0 (34.6–39.4)	368 (1192)	30.6 (29.8–31.3)	24.0 (23.1–25.0)	35.0 (33.6–36.5)	46.4 (43.8–49.2)
Spain	956 (2828)	31.6 (31.0–32.1)	25.1 (24.4–25.8)	36.0 (35.0–37.1)	47.2 (45.3–49.2)	383 (1207)	30.5 (29.4–31.0)	24.4 (23.5–25.4)	33.9 (32.5–35.4)	44.7 (42.2–47.4)	573 (1621)	32.6 (31.8–33.4)	25.7 (24.7–26.7)	37.5 (36.0–39.0)	48.9 (46.2–51.7)
Italy	722 (2179)	32.9 (32.3–33.5)	26.4 (25.7–27.1)	38.7 (37.6–39.8)	45.1 (43.2–47.0)	325 (974)	33.2 (32.4–34.0)	28.2 (27.2–29.2)	38.8 (37.3–40.3)	39.6 (37.2–42.1)	397 (1205)	32.5 (31.7–33.3)	24.9 (24.0–25.9)	38.6 (37.1–40.1)	48.6 (46.0–51.5)
France	644 (1977)	31.0 (30.5–31.6)	24.6 (23.9–25.2)	35.6 (34.6–36.6)	46.4 (44.6–48.4)	261 (803)	31.8 (31.1–32.6)	25.9 (25.0–26.9)	35.1 (33.7–36.6)	48.1 (45.5–50.9)	383 (1174)	30.5 (29.7–31.3)	23.5 (22.6–24.5)	35.9 (34.4–37.4)	45.6 (43.0–48.3)
Denmark	550 (1685)	32.7 (32.1–33.2)	25.6 (24.9–26.3)	37.3 (36.3–38.4)	50.3 (48.3–52.3)	234 (738)	32.2 (31.4–33.0)	25.9 (25.0–26.9)	36.5 (35.0–38.0)	47.1 (44.5–49.9)	316 (947)	33.0 (32.2–33.8)	25.3 (24.4–26.3)	37.9 (36.4–39.4)	52.3 (49.5–55.2)
Greece	638 (2129)	29.3 (28.7–29.8)	22.2 (21.5–22.8)	33.4 (32.4–34.4)	48.4 (46.4–50.3)	258 (938)	27.2 (26.5–28.0)	21.4 (20.5–22.3)	29.7 (28.4–31.1)	45.3 (42.7–48.0)	380 (1191)	30.8 (30.0–31.6)	22.8 (21.9–23.8)	36.0 (34.5–37.5)	50.6 (47.9–53.5)
Switzerland	446 (1674)	26.3 (25.8–26.8)	21.1 (20.4–21.7)	32.3 (31.3–33.3)	32.9 (31.4–34.6)	213 (759)	27.9 (27.1–28.6)	23.6 (22.7–24.6)	33.8 (32.4–35.2)	30.2 (28.0–32.4)	233 (915)	24.8 (24.2–25.6)	18.7 (17.9–19.5)	31.0 (29.7–32.4)	34.6 (32.3–37.0)
Belgium	807 (2303)	34.0 (33.4–34.6)	28.5 (27.8–29.2)	38.4 (37.3–39.5)	45.4 (43.5–47.3)	336 (982)	33.7 (32.9–34.5)	29.4 (28.4–30.5)	38.7 (37.2–40.2)	38.9 (36.5–41.5)	471 (1321)	34.0 (33.2–34.9)	27.8 (26.8–28.8)	38.2 (36.7–39.8)	49.4 (46.7–52.2)
Israel	579 (1513)	37.5 (36.9–38.2)	25.6 (24.9–26.3)	42.7 (41.6–43.8)	74.6 (72.2–77.0)	256 (664)	38.0 (37.1–38.8)	26.6 (25.6–27.6)	43.1 (41.5–44.8)	72.2 (68.9–75.6)	323 (849)	37.2 (36.4–38.1)	24.7 (23.7–25.6)	42.3 (40.8–44.0)	76.6 (73.2–80.1)
