

Revista Brasileira de Epidemiologia



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#### REFERÊNCIA

MORAES, Luci Fabiane Scheffer et al. Expenditures on the treatment of osteoporosis in the elderly in Brazil (2008 - 2010): analysis of associated factors. **Revista Brasileira de Epidemiologia**, São Paulo, v. 17, n. 3, p. 719-734, jul./set. 2014. DOI: <http://dx.doi.org/10.1590/1809-4503201400030012>. Disponível em: [http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S1415-790X2014000300719&lng=en&nrm=iso](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-790X2014000300719&lng=en&nrm=iso). Acesso em: 13 dez. 2019.

# Expenditures on the treatment of osteoporosis in the elderly in Brazil (2008 – 2010): analysis of associated factors

## *Gastos com o tratamento da osteoporose em idosos do Brasil (2008 – 2010): análise dos fatores associados*

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**ABSTRACT:** *Objective:* To analyze the expenditure of the Ministry of Health with osteoporosis treatment in the Brazilian Public Health System (SUS) in 2008–2010 triennium and estimate the influence of demographic, regional and disease related variables on average expenditure per procedures performed. *Methods:* A cross-sectional, descriptive and analytical study based on secondary data from DATASUS related to procedures for the elderly with a diagnosis of osteoporosis and related fractures. For the statistical analysis and multivariate model, Stata 11.0 was used. *Results:* According to the findings, 3,252,756 procedures related to the osteoporosis treatment among the elderly were carried out in Brazil during the 2008 – 2010 period, totalizing R\$ 288,986,335.15. The age group that most had procedures was 60 – 69 years (46.3%); the population of 80 years or older showed the highest spending per procedure, around R\$ 106 million in three years. The women were majority in terms of quantity (95.6%) and expense (76%) of procedures. The average cost per procedure showed a large gap between men and women, nearly 7 times (R\$ 480.14 versus R\$ 70.85, respectively). The ambulatory care procedures predominated in quantity (96.4%) and the hospital procedures predominated in resources (70.4%). It was found that there is no single standard for groups of procedures when these are analyzed separately. *Conclusion:* A disaggregated analysis of expenditure by procedures groups extracted from the SUS Management System of the Table of Procedures, Medicines, Orthotics, Prosthetics and Special Materials allowed a detailed overview of federal spending on the osteoporosis treatment in the elderly from Brazil.

**Keywords:** Osteoporosis. Aged. Therapeutics. Fees and charges. Unified Health System. Expenditures.

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**Conflict of interests:** nothing to declare – **Financing source:** none.

**RESUMO:** *Objetivo:* Analisar o dispêndio do Ministério da Saúde com o tratamento de osteoporose no Sistema Único de Saúde (SUS) no triênio 2008–2010 e estimar a influência de variáveis demográficas, regionais e associadas à doença nos gastos médios por procedimentos realizados. *Métodos:* Estudo transversal, descritivo e analítico com base em dados secundários do DATASUS relacionados a procedimentos para idosos com diagnóstico de osteoporose e de fraturas associadas. Para a análise estatística e para o modelo multivariado, foi utilizado o programa Stata 11.0. *Resultados:* Foram realizados 3.252.756 procedimentos relacionados ao tratamento de osteoporose em idosos do Brasil no triênio 2008 – 2010, que totalizaram R\$ 288.986.335,15. A faixa etária de 60 – 69 anos (46,3%) foi a que mais realizou procedimentos, e a população de 80 ou mais anos foi a que apresentou maior gasto por procedimento, em torno de R\$ 106 milhões no triênio. As mulheres foram majoritárias em termos de quantidade (95,6%) e de gastos (76%) com procedimentos. O gasto médio por procedimento apresentou uma grande disparidade entre homens e mulheres, de quase 7 vezes (R\$ 480,14 *versus* R\$ 70,85, respectivamente). Os procedimentos ambulatoriais predominaram em quantidade (96,4%) e os hospitalares, em recursos (70,4%). Verificou-se que não há um padrão único para os grupos de procedimentos, quando estes são analisados separadamente. *Conclusão:* A análise desagregada das despesas por grupos de procedimentos do Sistema de Gerenciamento da Tabela de Procedimentos, Medicamentos, Órtese, Prótese e Materiais Especiais do SUS permitiram uma visão mais detalhada dos gastos federais com o tratamento da osteoporose em idosos no Brasil.

**Palavras-chave:** Osteoporose. Idoso. Terapêutica. Honorários e preços. Sistema Único de Saúde. Gastos.

## INTRODUCTION

Osteoporosis is the most common osteometabolic disease among elderly, due to its high incidence and to the increased prevalence of fractures by bone's fragility<sup>1</sup>, representing, worldwide, one of the greatest challenges for contemporary public health.

Nowadays, worldwide, osteoporosis affects approximately 7% of men and 17% of women; from these, 70% are aged 80 years old or older<sup>2</sup>. In Europe, United States and Japan, osteoporosis affects approximately 75 million people and over 8 million hip fractures are estimated to happen in the next 50 years<sup>3</sup>. In Latin America, studies on the prevalence of hip fracture report a frequency of 2 cases every 10 thousand people<sup>4</sup>.

In Brazil, it is estimated that osteoporosis affects 10 million people, with a prevalence of 11 to 23.8% for all kinds of fracture by bone fragility<sup>4</sup>. Martini et al.<sup>5</sup> report that, from the 54,364 individuals who were interviewed, aged  $\geq 18$  years old, 4.4% of them reported having medical diagnosis for osteoporosis, with a higher prevalence among women (7 *versus* 1.3% men). When stratified by age, the prevalence tends to increase: in the population aged  $\geq 65$  years old, the prevalence is 22% for both gender (32.7% for women and 5.1% for men). According to Marques Neto et al.<sup>6</sup>, only one out of five people receive some kind of treatment.

