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Polypharmacy among the elderly: a population-based study

Polifarmácia em idosos: um estudo de base populacional

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ABSTRACT: *Objective:* To investigate polypharmacy among the elderly living in the urban area of Florianopolis, in the state of Santa Catarina, Brazil, estimating the prevalence and associated factors. *Methods:* This is a cross-sectional population-based study with a sample of 1,705 individuals aged 60 years old or older, between 2009 and 2010. The dependent variable was polypharmacy (defined as "use of five or more medications"). The following exploratory variables were utilized: sociodemographic data, use of health services and self-rated health status. Prevalence ratios (PR) were estimated by multivariate analysis using the Poisson regression. *Results:* The mean for the medications used by the elderly population was 3.8 (ranging from 0 to 28). The prevalence of polypharmacy was 32%, with 95% confidence interval (95% CI) 29.8 – 34.3. The characteristics presenting a positive association with polypharmacy were: female gender (PR = 1.27; 95%CI 1.03 – 1.57), increasing age (PR = 1.38; 95% CI 1.08 – 1.77), negative self-rated health status (PR = 1.99; 95% CI 1.59 – 2.48) and medical appointments in the 3 months prior to the interview (PR = 1.89; 95% CI 1.53 – 2.32). The groups of medication most utilized by the elderly individuals in polypharmacy were those indicated for the cardiovascular system, digestive tract and metabolism, as well as the nervous system. *Conclusion:* The pattern of medication use among this elderly population is within the national average. The prevalence of polypharmacy and the characteristics associated with it were similar to those found in other regions of Brazil.

Keywords: Polypharmacy. Medication use. Elderly individuals. Cross-sectional study. Pharmacoepidemiology. Aging.

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RESUMO: *Objetivo:* Investigar a polifarmácia em idosos residentes na área urbana de Florianópolis, Santa Catarina, Brasil, estimando a prevalência e os fatores a ela associados. *Métodos:* Foi realizado um estudo transversal de base populacional em uma amostra de 1.705 idosos, entre 2009 e 2010. A variável dependente foi polifarmácia (definida como "uso de cinco ou mais medicamentos"). Utilizaram-se variáveis sociodemográficas, uso de serviços de saúde e autoavaliação de saúde como exploratórias. Foram estimadas razões de prevalência (RP) por meio de análise multivariada utilizando-se da regressão de Poisson. *Resultados:* A média do uso de medicamentos por idosos foi de 3,8 (variando entre 0 e 28). A prevalência de polifarmácia foi de 32%, com intervalo de confiança de 95% (IC95%) 29,8 – 34,3. As características que apresentaram associação positiva com polifarmácia foram: sexo feminino (RP = 1,27; IC95% 1,03 – 1,57), aumento da idade (RP = 1,38; IC95% 1,08 – 1,77), autoavaliação de saúde negativa (RP = 1,99; IC95% 1,59 – 2,48) e realização de consulta médica nos últimos 3 meses anteriores à entrevista (RP = 1,89; IC95% 1,53 – 2,32). Os grupos de medicamentos mais utilizados pelos idosos na polifarmácia foram os indicados para o sistema cardiovascular, trato alimentar e metabolismo e sistema nervoso. *Conclusão:* O padrão de uso de medicamentos por idosos está dentro da média nacional. A prevalência de polifarmácia e as características a ela associadas foram semelhantes aos achados em outras regiões do Brasil.

Palavras-chave: Polimedicação. Uso de medicamentos. Idosos. Estudos transversais. Farmacoepidemiologia. Envelhecimento.

INTRODUCTION

During the 20th century, significant changes were observed worldwide in the demographic and morbidity and mortality profiles, although at different magnitudes[1]. Mortality rates due to infectious diseases and fertility reduced, and there was an increase in life expectancy and in deaths caused by chronic diseases[2]. In Brazil, the elderly population increased from 4.7%, in 1960, to 10.8%, in 2010, of the total population. In absolute numbers, this represents a growth from 3.3 million[3] to 20.5 million elderly people[4].

This epidemiologic and demographic context has led to long pharmacological treatments[5], higher use of medication and higher occurrence of polypharmacy, that is, the simultaneous use of multiple medications[5,6]. These situations are common in the elderly population, which presents the highest prevalence of chronic diseases and uses health services the most[2,7,8].

