

# Osteoporosis self-reported in the elderly: a population-based survey in the city of Campinas, São Paulo, Brazil

*Osteoporose autorreferida em população idosa: pesquisa de base populacional no município de Campinas, São Paulo*

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**ABSTRACT:** *Introduction:* Osteoporosis is a multifactorial disease that predisposes individuals to suffer falls and fractures, causing functional impairment and a consequent reduction in quality of life. *Objective:* To assess the prevalence and factors associated with self-reported osteoporosis in the elderly population living in Campinas, São Paulo, Brazil (ISACAMP 2008). *Methods:* Cross-sectional study with a random sample taken by conglomerates in 2 stages totaling 1,419 elderly people living in the urban area. The self-reported prevalence of osteoporosis was estimated according to socioeconomic and demographic variables, morbidity, health behaviors and problems. Crude prevalence ratios were estimated and adjusted by means of simple and multiple regressions using the Poisson svy commands in Stata 11.0 software. *Results:* We found a prevalence of osteoporosis of 14.8%, and significantly higher in females, in individuals who reported white skin, those who reported less than 7 hours of sleep/day, in patients with rheumatism/arthritis/arthrosis, asthma/bronchitis/emphysema, tendinitis, dizziness, insomnia, common mental disorders, BMI < 27, health self-related as bad and very bad, and reporting falls occurring in the last 12 months. *Conclusion:* The present study, by identifying the factors associated with osteoporosis, identified segments of older people with a higher prevalence of the disease; to this information may contribute to the planning of public health policies and programs aimed at controlling the disease and its consequences.

**Keywords:** Osteoporosis. Aged. Aging. Health surveys. Cross-sectional studies. Risk factors.

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**RESUMO:** *Introdução:* A osteoporose é uma doença multifatorial que predispõe o indivíduo a sofrer quedas e fraturas, provocando incapacidade funcional e uma consequente redução da qualidade de vida. *Objetivo:* Analisar a prevalência e fatores associados à osteoporose autorreferida na população de idosos residentes em Campinas, São Paulo (ISACAMP 2008). *Métodos:* Trata-se de estudo transversal, com amostra probabilística tomada por conglomerados em 2 estágios totalizando 1.419 idosos residentes na área urbana. Foram estimadas as prevalências de osteoporose autorreferida segundo variáveis socioeconômicas e demográficas, morbidades, problemas e comportamentos de saúde. Foram estimadas razões de prevalências brutas e ajustadas por meio de regressões simples e múltipla de Poisson utilizando os comandos svy do software Stata 11.0. *Resultados:* Encontrou-se uma prevalência de osteoporose de 14,8%, que foi significativamente mais elevada: no sexo feminino, nos indivíduos que autorreferiram cor de pele branca, naqueles que relataram menos de 7 horas de sono/dia, nos idosos com reumatismo/artrite/artrose, asma/bronquite/enfisema, tendinite, tontura, insônia, transtorno mental comum, IMC > 27, autoavaliação da saúde como ruim e muito ruim e nos que relataram ocorrência de queda nos últimos 12 meses. *Conclusão:* O presente estudo, por meio da identificação dos fatores associados à osteoporose, identificou subgrupos idosos com maior prevalência da doença, podendo contribuir com essas informações para o aprimoramento de programas de saúde voltados ao controle da doença e de suas consequências.

*Palavras-chave:* Osteoporose. Idoso. Envelhecimento. Inquéritos epidemiológicos. Estudos transversais. Fatores de risco.

## INTRODUCTION

The aged population growth is a worldwide phenomenon, and modifications in the age structure are happening very quickly owing to this growth in Brazil. In less than 40 years, Brazil migrated from a demographic profile that is typical of a young population to a population in which growth happens, mainly, in the most advanced age ranges<sup>1,2</sup>. Thus, a change in the population epidemiological profile has occurred with a significant increase of chronic and multiple illnesses. Diseases of the circulatory system, neoplasms, and metabolic bone diseases such as osteoporosis (OP) are known in the scenario of illnesses related to aging, which create high costs for the health system and that cause impairments and deaths<sup>3</sup>.