As for the costs related to osteoporosis, there is a great disparity of values among health systems, due to the method adopted and the kind of costs included in the studies. Haussler et al.<sup>7</sup> estimated the osteoporosis cost for Germany, finding a value of € 5.4 billion, including costs with medical drugs, hospitalizations fractures and rehabilitation. Brown et al.<sup>8</sup> indicate spendings of US\$ 1.15 billion in New Zealand, considering costs referring to osteoporosis and osteoporotic fractures. Martin et al.<sup>9</sup>, in their retrospective study with 765 Americans, estimated costs of US\$ 17.9 million for the treatment of osteoporotic fractures; the prospective study of Wiktotowicz et al.<sup>10</sup>, in Canada, with 504 individuals, estimated an investment of US\$ 659 million for the treatment of hip fractures. In Brazil, some retrospective or cross-sectional studies present different samples and methods, limiting then the representativeness of the Brazilian population<sup>3</sup>. Bortolon et al.<sup>11</sup>, in the 2006–2008 triennium, estimated costs of around R\$ 121.5 million for the treatment of femoral fractures of 1% of the elderly hospitalized in the period.

No populational based studies on the specific costs for osteoporosis in Brazil, which would take into account the handling recommended by the Ministry of Health, were found. According to the Clinical and Therapy Guidelines Protocol (CTGP)<sup>12</sup>, the use of the densitometric criteria by the World Health Organization for the clinical diagnosis is recommended, based on the T-score classification: normal (T-score  $\geq -1$ ), osteopenia (T-score  $< -1$  and  $> -2.5$ ) and osteoporosis (T-score  $\leq -2.5$ )<sup>13</sup>. For the treatment, it is recommended the supplementation with calcium and vitamin D, estrogens, bisphosphonates (alendronate, risedronate and pamidronate), raloxifene and calcitonine<sup>12</sup>, all provided by the Brazilian Public Health System (SUS).

It is necessary to know the distribution of financial resources spent by the SUS with this disease, since there is a tendency to the increase of the number of elderly in Brazil, and the available treatments tend to be costly, both in terms of diagnosis and treatment. This study aimed at analyzing the expenditure of the Ministry of Health with the treatment of osteoporosis in SUS in the 2008–2010 triennium and estimating the associations in average expenses by procedures performed on demographic, regional and disease-related variables.

## METHODS

A cross-sectional study was performed, with descriptive and analytical characteristics, based on secondary data from health information systems regarding the expenses by the Ministry of Health on ambulatorial and hospital care in SUS for elderly with associated osteoporosis diagnosis and fractures in the 2008 – 2010 triennium.

The secondary production data and the expenses with ambulatorial and hospital procedures related to osteoporosis were analyzed, based on the data source of the Outpatient Information System (SIA/SUS) and the Hospital Information System (SIH/SUS) under the Ministry of Health's perspective. In this sense, it was decided to have an indentation only of the resources paid out by federal entities, and the remaining ones — states and municipalities —

were excluded from this investigation. Moreover, only direct expenses (medical drugs and consultations, tests, surgeries, prostheses etc.) were included in this analysis, since the indirect ones (related to productivity loss, absenteeism and premature death) are not responsibility of the Ministry of Health. The same situation is true for the intangible costs (pain and suffering) which are diffused in the information system of the DATASUS, making its measurement impossible (other diseases of the International Classification Diseases – ICD-10 – not related to osteoporosis), given that the DATASUS was developed in order to fulfill an accounting role, focusing on procedures, rather than on patients.

The identification of the procedures related to osteoporosis and to fractures was made through the ICD-10, being registered in the Table Management System of Procedures, Medical drugs, Orthotics, Prosthetics and Special Materials of SUS (SIGTAP), available, in the Health Information Systems of the Ministry of Health, in this case, the SIH/SUS and the SIA/SUS<sup>14-16</sup>. The ICD-10 selected were:

1. M80 – osteoporosis with pathological fracture (M80.1-80.9);
2. M81– osteoporosis without pathological fracture (M80.1-80.9);
3. S22 – Fracture of rib(s), sternum and thoracic spine and S22.0 – Fracture of thoracic vertebra;
4. S32 – Fracture of lumbar spine and pelvis and S32.0 – Fracture of lumbar vertebra;
5. S52.5 – Fracture of lower end of radius;
6. S72 – Fracture of femur and S72.0 – Fracture of neck of femur.

The ICD-10 fractures were selected considering, from the epidemiological and clinical point of view, the most important and the most related to osteoporosis ones<sup>17</sup>, as well as the ones considered as a risk factor for the determination of the highest risk of fracture by osteoporosis<sup>12</sup>.

In order to assure greater consistency to the expenses analysis, we used the SIGTAP groups which presented production, according to the ICD-10 selected, available in the SIH/SUS and in the SIA/SUS<sup>14-16</sup>. They were:

1. medical drugs;
2. procedures for diagnostic purposes - tests;
3. clinical procedures;
4. surgical procedures;
5. orthotics, prosthetics and special materials (OPME); and
6. additional health care actions.

Moreover, the populational denominator from the Brazilian Institute of Geography and Statistics (IBGE) for the census years of 2010<sup>18</sup> was used. This resource was used in order to obtain the average expenditure measure of the elderly population, since the information systematization of the DATASUS is based on procedures rather than on users.