An elevated number of prescription medications and a higher load of diseases have also increased the unnecessary consumption of medication[9], whose pharmaceutical combinations represent potential dangers for adverse reactions and drug interactions, which are not indicated for the patient's clinical state[10]. This can increase the risk of iatrogenic effects[5,9], hospitalizations[11] and even death[10]. In this same context, studies have demonstrated that the physiological variations regarding aging tend to significantly change the pharmacokinetics and pharmacodynamics of medications[12,13]. Therefore, elderly people are more sensitive to the therapeutic and adverse effects of pharmaceuticals, which, in many cases, can be more damaging than beneficial to patients[12,14,15].

In Brazil, some population-based studies have described the prevalence of polypharmacy in the elderly population (from 25 to 35%), and its positive association with the female sex[7,8,14-17], people aged 75 years old or older[8,14,15,17,18], low schooling level[7,14], widowhood[15,17], regular[7,14] or negative[8,15,17] self-rated health status, living with a companion[8,14], having private health insurance[8,14] and having been hospitalized in the 12 months prior to the interview[8]. Thus, investigating the occurrence of polypharmacy and its associated factors is essential to subsidize actions that promote the rational use of medication, providing more safety to the pharmacotherapy used by the elderly population. Therefore, the objective of this study is to investigate polypharmacy in the elderly population of a state capital in the South of Brazil, estimating the prevalence and the factors associated with it.

METHODS

This is a population-based cross-sectional study, conducted in the city of Florianopolis, the capital of the state of Santa Catarina, Brazil. In 2009, the city had a population of 408,163 inhabitants, of which 10.8% were aged 60 years old or older. Life expectancy for those born in the city, in 2010, was 77.4 years of age[19].

The present study is part of the *Epifloripa Idoso* 2009/2010, a population-based survey investigating the health conditions of the elderly population (people aged 60 years old or older), of both sexes, in Florianopolis, between September 2009 and June 2010. More details about this study can be found in Confortim et al.[20].

The sample size was calculated using the software Epi-Info, version 6.04. A total of 44,460 elderly people was considered as the reference population, with an unknown prevalence of 50%, 95% confidence level, 4% sample error and design effect (deff) of 2. To compensate possible expected losses and to control confounding factors, 20% and 15% were added, respectively, resulting in a minimum sample of 1,599 elderly people. Because of the financial availability and with the objective of increasing its power, the sample was expanded to 1,911 elderly individuals.

The two-stage cluster sampling was used. The primary sampling unit was the census tract, and the secondary unit, the household. A municipal grid from the 2000 Census was used as base, stratifying 420 residential urban census tracts of the city, according to the mean decile income of the head of the family. Eight of these tracts were selected from each income decile to compose the present study. After defining each of the census tracts, the number of households was updated, since the most recent count was made in the 2000 Census. There was a wide gap between the number of households per census tract (from 61 to 725), therefore, the units with less than 150 households were grouped and the tracts with over 500 households were divided. The groupings respected the income decile and geographic proximity. After this procedure, the variation coefficient per census tract was reduced to 35.2%, and 83 census tracts, made up of 22,846 households, were obtained.

All individuals aged 60 years or older, residing in the selected households, were potential participants in this study. Elderly individuals who were institutionalized (in nursing homes, hospitals or prisons) were not included. In the case of elderly people who were unable to answer the

survey, it was answered by the person responsible for them, except for the question regarding self-rated health status. Elderly individuals not found in their homes, after four attempts, were considered as losses, whereas individuals who refused to participate were considered a refusal. The attempts included at least one weekend and one evening visit. The data were obtained by interviews. Researchers used a standardized questionnaire for data collection, which was applied in person by a previously trained interviewer, using a Personal Digital Assistant (PDA). Quality control was conducted every week for the data, by telephone, with the application of a reduced questionnaire on 10% of the sample. The reproducibility of the questions in the study was considered satisfactory, with Kappa values between 0.6 and 0.9 for the selected variables, such as diabetes, number of teeth, tobacco use, health insurance, and self-reported skin color.

Information was collected regarding the use of medication in the 30 days prior to the interview. Interviewees were asked to present to the interviewer all of the package inserts, packages, blister packs or prescriptions of the medication used in the last 30 days, and their commercial names and dosages were recorded. When the material did not exist, the information provided by the interviewee was recorded[21].