OP is defined as a metabolic bone disorder of multifactorial origin, characterized by the decrease of bone mineral density with deterioration of the microarchitecture, which results in a higher risk of fractures<sup>4</sup>. OP can be classified as primary, and it is subdivided into types I and II and secondary. In the type I primary OP, also known as postmenopausal type, there is a fast bone loss that happens in the recently menopausal woman. Type II or senile OP is associated with aging and is developed through calcium chronic impairment, increase of the parathormone activity, and decrease of bone formation<sup>5</sup>.

The secondary OP can occur owing to inflammatory processes such as those produced by the rheumatoid arthritis, to endocrine alterations such as those present in hyperthyroidism, and in adrenal disorders; it can also be caused owing to the use of drugs such as heparin, alcohol, vitamin A, and use of corticoids, among other causes<sup>5</sup>.

OP is a multifactorial disease with high prevalence that predisposes the subject to suffering falls and fractures, thus provoking functional impairment and a consequent reduction in the quality of life. This disease has become an important public health issue, especially after the increase of population's life expectation<sup>6</sup>. It is estimated that around 200 million people in the world have OP<sup>7</sup>. In the United States, 10 million people aged 50 years or older have OP<sup>8</sup>. In Spain, there is a 31.8% prevalence<sup>9</sup>. According to estimations from the WHO for 2020, more than 270 million people only in India and China will suffer from OP<sup>10</sup>.

Brazilian population-based studies point out a prevalence that varies from 4.4 to 27.4%, depending on the investigated methodology and age range<sup>6,11,12</sup>. Research developed in other countries has showed factors associated with OP such as OP history in the family, low schooling level, sedentary lifestyle, alcoholic beverage consumption, and diet with poor amount of calcium<sup>13</sup>. In Brazil, few population-based studies have analyzed the factors associated with OP. The factors identified in national studies included, among others: longer time of menopause, bad self-perception of health, arthrosis, problems in balance maintenance, advanced age, and current smoking habit<sup>11,12</sup>. However, Martini et al.<sup>6</sup> assessed that the prevalence and factors associated with OP have not yet been enough elucidated in the Brazilian population.

Given the increasing prevalence of OP together with the fast aging of the population, the serious implications the disease causes to quality of life, the increased risk of fractures, and the lack of Brazilian population-based studies on this disease, this study aimed at analyzing the prevalence and factors associated with self-reported OP in the population of aged subjects who lived in Campinas city, São Paulo state, Brazil, through assessment of the disease association with demographic, socioeconomic, health behavioral, and morbidity factors.

## METHODS

This is a cross-sectional and population-based study that was developed in a sample with noninstitutionalized aged subjects ( $\geq 60$  years), who lived in the urban area of Campinas city, in São Paulo. Data were taken from the Health Household Survey (ISACAMP 2008) that aimed at obtaining information from several health dimensions related to three age domains: adolescents (10 – 19 years), adults (20 – 50 years), and aged ( $\geq 60$  years) subjects.

The minimum amount of people to constitute the sample of each domain was defined considering the situation that was related to the maximum variability for the frequency of studied events ( $p = 0.50$ ), a 95% confidence coefficient in the determination of the confidence intervals ( $z = 1.96$ ), sampling error between 4 and 5 percentage points, and outlining effect equals to 2. Thus, a minimum number of a thousand interviews was established for each age domain.

The survey sample was obtained by means of probabilistic sampling procedures, by conglomerates, and in two stages: censor sector and household. In the first stage, 50 censor

sectors were sorted with a probability in the same proportion to the size (number of households). In the second stage, in order to achieve the necessary size of the sample, 2,150; 700 and 3,900 households were independently sorted to obtain the minimum desired number of adolescents, adults, and aged subjects, respectively.