This study was approved by the Research Ethics Committee of the Faculdade de Ciências da Saúde of the Universidade de Brasília (UnB).

The descriptive statistic was used in order to analyze the characteristics of the records on osteoporosis procedures in Brazilian elderly by absolute and relative frequencies, average values and standard deviation (SD) and the total amount of expenses with osteoporosis. The multiple (adjusted) linear regression analysis was used in order to verify the association between the dependent variable (expenses with the treatment of osteoporosis and fractures) and the demographic variables (gender and age range), the ICD-10 for osteoporosis and fracture and the geographic region, estimating the regression coefficients ( $\beta$ ) and the confidence intervals of 95% (95%CI). All independent variables were part of the adjusted analysis. For all the inferential analyses, the significance level considered was 5%. All the analyses were performed and stratified by the year of the data (2008, 2009 and 2010) and by the group of procedure. The Stata 11.0 software was used for the statistical analyses.

## RESULTS

In Tables 1 a 3, it is observed the distribution of information in the years of 2008, 2009 and 2010, according to the type of osteoporosis and fractures, considering the ICD-10, the age range, the gender, geographic regions, the group of the recommended procedure and the information system from which the data is derived.

R\$ 288,986,335.15 were spent with 3,252,756 procedures related to osteoporosis in elderly in Brazil in the 2008–2010 triennium. From this, R\$ 89,343,911.73 were spent in 2008, with 1,100,959 procedures; in 2009, R\$ 102,395,316.43 were spent with 1,274,333 procedures and, in 2010, R\$ 97,247,106.99 with 877,464 procedures.

When analyzing the data from each year of the triennium, it is observed that the age range which has performed the most procedures was 60 – 69 years of age, with 47.2% on 2008, 46% in 2009 and 45.5% in 2010, followed by the age range from 70 to 79 years of age, with 37.9% in 2008, 38.6% in 2009 and 38.1% in 2010, and 80 years of age or more, with 14.8% in 2008, 15.4% in 2009 and 16.4% in 2010. However, when analyzing the expenses, it is observed that the population of 80 years of age was the one which presented the highest expenses over the period: R\$ 31,515,377.65 in 2008, R\$ 37,225,809.12 in 2009 and R\$ 38,205,988.69 in 2010, and the highest average values related to the procedures was R\$ 193.15 in 2008, R\$ 189.03 in 2009 and R\$ 265.79 in 2010, which represents, on average, approximately 4 times the average expenditure of the age range 60 – 69 years of age.

As for the quantity of procedures, women were the majority, with an average of 95.6% in the entire period. A similar pattern is observed on relation to the expenses, though in smaller proportion for each year of the triennium: 77.8% in 2008, 76.7% in 2009 and 74.4% in 2010. When the average expenditure by procedure is verified, there is a great difference between men and women, since a difference of almost 7 times was observed in each year analyzed — R\$ 416.69 (men) *versus* R\$ 65.96 (women) in 2008; R\$ 420.40 (men) *versus* R\$ 64.48 (women) in 2009 and R\$ 646.90 (men) *versus* R\$ 86.23 (women) in 2010.

Table 1. General data of osteoporosis by groups of procedures from Unified Health System Management System of the Table of Procedures, Medicines, Orthotics, Prosthetics and Special Materials. Brazil, 2008.

Year 2008														
Variables	Group 1 Medicines (drugs)		Group 2 Tests		Group 3 Clinical procedures		Group 4 Surgical procedures		Group 5 Orthotics and prosthetics		Group 6 Complementary		Total Cost	
	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost
Gender														
Male	30,634	471,481.76	3,559	214,684.72	3,365	689,519.62	10,085	18,483,240.45	21	4,752.70	7	188.10	47,671	19,863,867.35
Female	928,060	23,616,424.24	94,733	5,268,488.18	10,018	1,247,724.69	20,273	39,299,666.62	142	44,739.45	62	3,001.20	1,053,288	69,480,044.38
Age range (years)														
60 – 69	451,137	11,812,988.27	57,188	3,179,702.01	5,072	512,788.39	6,794	10,966,044.46	44	17,125.00	38	1,901.55	520,273	26,490,549.68
70 – 79	370,935	9,034,297.49	31,721	1,779,203.20	4,339	618,540.14	10,443	19,891,507.42	54	13,148.40	30	1,287.75	417,522	31,337,984.40
≥ 80	136,622	3,240,620.24	9,383	524,267.69	3,972	805,915.78	13,121	26,925,355.19	65	19,218.75	1	-	163,164	31,515,377.65
Geographic region														
North	26,645	683,752.90	7,120	396,633.28	835	136,832.29	919	1,487,814.85	28	6,825.90	19	1,291.05	35,566	2,713,150.27
Northeast	374,978	8,231,276.95	31,022	1,739,232.92	3,475	380,429.57	5,763	10,242,143.45	54	16,324.85	30	1,405.80	415,322	20,610,813.54
Midwest	87,235	1,747,261.13	8,091	450,940.85	819	98,796.68	1,731	2,939,314.39	33	6,210.00	2	-	97,911	5,242,523.05
Southeast	406,619	11,802,662.77	46,309	2,573,892.13	6,837	1,016,136.70	16,407	32,301,600.03	37	17,562.20	15	477.60	476,224	47,712,331.43
South	63,217	1,622,952.25	5,750	322,473.72	1,417	305,049.07	5,538	10,812,034.35	11	2,569.20	3	14.85	75,936	13,065,093.44
ICD-10														
M80 with fracture	221,068	5,979,431.62	3,601	215,934.94	1,414	65,245.67	0	-	54	20,976.50	9	388.50	226,146	6,281,977.23
M81 without fracture	737,626	18,108,474.38	94,685	5,264,620.94	6,047	163,133.00	3	84.00	109	28,515.65	60	2,800.80	838,530	23,567,628.77
Fractures	-	-	6	2,617.02	5,922	1,708,865.64	30,355	57,782,823.07	-	-	-	-	36,283	59,494,305.73
System														
SIA	958,694	24,087,906.00	98,286	5,480,555.88	7,461	228,378.67	3	84.00	163	49,492.15	69	3,189.30	1,064,676	29,849,606.00
SIH	-	-	6	2,617.02	5,922	1,708,865.64	30,355	57,782,823.07	-	-	-	-	36,283	59,494,305.73
Total	958,694	24,087,906.00	98,292	5,483,172.90	13,383	1,937,244.31	30,358	57,782,907.07	163	49,492.15	69	3,189.30	1,100,959	89,343,911.73