Polypharmacy — considered to be the "concomitant use of five or more medications"[6-9,16-18,22,23] — consumed within the 30 days prior to the interview was considered a dependent variable. The medication was classified according to the pharmacological class or the chemical group (level 3) of the Anatomical Therapeutic Chemical (ATC) Classification System, created by the World Health Organization Collaborating Centre for Drug Statistics Methodology.

The following independent variables were analyzed: sex, age (60 to 69; 70 to 79; 80 years old or older), education level (0 to 4; 5 to 8; 9 to 11 and 12 schooling years or more), self-rated health status [positive (good or very good) and negative (regular, poor or very poor)], per capita income in quartiles (income was the sum of financial gain including salary, retirement and pension received in the last month), medical appointment in the last 3 months (yes or no), private health insurance (yes or no) and hospitalization within the last 6 months (yes or no).

Unadjusted and adjusted multivariate analyses were conducted using the Poisson regression in order to test the association between the outcome and the independent variables. Prevalence ratios (PR) were estimated along with their respective 95% confidence intervals (95% CI). The stepwise-forward method was used to include the variables in the multiple models. The inclusion criteria for the adjusted analysis was $p < 0.200$. The maintenance criteria for the variables in the multiple models was $p < 0.05$. The analyses were conducted using the software Stata 9.0, with the *svy* command to consider the design effect and the sample weights.

The study was approved by the Research Ethics Committee from Universidade Federal de Santa Catarina, protocol n° 352/2008.

RESULTS

A total of 1,705 elderly individuals were interviewed, with a response rate of 89.2 (n = 206 losses/refusals, with 3 losses being owed to the hospitalization of the elderly person), which did not affect the results.

Most of the sample was composed of female participants (63.9%), aged between 60 and 69 years old (50.1%) and presenting 8 schooling years (63.0%). Regarding medical appointments, 72% of the elderly individuals reported having attended one in the last 3 months, and 7.9% had been hospitalized in the last 6 months. In addition, almost two thirds (63.8%) of the individuals had private health insurance.

The mean use of medication in the 30 days prior to the interviews was 3.8 medications (ranging between 0 and 28). The prevalence of polypharmacy was 32.0% (95% CI 29.8 – 34.3), being higher for women, people aged 80 years old or older, with negative self-rated health status, those who had attended a medical appointment within the last 3 months, the ones who had been hospitalized in the 6 months prior to the interview; and lower for the elderly individuals who had a higher level of education (12 years or more) (Table 1).

In the unadjusted analysis, the prevalence of polypharmacy was associated with the female sex, increasing age (70 to 79 years old, 95%CI 1.15 – 1.68; 80 years old or older, 95%CI 1.22 – 2.02), negative self-rated health status, medical appointment within the last 3 months and hospitalization in the last 6 months (Table 2).

In the adjusted analysis, the following variables were related to the outcome: female sex (PR = 1.27; 95%CI 1.03 – 1.57), older individuals (70 to 79 years old, PR = 1.26; 95% CI 1.06 – 1.49; 80 years old or older, PR = 1.38; 95%CI 1.08 – 1.77), negative self-rated health status (PR = 1.99; 95%CI 1.59 – 2.48) and medical appointment in the last 3 months (PR = 1.89; 95%CI 1.53 – 2.32) (Table 2).

According to the pharmacological classification or chemical group (level 3) of the ATC, the groups of medications most used by the elderly population, in polypharmacy, were those indicated for the cardiovascular system, digestive tract and metabolism, as well as the nervous system.

DISCUSSION

The results from this study demonstrate that the pattern of medication use in Florianopolis is within the national mean[7,8,14-16]. This can be explained by studies showing that the higher the use of health services[8,14,24,25] the higher the use of medications. Another factor that can explain this phenomenon is the repetition of prescriptions resulting from being treated by different specialists or health care professionals, at different moments. However, the implications of this intake need to be reassessed regarding the risk/benefits, and should be frequently monitored. It is important to remember that the practice of polypharmacy is often really necessary for the elderly person, especially when there is a clear indication, when it is well tolerated and in case there is a good cost-efficacy relationship.

The prevalence of polypharmacy in Florianópolis (32.0%) is similar to that found in other studies, which employed the same definition for the outcome (use of five medications or more), conducted in cities like São Paulo (36%)[14], Porto Alegre (27%)[16], Tubarão (28.8%)[7] and Rio de Janeiro (32.7%)[8]. The concomitant use of various medications by elderly people contributes significantly with the appearance of adverse reactions. It is estimated that

Table 1. Sample characteristics and prevalence of polypharmacy according to the demographic, socioeconomic and behavioral variables, as well as variables pertaining to the use of health services. *Epifloripa Idoso* Study, Florianópolis, 2009/2010.