Information was obtained through a structured questionnaire that was composed of several thematic blocks that included information regarding: morbidity, emotional problems, accidents and violence, quality of life, use of services, preventive practices, use of medications, health-related behaviors, and socioeconomic characteristics. The questionnaires were applied by qualified interviewers through readings, content discussions, and training of questionnaire use with friends and relatives. Activities were monitored throughout the entire period of field research.

Only data from the survey regarding people aged  $\geq 60$  years were used in this study.

The dependent variable that was used in this study was OP self-reported diagnosis, which was achieved through the question: "Has any physician or other health professional told you have OP?" (Yes or no).

The following independent variables were chosen based on the literature and on the ISACAMP 2008 checklist:

- socioeconomic and demographic: gender, age, marital status, schooling, paid job, per capita monthly family income in minimum wage, and possession of health insurance;
- chronic morbidity, referred as diagnosed by a physician or other health professional: hypertension, diabetes, rheumatism/arthritis/arthrosis, asthma/bronchitis/emphysema, tendinitis/reading, and the total number of chronic diseases referred among the nine diseases present in the checklist;
- health problems/symptoms: dizziness, insomnia, and number of health problems mentioned among the 10 health problems present in the checklist;
- occurrence of falls in the last year (reported through the main accident that happened in the last 12 months);
- body mass index (BMI) divided into: low weight ( $\text{BMI} < 22 \text{ kg/m}^2$ ), eutrophic ( $\text{BMI} \geq 22 \text{ kg/m}^2$  and  $\text{BMI} \leq 27 \text{ kg/m}^2$ ), and overweight ( $\text{BMI} > 27 \text{ kg/m}^2$ ), according to recommendations of Lipschitz<sup>14</sup>, who consider the modifications in the body composition of aging itself;
- common mental disorder (CMD), assessed by the Self-Reporting Questionnaire (SRQ 20) with cut point of six or more positive answers<sup>15</sup>;
- health self-assessment divided into excellent/very good, good, and bad/very bad;
- frequency of alcohol consumption divided into: does not drink, drinks one to four times/month and two or more times/week;
- abusive use of alcoholic beverage, assessed by the Alcohol Use Disorder Identification Test (AUDIT) that is composed of 10 questions and identifies the risk of alcohol abuse/dependence when its score (range of 0 – 40) is equal to eight or more<sup>16</sup>;
- smoking divided into: never smoked, former smoker, and current smoker. Former smokers were subjects who mentioned having smoked at least 100 cigarettes at life and had

- stopped consumption; current smokers were those who continued smoking owing to the interview;
- physical activity in leisure and the classification considered active subjects the aged people who practiced at least 150 minutes per week, which was distributed, at least, for 3 days; not enough active those who practiced less than 150 minutes or more than 150 minutes, but in less than 3 days in a week; and nonactive those who did not practice any kind of physical activity of leisure in any day of the week<sup>17</sup>;
  - sleeping hours divided into less than 7; 7 to 8; and more than 9 hours<sup>18</sup>.

Data from the survey were typed in a database that was developed with the use of the software EpiData, version 3.1 (Epidata Assoc., Odense, Denmark) and submitted to consistency assessment. Estimations of prevalence and of 95% confidence intervals (95%CI) were produced for the analyses of this study. Associations between the independent variables and OP were analyzed through the  $\chi^2$ -test. Poisson simple and multiple regression analyses were also applied to estimate the gross and adjusted prevalence ratios (PRs).

The analyses were conducted with the software Stata 11.0 (Stata Corp, Colégio Station, United States) using the *svy* commands that incorporate the needed ponderations owing to the sampling design.

The project of this study received approval of the Ethics Committee from the School of Medical Sciences of *Universidade Estadual de Campinas*, in an addendum to protocol number 079/2007.