Qty.: quantity; SIA: Ambulatory Information System; SIH: Hospital Information System.

Table 2. General data of osteoporosis by groups of procedures from Unified Health System Management System of the Table of Procedures, Medicines, Orthotics, Prosthetics and Special Materials. Brazil, 2009.

Ano 2009														
Variables	Group 1 Medicines (drugs)		Group 2 Tests		Group 3 Clinical procedures		Group 4 Surgical procedures		Group 5 Orthotics and prosthetics		Group 6 Complementary		Total Cost	
	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty..	Cost	Qty.	Cost
Gender														
Male	38,132	537,238.61	3,903	227,070.20	3,488	761,449.12	11,250	22,353,083.47	26	7,554.75	23	1,843.35	56,822	23,888,239.50
Female	1,090,305	25,832,323.79	94,537	5,273,951.10	10,488	1,607,768.46	22,021	45,775,930.93	52	13,638.10	108	3,464.55	1,217,511	78,507,076.93
Age range (years)														
60 – 69	516,994	12,500,520.37	56,697	3,158,928.55	4,486	554,280.63	7,332	12,743,616.51	45	11,283.35	76	3,886.05	585,630	28,972,515.46
70 – 79	443,319	10,096,270.09	32,100	1,803,541.20	4,864	811,488.20	11,414	23,478,522.81	20	5,747.70	55	1,421.85	491,772	36,196,991.85
≥ 80	168,124	3,772,771.94	9,643	538,551.55	4,626	1,003,448.75	14,525	31,906,875.08	13	4,161.80	-	-	196,931	37,225,809.12
Geographic region														
North	38,563	1,160,379.86	7,900	437,520.58	816	155,748.95	982	1,685,499.17	14	2,720.20	37	2,429.10	48,312	3,444,297.86
Northeast	389,570	8,408,977.10	29,022	1,633,187.79	3,859	573,246.51	6,359	12,137,026.60	2	632.40	68	2,574.00	428,880	22,755,644.40
Midwest	110,557	2,377,348.80	9,942	552,409.01	914	110,673.71	2,062	3,680,502.09	5	1,135.40	-	-	123,480	6,722,069.01
Southeast	494,515	12,407,564.37	45,427	2,510,850.45	6,771	1,193,523.56	17,850	37,780,051.74	39	11,314.65	22	255.30	564,624	53,903,560.07
South	95,232	2,015,292.27	6,149	367,053.47	1,616	336,024.85	6,018	12,845,934.80	18	5,390.20	4	49.50	109,037	15,569,745.09
ICD-10														
M80 with fracture	244,667	5,711,531.25	4,011	235,866.76	1,545	108,190.88	-	-	45	12,217.15	28	2,128.80	250,296	6,069,934.84
M81 without fracture	883,770	20,658,031.15	4,423	5,261,771.03	5,587	98,875.44	-	-	33	8,975.70	103	3,179.10	983,916	26,030,832.42
Fractures	-	-	6	3,383.51	6,844	2,162,151.26	33,271	68,129,014.40	-	-	-	-	40,121	70,294,549.17
System														
SIA	1,128,437	26,369,562.40	98,434	5,497,637.79	7,132	207,066.32	-	-	78	21,192.85	131	5,307.90	1,234,212	32,100,767.26
SIH	-	-	6	3,383.51	6,844	2,162,151.26	33,271	68,129,014.40	-	-	-	-	40,121	70,294,549.17
Total	1,128,437	26,369,562.40	98,440	5,501,021.30	13,976	2,369,217.58	33,271	68,129,014.40	78	21,192.85	131	5,307.90	1,274,333	102,395,316.43

Qty.: quantity; SIA: Ambulatorial Information System; SIH: Hospital Information System.



Table 3. General data of osteoporosis by groups of procedures from Unified Health System Management System of the Table of Procedures, Medicines, Orthotics, Prosthetics and Special Materials. Brazil, 2010.