Czech Republic	896 (2317)	39.9 (39.3–40.5)	32.0 (31.3–32.8)	43.1 (41.9–44.2)	64.6 (62.4–66.9)	381 (956)	40.8 (39.9–41.7)	34.8 (33.7–36.0)	42.9 (41.3–44.5)	60.7 (57.7–63.8)	515 (1361)	39.2 (38.4–40.1)	30.0 (29.0–31.1)	43.2 (41.6–44.8)	67.6 (64.4–70.9)
Poland	438 (1321)	33.8 (33.3–34.4)	26.1 (25.4–26.8)	37.4 (36.3–38.5)	57.0 (54.9–59.1)	185 (568)	33.2 (32.4–34.0)	27.8 (26.8–28.8)	37.2 (35.8–38.7)	45.2 (42.6–47.9)	253 (753)	33.8 (33.0–34.6)	24.7 (23.8–25.7)	37.5 (36.0–39.0)	62.3 (59.3–65.5)
Luxembourg	361 (1259)	29.5 (28.9–30.0)	22.7 (22.1–23.4)	34.3 (33.3–35.3)	45.2 (43.3–47.1)	163 (558)	30.5 (29.7–31.3)	23.9 (23.0–24.9)	35.0 (33.6–36.5)	46.2 (43.5–48.9)	198 (701)	28.6 (27.9–29.4)	21.7 (20.8–22.6)	33.8 (32.4–35.2)	44.4 (41.9–47.1)
Portugal	477 (1382)	36.9 (36.3–37.5)	30.1 (29.4–30.9)	36.1 (35.1–37.1)	67.6 (65.3–69.9)	202 (593)	36.7 (35.8–37.6)	30.1 (29.0–31.1)	36.4 (34.9–37.9)	65.4 (62.3–68.6)	275 (789)	37.0 (36.2–37.9)	30.1 (29.1–31.2)	35.9 (34.5–37.4)	68.8 (65.5–72.1)
Slovenia	579 (2030)	28.1 (27.6–28.6)	21.8 (21.1–22.4)	35.2 (34.2–36.3)	36.3 (34.6–38.0)	262 (862)	30.4 (29.6–31.2)	23.9 (23.0–24.9)	38.3 (36.8–39.9)	37.0 (34.7–39.5)	317 (1168)	26.4 (25.7–27.1)	20.0 (19.1–20.8)	33.1 (31.7–34.5)	35.9 (33.6–38.3)
Estonia	691 (2371)	28.4 (27.8–28.9)	23.4 (22.8–24.1)	35.2 (34.1–36.2)	31.6 (30.0–33.2)	269 (910)	29.3 (28.5–30.0)	25.6 (24.6–26.5)	33.1 (31.8–34.6)	34.8 (32.5–37.2)	422 (1461)	27.8 (27.0–28.5)	21.9 (21.0–22.9)	36.3 (34.9–37.8)	29.9 (27.8–32.1)
Croatia	380 (1375)	27.3 (26.8–27.9)	23.6 (23.0–24.3)	33.2 (32.2–34.2)	27.8 (26.3–29.3)	163 (576)	28.3 (27.5–29.0)	24.6 (23.6-25.5)	34.1 (32.7–35.6)	28.6 (26.5–30.7)	217 (799)	26.7 (26.0-27.4)	22.9 (22.0–23.8)	32.6 (31.2–34.0)	27.5 (25.4–29.6)
Total	**10989** (34,232)	**32.1 (31.5–32.7)**	**25.3 (24.6–26.0)**	**36.4 (35.4–37.5)**	**46.5 (44.6–48.4)**	**4713** (14,688)	**32.2 (31.4–33.0)**	**26.6 (25.6–27.6)**	**36.2 (34.7–37.7)**	**45.3 (42.7–48.0)**	**6276** (19,544)	**32.1 (31.3–32.9)**	**24.0 (23.1–25.0)**	**36.5 (35.0–38.0)**	**49.0 (46.3–51.8)**