Variables	Sample n (%)	Prevalence of Polypharmacy (95%CI)
Sex		
Female	1089 (63.9)	35.8 (33.0 – 38.7)
Male	616 (36.1)	25.3 (21.9 – 28.8)
Age (years)		
60 to 69	854 (50.1)	25.5 (22.6 – 28.5)
70 to 79	612 (35.9)	37.3 (33.4 – 41.1)
80 or older	239 (14.0)	42.0 (35.6 – 48.1)
Education Level (in years)		
0 to 4	745 (44.0)	34.4 (31.0 – 37.8)
5 to 8	321 (19.0)	33.3 (28.2 – 38.5)
9 to 11	234 (13.8)	34.2 (28.1 – 40.3)
Higher or equal to 12	394 (23.26)	25.4 (21.1 – 29.7)
Self-rated Health Status		
Positive	860 (51.2)	20.0 (17.3 – 22.7)
Negative	821 (48.84)	44.2 (40.8 – 47.6)
Per Capita Income (R$)		
Quartile 1	427 (25.0)	31.2 (26.8 – 35.6)
Quartile 2	435 (25.5)	32.4 (28.0 – 36.8)
Quartile 3	425 (24.9)	31.8 (27.3 – 36.2)
Quartile 4	418 (24.5)	32.8 (28.3 – 37.3)
Consulted with a doctor in the last 3 months		
No	481 (28.2)	14.8 (11.6 – 17.9)
Yes	1224 (71.8)	38.8 (36.1 – 41.6)
Private Health Insurance		
No	618 (36.25)	30.3 (26.6 – 33.9)
Yes	1087 (63.75)	33.0 (30.2 – 35.8)
Hospitalization in the last 6 months		
No	1.570 (92.1)	30.1 (27.8 – 32.5)
Yes	135 (7.9)	54.8 (46.5 – 63.2)

95%CI: 95% confidence interval; *use of 5 medications or more.

Table 2. Association between polypharmacy and demographic, socioeconomic and behavioral variables, as well as variables pertaining to the use of health services. *Epifloripa Idoso* Study, Florianopolis, 2009/2010.

Variables	Raw PR (95%CI)	p-value	Unadjusted PR (95%CI)	p-value
Sex		0.007		0.020
Male	1.00		1.00	
Female	1.41 (1.10 – 1.80)		1.27 (1.03 – 1.57)	
Age (years)		< 0.001		0.002
60 to 69	1.00		1.00	
70 to 79	1.39 (1.15 – 1.68)		1.26 (1.06 – 1.49)	
80 or older	1.57 (1.22 – 2.02)		1.38 (1.08 – 1.77)	
Education Level (in years)		0.127	**	**
Higher or equal to 12	1.00			
9 to 11	0.79 (0.59 – 1.05)			
5 to 8	1.04 (0.83 – 1.31)			
0 to 4	1.03 (0.82 – 1.29)			
Self-rated Health Status		< 0.001		< 0.001
Positive	1.00		1.00	
Negative	2.24 (1.79 – 2.81)		1.99 (1.59 – 2.48)	
Per Capita Income (R$)		0.647	*	*
Quartile 1	1.00			
Quartile 2	1.07 (0.83 – 1.39)			
Quartile 3	0.97 (0.75 – 1.24)			
Quartile 4	1.09 (0.87 – 1.38)			
Consulted with a doctor in the last 3 months		< 0.001		< 0.001
No	1.00		1.00	
Yes	2.75 (2.26 – 3.34)		1.89 (1.53 – 2.32)	
Private Health Insurance		0.230	*	*
No	1.00			
Yes	0.88 (0.72 – 1.08)			
Hospitalization in the last 6 months		< 0.001		
No	1.00		1.00	
Yes	1.59 (1.26 – 2.00)		1.28 (1.00 – 1.62)	

PR: prevalence ratio; 95%CI: 95% confidence interval; *not included in the multivariate analysis because p value was > 0.20 in the raw analysis; **removed from analysis due to significant statistical loss in the adjusted analysis p > 0.05.

the risk of adverse reactions increases exponentially, around 50%, when 5 medications are used, and surpasses 95% when 8 or more are used[5,6]. In some cases, these adverse reactions present severe consequences, which can be minimized by adequately monitoring the correct adherence, prescription, dose and duration of treatment. In this study, polypharmacy was also related to hospitalization (55%), suggesting worse health status[8,14]. In Canada, it is estimated that one out of five hospital admissions of elderly individuals are owed to polypharmacy related to iatrogenics[5].