Year 2010														
Variables	Group 1 Medicines (drugs)		Group 2 Tests		Group 3 Clinical procedures		Group 4 Surgical procedures		Group 5 Orthotics and prosthetics		Group 6 Complementary		Total Cost	
	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost	Qty.	Cost
Gender														
Male	19,567	487,420.53	4,471	274,698.71	2,651	489,844.26	11,756	23,643,851.32	11	3,983.60	40	3,117.95	38,496	24,902,916.37
Female	698,804	16,238,975.58	106,665	6,064,287.88	10,395	997,403.80	23,023	49,026,768.12	35	9,441.99	46	7,313.25	838,968	72,344,190.62
Age range (years)														
60 – 69	322,826	8,103,655.30	64,565	3,660,675.85	4,517	424,732.48	7,555	13,745,334.04	17	4,885.29	59	9,108.70	399,539	25,948,391.66
70 – 79	281,814	6,121,131.34	35,664	2,060,399.85	4,841	510,753.63	11,819	24,393,497.52	20	6,038.00	24	906.30	334,182	33,092,726.64
≥ 80	113,731	2,501,609.47	10,907	617,910.89	3,688	551,761.95	15,405	34,531,787.88	9	2,502.30	3	416.20	143,743	38,205,988.69
Geographic region														
North	23,903	341,812.94	8,110	449,251.24	653	130,764.74	960	1,615,568.43	7	2,123.10	53	9,101.15	33,686	2,548,621.60
Northeast	242,869	12,325,175.19	29,060	1,690,754.69	4,253	287,079.56	6,393	12,458,141.65	7	2,139.80	19	1,197.90	282,601	26,764,488.79
Midwest	53,830	559,026.16	10,660	610,923.23	740	65,463.94	2,145	4,138,465.74	3	340.20	3	4.95	67,381	5,374,224.22
Southeast	343,703	3,001,239.74	55,539	3,141,781.00	6,178	832,904.56	18,743	40,179,403.78	9	2,243.29	6	48.00	424,178	47,157,620.37
South	54,066	499,142.08	7,767	446,276.43	1,222	171,035.26	6,538	14,279,039.84	20	6,579.20	5	79.20	69,618	15,402,152.01
ICD-10														
M80 with fracture	128,035	1,327,693.02	4,043	240,167.59	2,084	120,574.94	-	-	30	9,860.19	50	7,611.60	134,242	1,705,907.34
M81 without fracture	590,336	15,398,703.09	107,088	6,093,344.75	6,358	136,999.60	1	22.27	16	3,565.40	36	2,819.60	703,835	21,635,454.71
Fractures	-	-	5	5,474.25	4,604	1,229,673.52	34,778	72,670,597.17	0	-	-	-	39,387	73,905,744.94
System														
SIA	718,371	16,726,396.11	111,131	6,333,512.34	8,442	257,574.54	1	22.27	46	13,425.59	86	10,431.20	838,077	23,341,362.05
SIH	-	-	5	5,474.25	4,604	1,229,673.52	34,778	72,670,597.17	0	-	-	-	39,387	73,905,744.94
Total	718,371	16,726,396.11	111,136	6,338,986.59	13,046	1,487,248.06	34,779	72,670,619.44	46	13,425.59	86	10,431.20	877,464	97,247,106.99

Qty.: quantity; SIA: Ambulatory Information System; SIH: Hospital Information System.

It is also observed the great participation of ambulatorial procedures (96.4%) in relation to hospital ones (3.6%). In terms of expenditure, this pattern is inverted, being the hospital procedures the ones in need of more resources (66.6, 68.6 and 76% each year) in relation to the ambulatorial ones (33.4, 31.4 and 24%, respectively).

The Southeast region has the largest share of procedures (43.2% in 2008, 44.3% in 2009 and 48.3% in 2010) and the highest expenses when compared to the remaining regions (53.4% in 2008, 52.4% in 2009 and 48.5% in 2010). This is directly related to the great concentration of elderly population in this region (46%). Regions North and Northeast present a participation in average total expenditure of approximately 3 and 24.3%, respectively, lower than its elderly population proportion (5 and 26%, respectively), and a divergent pattern in relation to the total procedures number in the triennium (3.6 and 34.6%, respectively). Regions Midwest and South showed proportionality in relation to the elderly population's participation and to the expenses incurred with the treatment of osteoporosis (6 and 15.2%, respectively), differing in relation to the number of procedures (8.9 and 7.8%, respectively), as described in Tables 1 to 3.

Table 4 presents the adjusted analysis between the expenditures on osteoporosis and fractures treatment and the independent variables according to each year and group of procedure. In 2008, 2009 and 2010, for the procedures related to drugs, the populational subgroups which spent more with osteoporosis were the younger female elderly (except 2010), whose analyzed ICD-10 was the osteoporosis with pathological fracture one (except 2009) and the ones from regions Southeast (in 2008), North (in 2009) and Northeast (in 2010). For the procedures related to the tests, in 2008 and 2009, the elderly who spent more with osteoporosis were the male ones, whose analyzed ICD-10 was fracture. In the year of 2010, for the procedures related to the tests, no variable was associated to higher or lower expenses with osteoporosis. For the clinical procedures, the male elderly (in 2008), from the fractures ICD-10 (in 2008, 2009 and 2010) and from the North region (in 2010) were the ones who spent more on osteoporosis. As for the surgical procedures, the elderly subgroups which spent more with osteoporosis were those above 80 years of age, females (2008 and 2010), with ICD-10 of fractures (2008) and from regions Southeast (in 2008) and South (2009 and 2010). For the procedures of OPM, the elderly in Southeast and South, in 2009, were the ones who spent more with osteoporosis. In the procedures related to complementary actions, female elderly (in 2010), living in Northeast (in 2010) and North (in 2008 and 2009), were the ones who spent more with osteoporosis.