95% CI – 95% Confidence interval.

Table 2
Association of explanatory variables with polypharmacy; unadjusted and adjusted models.

	N	*N* (%) polypharmacy	Unadjusted model			Adjusted model		
	29,342	9450 (32.2)	OR	CI 95	*p*	OR	CI 95	*p*
Age								
≥85 years	2921	1259 (43.1)	1	–	–	1	–	–
75–84 years	10,606	3974 (37.5)	0.760	0.692–0.836	< 0.001	1.008	0.916–1.110	0.867
65–74 years	15,815	4217 (26.7)	0.450	0.410–0.492	< 0.001	0.787	0.714–0.866	< 0.001
Gender								
Female	16,446	5425 (33.0)	1	–	–	1	–	–
Male	12,896	4025 (31.2)	0.917	0.870–0.967	0.001	1.164	1.102–1.230	< 0.001
Education								
Number of years of education	29,342	9450 (32.2)	0.972	0.967–0.978	< 0.001	1.007	1.000–1.013	0.038
Physical inactivity								
Never vigorous nor moderate physical activity	4399	2449 (55.7)	1	–	–	1	–	–
Other	24,943	7001 (28.1)	0.261	0.243–0.281	< 0.001	0.557	0.512–0.606	< 0.001
Number of limitations with activities of daily living								
ADL	29,342	9450 (32.2)	1.793	1.740–1.858	< 0.001	1.286	1.241–1.333	< 0.001
Network satisfaction								
Network satisfaction	29,342	9450 (32.2)	0.960	0.942–0.979	< 0.001	1.030	1.010–1.051	0.003
Quality of life and well-being								
CASP-12	29,342	9450 (32.2)	0.928	0.924–0.932	< 0.001	0.982	0.977–0.988	< 0.001
Depression								
Euro-D	29,342	9450 (32.2)	1.269	1.255–1.284	< 0.001	1.127	1.111–1.143	< 0.001
Number of chronic diseases								
≥2	19,462	8230 (42.3)	1	–	–	1	–	–
< 2	9880	1196 (12.1)	0.229	0.217–0.242	< 0.001	0.300	0.283–0.317	< 0.001
Difficulty in taking medication								
Yes	572	404 (70.6)	1	–	–	1	–	–
No	28,770	9046 (31.4)	0.149	0.123–0.180	< 0.001	0.738	0.599–0.909	0.004
Shortage of Money								
Never	9164	2811 (30.7)	1	–	–	1	–	–
Rarely	6266	1843 (29.4)	0.940	0.873–1.013	0.105	0.906	0.839–0.978	0.012
Sometime	7729	2445 (31.6)	1.048	0.978–1.124	0.185	0.888	0.822–0.959	0.003
Often	6186	2351 (38.0)	1.428	1.326–1.539	< 0.001	0.848	0.775–0.928	< 0.001

ADL: activities of daily living; CASP-12: a scale that evaluates four domains: Control, Autonomy, **S**elf-Realization, and Pleasure; EURO-D: depression scale.

variables, from all the participants selected for the prevalence study, we selected those who answered the questions related to the explanatory variables: number of limitations with activities of daily living, number of chronic diseases, quality of life and well-being, depression, physical inactivity, network satisfaction, difficulty in taking medication, number of years of education and shortage of money, resulting in 29,342 individuals (Fig. 1). Of these, the average age was 74.6 (± SD) ± 6.9 years, and 16,397 (56.0%) were female. Analyzing all the countries together, and using unadjusted models, we verified an association between polypharmacy and all included exploratory variables (Table 2). For the adjusted model, we found that age was an independent variable associated with polypharmacy, once polypharmacy increased with age, as well as with being a male [OR = 1.164 (1.102–1.230)] and with lower number of years of education [OR = 1.007 (1.000–1.013)]. Engaging in physical activities was correlated with the lowest prevalence of polypharmacy [OR = 0.557 (0.512–0.606)], having no difficulties in taking medication, and having less than two diseases, were also associated with lower prevalence of polypharmacy ([OR = 0.738 (0.599–0.909)] and [OR = 0.300 (0.283–0.317)] respectively). Number of limitations with activities of daily living and depression were also positively correlated with polypharmacy ([OR = 1.286 (1.241–1.333)] and [OR = 1.127 (1.111–1.143)] respectively). Lower quality of life and well-being [OR = 0.982 (0.977–0.988)] and higher network satisfaction [OR = 1.030 (1.010–1.051)] were also associated with polypharmacy. Individuals who reported rarely [OR = 0.906 (0.839–0.978)], sometimes [OR = 0.888 (0.822–0.959)] and often [OR = 0.848 (0.775–0.928)] shortage of money also showed higher prevalence of polypharmacy.

4. Discussion

Previous studies showed that polypharmacy is a very common condition in the older population, with prevalence between 27%–59% in primary care patients, and 46%–84% in hospital care (Elmståhl & Linder, 2013). In this study, we found polypharmacy prevalence in 32.1% of the older population (85+), which is in accordance with that found in primary care patients.