The analysis between polypharmacy and sociodemographic characteristics revealed a connection with the female sex[7,8,14-17] and the age of 80 years old or older[15,17]. Regardless of the socioeconomic variables, studies found a higher prevalence of polypharmacy in the female sex[7,14-16,23,26,27]; the potential explanations for this are: women have higher life expectancy in relation to men, and thus deal with chronic processes for a longer period of time; women are more affected by non-fatal health problems and are more aware of their health, reporting more signs and symptoms to health professionals, often resulting in prescriptions[24,25]; women are responsible for the family and, therefore, are more familiarized with medication and better cared for by public health policies, being subject to medicalization[25-27], corroborating the results from this study. As for the association between polypharmacy and age, the most accepted hypotheses are that it can be associated with the increase in the number/severity of diseases among the elderly, as well as the wider use of health services by this age group, rather than due to aging.

According to Santos et al.[15], Linjakumpu et al.[17], Rozenfeld et al.[8], Silveira et al.[23] and Loyola et al.[25], the lower self-rated health status is often related to polypharmacy, as observed in this study. This relationship is expected since elderly individuals who perceive to be sick try to solve their problems by seeking health services, getting medication prescriptions or even by self-medicating[25]. This variable (which is subjective) was not considered for the elderly individuals who had their questionnaire answered by an informant (n=54).

Regarding health services, a strong association between medical appointments and polypharmacy became clear, which proves the increasing access of the population to health services, similarly to what was observed in Tubarão[7], Porto Alegre[16], Rio de Janeiro[8], Bambuí[24], Santa Rosa[26], and in the metropolitan area of Belo Horizonte[25], reinforcing the importance of medication in caring for one's health and the need to guarantee that elderly people, as much as possible, have efficient and high-quality pharmaceutical care, in order to reduce possible complications due to polypharmacy. Even though the exposure to polypharmacy is not a synonym of inadequate use, the lucrative character of these private services, the ideological approach and the interaction of doctors with the pharmaceutical industry can explain the quality and quantity of inadequate medications consumed by elderly individuals, as well as the health care model, which has been its main form of intervention[13,27].

The most used groups of medication in polypharmacy [7,14,15,17]reflect the high prevalence of cardiovascular diseases and diabetes in the elderly population, as well as cases of insomnia, anxiety and states of confusion[21], confirming the results in this study, in which groups of medication affecting the cardiovascular system, digestive tract and metabolism, as well as the nervous system, were also the most used ones by this population. Nonetheless, it is

important that public policies providing medication be aware of the peculiarities that involve the aging organism, so that this group's access to medication could be safe and efficient, considering that the medications that work on the nervous system are the ones that cause the most adverse effects.

Among the limitations of this study are the difficulties to establish a cause-and-effect relationship because of the cross-sectional design and the self-reported measurements. In order to minimize a possible recall bias, the strategy was for the interviewer to adopt standardized procedures during data collection, such as requesting to see the prescription, package, or package inserts of the reported medication[21].

The strong features of this study are its sample size, the fact that it is a population-based study and the rigor in collecting data. Regarding the medications, it is important to note the highly complete and comprehensive information registered about them, due to careful data collection and analysis. As this is not the objective of this study, self-medication was not contemplated in the analysis.

FINAL CONSIDERATIONS

The pattern of medication use among the elderly population in Florianópolis is within the national mean. The prevalence of polypharmacy and the characteristics associated with it are similar to findings from other regions in Brazil, suggesting there is a certain uniformity to the practice of polypharmacy and to its determiners, among different populations. It is possible that the lack of clinical protocols and easy access to medication, through the Unified Health System(SUS), as well as through private pharmacies, can contribute with the practice of the elderly population's regarding polypharmacy.

This habit is often necessary, since a large portion of the elderly population has multiple comorbidities and requires the use of various medication to control and prevent their conditions. This practice does not necessarily indicate that the prescription and/or use of medication is incorrect, but that a more critical approach and close monitoring of this profile of elderly individuals is necessary.

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