## DISCUSSION

In Brazil, over the last few decades, the interest in using databases originated by health services as a tool for the development of policies, the analysis of the epidemiological systems in health, for planning and resource management has been expanding<sup>19,20</sup>. According to Bittencourt et al.<sup>21</sup>, the systems provided by DATASUS are an important source in this context,

Table 4. Multiple linear regression analysis between expenditure with the treatment of osteoporosis and independent variables. Brazil, 2008 – 2010.

Year 2008												
Procedure	Group 1 Medicines (drugs)		Group 2 Tests		Group 3 Clinical procedures		Group 4 Surgical procedures		Group 5 OPM		Group 6 Complementary actions	
Variables	Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)	
	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value
Age range (years)												
60 – 69	Reference	< 0.01	Reference	0.16	Reference	0.07	Reference	< 0.01	Reference	0.52	Reference	0.66
70 – 79	-1.9 (-2.0 – -1.8)		0.3 (0.1 – 0.6)		-10.4 (-23.2 – 2.3)		279.8 (242.8 – 316.8)		-161.1 (-310.4 – -11.8)		-1.9 (-21.8 – 17.8)	
≥ 80	-2.3 (-2.5 – -2.1)		0.1 (-0.4 – 0.5)		-8.0 (-21.9 – 5.7)		423.4 (387.4 – 459.3)		-87.5 (-237.0 – 61.9)		-49.2 (-121.1 – 22.6)	
Gender												
Male	Reference	< 0.01	Reference	< 0.01	Reference	< 0.01	Reference	0.02	Reference	0.23	Reference	0.54
Female	10.1 (9.7 – 10.5)		-4.2 (-5.0 – -3.5)		-21.8 (-34.2 – -9.4)		34.1 (4.8 – 63.4)		104.1 (-66.4 – 274.6)		3.8 (-26.4 – 34.2)	
ICD-10												
M80 with fracture	Reference	< 0.01	Reference	< 0.01	Reference	< 0.01	Reference	0.02	Reference	0.16	Reference	0.92
M81 without fracture	-0.8 (-0.9 – -0.6)		-4.3 (-5.1 – -3.6)		-21.5 (-39.8 – -3.2)		-		-32.7 (-194.1 – 128.6)		-0.9 (-29.7 – 27.8)	
Fractures	-		373.6 (355.7 – 391.5)		241.9 (223.3 – 260.6)		1.620.9 (259.7 – 2982.1)		-		-	
Geographic region												
North	Reference	< 0.01	Reference	0.07	Reference	0.69	Reference	< 0.01	Reference	0.76	Reference	0.02
Northeast	-3.5 (-4.0 – -3.1)		0.4 (-0.1 – 1.0)		22.9 (-0.7 – 46.6)		113.4 (29.6 – 197.3)		68.0 (-99.1 – 235.1)		-19.6 (-41.3 – 2.0)	
Midwest	-5.3 (-5.8 – -4.9)		-0.1 (-0.7 – 0.6)		-1.5 (-31.5 – 28.3)		70.8 (-25.3 – 167.0)		-71.0 (-256.3 – 114.3)		-65.9 (-120.2 – -11.6)	
Southeast	3.4 (3.0 – 3.9)		-0.1 (-0.6 – 0.4)		4.5 (-17.7 – 26.8)		310.5 (230.5 – 390.5)		204.0 (-9.4 – 417.6)		-35.4 (-61.9 – -8.9)	
South	0.2 (-0.2 – 0.6)		0.2 (-0.5 – 0.9)		10.0 (-16.5 – 36.7)		297.7 (213.7 – 381.8)		-32.7 (-194.1 – 128.6)		-61.3 (-106.1 – -16.5)	

Continue...

Table 4. Continuation.

Year 2009												
Procedure	Group 1 Medicines (drugs)		Group 2 Tests		Group 3 Clinical procedures		Group 4 Surgical procedures		Group 5 OPM		Group 6 Complementary actions	
Variables	Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)	
	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value
Age range (years)												
60–69	Reference	< 0.01	Reference	0.48	Reference	0.08	Reference	< 0.01	Reference	0.18	Reference	0.36
70–79	-1.3 (-1.4 – -1.2)		0.4 (-0.1 – 1.0)		-0.2 (-24.6 – 24.6)		304.7 (260.3 – 349.0)		41.1 (-29.2 – 111.4)		-1.5 (-17.6 – 14.4)	
≥ 80	-1.4 (-1.6 – -1.3)		0.1 (-0.9 – 1.0)		-7.1 (-33.0 – 18.8)		440.9 (398.1 – 483.8)		70.3 (-15.0 – 155.8)		-	
Gender												
Male	Reference	< 0.01	Reference	< 0.01	Reference	0.27	Reference	0.12	Reference	0.7	Reference	0.07
Female	9.5 (9.2 – 9.9)		-2.3 (-3.7 – -0.8)		13.2 (-10.6 – 37.1)		20.3 (-14.2 – 55.0)		-13.6 (-83.9 – 56.6)		-27.1 (-54.8 – 0.5)	
ICD-10												
M80 with fracture	Reference	< 0.01	Reference	< 0.01	Reference	< 0.01	Reference	-	Reference	0.84	Reference	0.39
M81 without fracture	1.1 (0.9 – 1.2)		-3.0 (-4.4 – -1.5)		-58.1 (-92.4 – -23.9)		-		5.4 (-57.4 – 68.3)		-15.1 (-43.1 – 12.8)	
Fractures	-		504.7(468.9 – 540.4)		254.2 (220.2 – 288.3)		-		-		-	
Geographic region												
North	Reference	< 0.01	Reference	0.4	Reference	0.51	Reference	< 0.01	Reference	0.02	Reference	0.02
Northeast	-8.5 (-8.8 – -8.2)		1.0 (-0.1 – 2.1)		36.8 (-8.9 – 82.7)		145.1 (44.2 – 246.0)		77.8 (-122.0 – 277.6)		-2.1 (-22.8 – 18.4)	
Midwest	-8.3 (-8.7 – -8.0)		0.2 (-1.0 – 1.5)		-3.3 (-60.4 – 53.7)		48.9 (-65.0 – 162.9)		26.0 (-108.0 – 160.0)		-	
Southeast	-4.6 (-4.9 – -4.3)		-0.1 (-1.1 – 0.9)		-4.7 (-48.4 – 39.0)		348.1 (251.6 – 444.5)		83.1 (-3.4 – 169.7)		-27.8 (-49.2 – -6.4)	
South	-8.7 (-9.1 – -8.3)		4.3 (2.8 – 5.7)		-13.8 (-64.7 – 36.9)		375.1 (273.8 – 476.4)		105.1(10.4 – 199.7)		-26.6 (-62.8 – 9.5)	