The prevalence of polypharmacy was lower in Switzerland (26.3%), Croatia (27.3%) and Slovenia (28.1%), and higher in Portugal (36.9%), Israel (37.5%) and Czech Republic (39.9%). When we compare these prevalence rates with those that are already reported in the literature, certain differences emerge. In some countries, the prevalence of polypharmacy was described as being higher (Charalampopoulou, Kontogiorgis, Nena, Constantinides, & Kolios, 2017; Elmståhl & Linder, 2013; Herr, Sirven, Grondin, Pichetti, & Sermet, 2017; Nobili, Garattini, & Mannucci, 2011; Pinto et al., 2014) than what we have found, while in others it was lower (Castioni, Marques-Vidal, Abolhassani, Vollenweider, & Waeber, 2017; Junius-Walker, Theile, & Hummers-Pradier, 2007; Niclós, Olivar, & Rodilla, 2017; Venturini et al., 2011). These differences can be easily explained by the heterogeneity of the samples used in those different studies. As the terms “elderly” and “polypharmacy” are very wide, there is some discrepancy in the age at which a person is considered elderly, as well as in the number of medicines taken to be the threshold of “polypharmacy”. In addition, some studies used individuals from nursing homes and hospitals, which can be a factor that affected the results, whereas in our study only patients living at home were considered, thus excluding patients with

severe disability and severe cognitive impairment. In fact, the SHARE project included for the first time in this wave the question that allowed us to evaluate polypharmacy and the community-dwelling people aged 65 years or more, who took five or more different medications per day, were considered. This allowed the comparison of prevalence of polypharmacy among the different countries.

Our findings suggest that age, gender, physical inactivity, number of limitations with activities of daily living, network satisfaction, quality of life, depression, number of chronic diseases, difficulty in taking medication and shortage of money were associated with polypharmacy. Globally, the prevalence of polypharmacy increases with age, being higher for women and the elderly aged 85 or more years (Bjerrum, Søgaard, Hallas, & Kragstrup, 1998). In this study, this pattern was also observed: the prevalence of polypharmacy for the elderly between 65–74 years was globally 26.7%, while for the elderly aged 85 or more years it was 43.1%, being more pronounced in females. In general, among the population that suffered from polypharmacy, the majority were females, which could be related to the fact that they usually are more concerned about their health, and as such, they consult doctors more regularly and earlier than men, and therefore are more accustomed to the consumption of medicines (Venturini et al., 2011). However, we found in this study that, starting from the age of 80 years, men were more prone to polypharmacy; this could be hypothesized to be related to the fact that men do not give so much importance to the symptoms as females, and visit the doctor later than women, when the disease process has already begun (Suominen-Taipale, Martelin, Koskinen, Holmen, & Johnsen, 2006). In this study, we found a weak association between low level of schooling and polypharmacy. This association has already been described in previous studies (Walckiers, Van der Heyden, & Tafforeau, 2015).

Less economically advantaged individuals, who reported shortage of money, seemed to be more susceptible to polypharmacy (Walckiers et al., 2015). Although there are major differences between healthcare systems in different countries, affordability and accessibility of medicines were identified by the European Commission as key objective of the public health policy. Despite the efforts that have been made, there is still a large discrepancy at the reimbursement regimens across countries. For example, in the UK, the elderly population does not pay for medication, providing equal care for elderly of all socioeconomic status and avoiding the economic burden caused by polypharmacy.

The high use of drugs among the elderly can be explained by the exponential increase in the prevalence of chronic diseases and the sequelae that accompany advancing age (McLean & Le Couteur, 2004b). Thus, multimorbidity is obviously associated with polypharmacy (Jacobs & Fisher, 2013). Indeed, in this study, as expected, we proved that older adults with less than two chronic diseases are less susceptible to polypharmacy.

It is known that levels of physical activity tend to decrease with age. The prevalence of physical inactivity among the European elderly population is between 4.9% and 29% (Gomes et al., 2017). This study suggests that physical inactivity is also a predictor of polypharmacy. Scientific evidence clearly indicates that participation in physical activity programs is effective in reducing and/or preventing a series of functional declines associated with ageing (Illario et al., 2016; Vogel et al., 2009). Functional status is a pillar in geriatrics and serves as an indicator of overall well-being. One of the ways that can be used to measure it is the activities of daily living, which include bathing, dressing, grooming, using the toilet and feeding. An impairment in any of these may be challenging for older adults. It is known that functional dependency is associated with higher prevalence of diseases, which leads to increased healthcare utilization (Bahat et al., 2014; Peron, Gray, & Hanlon, 2011). In this study, we found a direct association between difficulties in activities of daily living and polypharmacy. Other studies show that excessive polypharmacy is associated with decline in nutritional status, functional ability and cognitive capacity in elderly persons aged 75 years and older (Guerriero et al., 2015; Jyrkkä, Enlund, Lavikainen, Sulkava, & Hartikainen, 2011).

According to the World Health Organization, health is defined as a state of physical, social and psychological well-being, so all these domains must be considered when assessing health status (Wu, Cagney, & St John, 1997). Family networks and friends are an essential support for the elderly. The innumerable advantages of these relationships have already been referred to by several studies (Litwin & Shiovitz-Ezra, 2011; Litwin & Stoeckel, 2013; Pinquart & Sörensen, 2000). In this study, we found also a weak association between lower rates of network satisfaction with the use of more medicines. Quality of life is a crucial component for successful ageing because low quality of life during ageing is associated with low activity and physical capacity, increased chronic diseases and social isolation (Wahrendorf & Siegrist, 2010; Wikman, Wardle, & Steptoe, 2011). One of the scales that are used to evaluate the quality of life in the older population is the CASP scale (which evaluates four domains: Control, Autonomy, Self-Realization and Pleasure). The normal scale has 19 items, but a shortened version with only 12 is used on the SHARE questionnaire (Towers, Yeung, Stevenson, Stephens, & Alpass, 2015). From this study, quality of life and well-being can be a predictor of polypharmacy, whereas lower rates of quality of life and well-being are associated with higher use of medications.

There are several factors that can affect the ability of patients to take a medication correctly, such as vision, memory, swallowing and hearing (Lin, Sklar, Oh, & Li, 2008). Indeed, physical limitations were already established as a predictor of difficulty in medication intake (Figueiredo, Teixeira, & Poveda, 2016). A relationship has been established between difficulties in taking medications with poorer health status and quality of life and social limitations and depression (Figueiredo et al., 2016; Morgan et al., 2006). In this study, we found an association between individuals who have difficulties in taking medication and polypharmacy. The individuals who receive more prescriptions are the ones that have a poorer health status, which may explain the difficulties that they encounter. We also found a relationship between depression and polypharmacy. Depression is a condition that compromises the global health status, so the individuals who suffer from depression are more prone to polypharmacy. This is a link that was already well established by other authors (Antonelli Incalzi, Corsonello, Pedone, Corica, & Carbonin, 2005). Furthermore, depression can also be a consequence and not only a predictor of polypharmacy (Liu, Leung, & Chi, 2011). Indeed, the use of multiple drugs in the same therapeutic regimen is often a necessary choice to treat comorbidities and/or drug-resistant diseases, it also enhances the risk of adverse drug reactions, which may cause hospitalization or even death; it lowers therapy adherence and it directly and indirectly increases health costs. The potential repercussions of inappropriate polypharmacy can be considered as an important public health problem because it relates to increased mortality (Dhalwani et al., 2017).

There are some limitations in this study that should be addressed. All the data in SHARE is self-reported, which might pose some questions. It is well known that people who volunteer to participate in research surveys like SHARE are likely to be more motivated and healthier (probably with fewer disabilities and less cognitively impaired) than those who declined or were unable to participate, and therefore a high number of older people with comorbidities might have been excluded. Furthermore, it was not possible to take into consideration the caregiver's role, which covers an important role in healthcare management in the elderly.

Some strengths could be stressed, as well: the high number of subjects involved and the international cross-sectional structure of the study, allowing comparisons and suggestions for stakeholders with a wider perspective. Moreover, this is one of the first studies taking into consideration self-care management with drugs taken without prescription (OTC drugs) and dietary supplements such as vitamins and minerals, showing light on a trend in industrialized countries, which requires an alert for healthcare providers. A boost of dietary

supplements use was observed recently in several European countries (Care & Care, 2012).

In conclusion, our results show that polypharmacy is a highly prevalent condition across the elderly population with rates between 26.3% and 39.9% in Europe and Israel. In addition, this is a multifactorial condition that is associated with age, gender, physical inactivity, number of limitations with activities of daily living, quality of life and well-being, depression, number of chronic diseases, difficulties in taking medication, years of education and shortage of money. Identification of variables associated with polypharmacy is important for identifying and monitoring the elderly groups most vulnerable to this problem. Interventions aiming to reduce this condition must consider this diversity of factors linked with polypharmacy (Stewart et al., 2017).

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