Continue...

Table 4. Continuation.

Year 2010												
Procedure	Group 1 Medicines (drugs)		Group 2 Tests		Group 3 Clinical procedures		Group 4 Surgical procedures		Group 5 OPM		Group 6 Complementary actions	
Variables	Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)		Adjusted analysis (multivariate)	
	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value	$\beta$ (95%CI)	p-value
Age range (years)												
60 – 69	Reference	< 0.01	Reference	0.77	Reference	0.43	Reference	< 0.01	Reference	0.37	Reference	0.15
70 – 79	-2.8 (-4.1 – -1.6)		0.9 (-1.5 – 3.4)		-5.6 (-20.4 – 9.1)		231.0 (183.7 – 278.4)		59.8 (-14.7 – 134.3)		-185.0 (-348.6 – -21.4)	
≥ 80	-3.7 (-5.4 – -2.1)		-0.1 (-4.0 – 3.7)		-14.7 (-31.1 – 1.7)		401.9 (356.2 – 447.6)		15.2 (-80.1 – 110.6)		-28.1 (-363.6 – 307.3)	
Gender												
Male	Reference	< 0.01	Reference	0.12	Reference	0.07	Reference	< 0.01	Reference	0.16	Reference	< 0.01
Female	-5.4 (-8.9 – -1.8)		-3.8 (-9.6 – 1.8)		-14.7 (-31.1 – 1.7)		51.1 (14.3 – 88.1)		-56.7 (-138.4 – 24.8)		461.3 (275.3 – 647.3)	
ICD-10												
M80 with fracture	Reference	< 0.01	Reference	0.71	Reference	< 0.01	Reference	0.19	Reference	0.15	Reference	0.06
M81 without fracture	-5.0 (3.5 – 6.5)		-2.5 (-8.6 – 3.4)		-43.2 (-61.4 – -25.1)		-2.110.0 (99.3 – 1079.2)		-59.0 (-141.1 – 22.9)		-149.2 (-300.1 – 1.6)	
Fractures	-		1.033.6 (865.4 – 201.8)		217.6 (197.5 – 237.7)		-		-		-	
Geographic region												
North	Reference	< 0.01	Reference	0.71	Reference	< 0.01	Reference	< 0.01	Reference	0.7	Reference	0.01
Northeast	35.7 (32.4 – 38.9)		2.8 (-1.8 – 7.5)		-83.1 (-113.2 – -53.1)		242.0 (131.5 – 352.4)		27.0 (-90.0 – 144.1)		299.8 (-491.3 – 108.3)	
Midwest	-4.6 (-8.3 – -0.9)		1.8 (-3.6 – 7.3)		-117.0 (-155.2 – -78.7)		254.8 (130.9 – 378.6)		-153.1 (-320.3 – 13.9)		-456.7 (-803.0 – 110.5)	
Southeast	-5.3 (-8.5 – -2.1)		1.1 (-3.3 – 5.5)		-110.0 (-139.5 – -80.6)		435.8 (330.3 – 541.4)		-12.0 (-128.9 – 104.8)		-308.1 (-581.6 – 34.6)	
South	-5.1 (-8.7 – -1.3)		2.1 (-3.8 – 8.0)		-118.9 (-153.8 – -84.0)		477.8 (367.4 – 588.0)		28.1 (-67.3 – 123.5)		-261.1 (-534.8 – 12.5)	

Adjusted analysis by all the independent variables.

OPM: orthosis, prosthesis and special materials;  $\beta$ : regression coefficient; 95%CI: confidence interval of 95%.

for they have nationwide coverage, free access, in addition to having internal consistency and coherence with evidences found in literature.

The SIH/SUS is the only one with nationwide coverage, originated in the Hospitalization Authorizations (AIH) — destined for the payment of hospitalizations in public hospitals and in private ones in partnership with SUS — and the advantage of providing diagnostic, demographic and geographic information for each hospitalization<sup>21</sup>. The SIA/SUS, in turn, aims at registering the visits and procedures performed in each health establishment on ambulatorial basis, focusing on production and, consequently, in the actual payment for services provided by<sup>22</sup>. In this sense, some limitations concerning this base may arise, such as the absence of procedures performed for exceeding the financial limit of the operation and divergences due to fraudulent alterations of codes<sup>23</sup>, in order to get a better payment. This way, the evidence risen by this study may be underestimated due to these features, and becoming a limitation in this study. However, these systems are still important sources of information for knowing national expenditure<sup>22</sup>.

In this work, it was verified that women are more often in use of osteoporosis related procedures, presenting higher expenses in an overall point of view. However, when adjusting total expenditure by quantity, it is observed that men have a higher average cost per procedure. This is explained, partly, by the higher frequency of men in more complex procedures<sup>24,25</sup>, which may indicate a possible delay in starting the treatment, searching for medical care in advanced stages of the diseases. For instance, considering all six groups of procedures, men used only 4.4% of the total, but this relation changes when we observe the data by group of procedures. In the specific case of surgical procedures, which are highly complex and costly, men are responsible for 33% of the procedures performed in those 3 years. This is corroborated by Siqueira et al.<sup>26</sup>, when identifying higher occurrence of osteoporotic fractures in men, with high incidence or mortality and morbidity and significant costs. In the same direction, Oliveira et al.<sup>27</sup> identified a 50% higher risk of fractures in men when comparing to women, considering a sample of 3,214 individuals in the city of Pelotas (RS).

Moreover, since it is a silent and asymptomatic disease (until a fracture actually happens), prevention is essential. The primary osteoporosis diagnosis is clinical, later complemented by bone densitometry (gold standard)<sup>12,13</sup>. In this sense, based on the data observed in this study, it was verified that men have a lower frequency of going under bone densitometry (11,933 tests in the triennium, representing annual average of 3.8%) when compared to women (295,935 tests in the triennium, representing annual average of 96.2%). Thus, without the confirmation of the diagnosis, the possible treatments are delayed (drug based ones or not), aggravating the patient's health condition.

As to age range, 80 years old or older patients had the lowest number of procedures (14.8% in 2008, 15.4% in 2009 and 16.4% in 2010) in relation to the remaining ones, though with highest cost (35.3, 36.3 and 39.3%, respectively). These data are distributed annually in higher proportions among the groups of surgical (64.7, 66.5 and 74.7%) and drug-based (27, 5.7 and 6.7%) procedures, characterizing the use of such resources primarily to the treatment of osteoporosis fractures.

Regarding the distribution of expenses related to osteoporosis in Brazilian regions, there was a higher participation — both absolute and relative — of the Southeast region when compared to the others, even adjusted by the number of elderly residing there; the opposite occurs in Northeast in terms expenses related to the elderly population. This expenditure pattern may be associated to the climatic, racial and genetic factors<sup>27</sup>. This data is also corroborated by Silveira<sup>28</sup>, in studies carried out in the Southeast and Northeast regions, in which it was observed a possible influence of the climatic conditions in order to justify the found data.

As for the years of analysis, there was a sharp decrease in the number of procedures in 2010. This is explained by the change in agreements between the federate entities, where the liability for some drugs became states and municipalities' matters, according to the ordinance 2,981, of November 26<sup>th</sup>, 2009. It is noteworthy, however, that, in terms of expenses, this drop was smaller. For instance, the decrease in the number of procedures was 45% between 2009 and 2010; now regarding the expenses, it was 5% in the same period.

In relation o the ICD-10, the osteoporosis without fracture is the majority in terms of quantity and cost of the drugs, representing 76.9, 78.3 e 82.1% and 75.2, 78.3 and 92, each year, respectively. Out of the total procedures identified by ICD-10 on fractures, there were 115,791 registers in the triennium, summing up 3.6% of the total. These are essentially hospital ones and they represented 3.3% in 2008, 3.1% in 2009 and 4.5% in 2010. It is worth noting that, despite the reduced number of procedures related to the remaining ICDs, the amount spent is substantial, representing 70% of the triennium's total and, each year, 66.6, 68.5 and 76%, respectively. The same is not true for ICDs of osteoporosis with fracture, which present reduced participation in the total cost of this disease. One possible explanation lies in the fact that this ICD-10 is not commonly used in hospitals, since there are no records of surgical procedure. The expenses 92.5% with medical drugs prevailed in the triennium, representing, each year, 95.2, 94.1 and 77.8%, and the expenses with tests were 5% in the triennium, featuring 3.4, 3.8 e 14.0%, respectively. This discrepancy is due to the kind of test used in the ICDs, since the one with the highest financial impact for ICD-10 osteoporosis with and without fracture was the dual-energy bone densitometry of spinal column (R\$ 55.34).

## CONCLUSION

Based on the data found in this study, we obtained a general overview of the expenses spent by the Ministry of Health with the treatment of osteoporosis in 2008, 2009 and 2010. There was a progress towards disaggregating expenses by groups of SIGTAP procedures, allowing a more detailed view of the expenses made. Moreover, multivariate models were used in order to estimate the magnitude (regression coefficient) and direction (coefficient signal) of variables which may explain the expenses related

to osteoporosis in Brazil. It was found that there is no single pattern for the groups of procedures, when these are analyzed separately.

In the group of medical drugs, there was a higher expense in procedures by women aged 60 to 69 years old and whose ICD-10 would relate to osteoporosis with pathological fracture. In the group of medical testing, more was spent on procedures with men under fracture treatment. In the group of clinical procedures, there was a higher expense by procedure for men (except in 2009 and 2010) of the North region (only in 2010), under treatment of fractures. In the group of surgical procedures, there was a higher expense by procedure with women (except in 2009) in the South and Southeast regions, who were 80 years old or older. In the group of OPM procedures, there was a higher expense with the elderly from the South region. In the group of complementary actions procedures, women in North (in 2008 and 2009) and Northeast (in 2010) presented higher cost per performed procedure.

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Received on: 03/10/2014

Accepted: 05/22/2014