## RESULTS

Among the households sorted to obtain the sample of aged subjects, there was a loss of 6.5% owing to the impossibility of finding a resident or the refusal of such resident in enrolling the subjects who lived in the household. Of the aged subjects enrolled in the sorted households and whom should be interviewed, 2.3% refused in participating. Thus, data from 1,419 aged subjects were analyzed in this study.

Of the studied population, 14.8% referred diagnosis of OP, with a pretty higher prevalence of women (22.8%) compared with men (4.4%). Subjects who self-reported black skin color presented lower prevalence of the disease, even after adjustment by gender and age. In subjects aged 80 years or older, OP prevalence was about two times higher than in the age range of 60 to 69 years. The first associations found with marital status, schooling, and paid job lost significance after the adjustment by gender and age (Table 1).

In Table 2, the variable of sleeping hours was associated with OP, presenting a significantly higher prevalence in the segment of less than 7 sleeping hours per day. The frequency of alcohol consumption and dependence, assessed through AUDIT, also presented  $p \leq 0.05$ ; however, the associations lost significance after the adjustments. Table 3 presents the OP prevalence according to morbidity, health problems, fall occurrence, and health self-assessment.

Table 1. Osteoporosis prevalence according to demographic and socioeconomic variables in subjects aged 60 years or older. Health Survey from Campinas city, SP, 2008 – 2009.

Variables	Subjects in the sample n (%)	Osteoporosis prevalence % (95%CI)	p-value	PR (95%CI)	Adjusted PR (gender and age)
<b>Gender</b>					
Male	578 (40.5)	4.4 (3.0 – 6.2)	0.0000*	1	1
Female	841 (59.5)	22.8 (19.2 – 26.7)		5.21 (3.70 – 7.35)	5.02 (3.58 – 7.04)
Total	1419 (100)	14.8 (12.5 – 17.6)			
<b>Skin/race color</b>					
White	1073 (77.4)	16.1 (13.3 – 19.3)	0.0281	1	1
Black	100 (7.1)	5.8 (2.4 – 13.5)		0.36 (0.13 – 0.96)	0.42 (0.18 – 0.97)
Pardo	215 (15.5)	11.8 (7.6 – 17.8)		0.73 (0.44 – 1.19)	0.82 (0.53 – 1.26)
<b>Age (years)</b>					
60 – 69	796 (55.9)	11.7 (9.4 – 14.4)	0.0002	1	1
70 – 79	462 (32.8)	16.5 (12.6 – 21.3)		1.41 (1.02 – 1.94)	1.35 (1.00 – 1.83)
≥ 80	161 (11.3)	25.7 (19.1 – 33.6)		2.20 (1.53 – 3.15)	1.99 (1.43 – 2.76)
<b>Marital status</b>					
Married	806 (56.8)	10.9 (8.3 – 14.4)	0.0000	1	1
Widowed	413 (29.0)	24.0 (19.4 – 29.3)		2.19 (1.57 – 3.05)	1.13 (0.78 – 1.63)
Other	200 (14.2)	12.2 (8.3 – 17.7)		1.11 (0.71 – 1.74)	0.80 (0.50 – 1.27)
<b>Schooling (in years)</b>					
0 – 3	500 (35.2)	18.8 (14.7 – 23.6)	0.0030	1	1
4 – 11	583 (41.2)	15.1 (11.8 – 19.7)		0.80 (0.58 – 1.09)	0.92 (0.68 – 1.25)
≥ 12	335 (23.6)	9.0 (5.8 – 13.6)		0.48 (0.30 – 0.76)	0.67 (0.42 – 1.08)
<b>Paid job</b>					
No	1109 (78.3)	16.7 (14.1 – 19.7)	0.0001	1	1
Yes	309 (21.7)	8.3 (5.8 – 11.9)		0.49 (0.35 – 0.70)	0.89 (0.61 – 1.29)
<b>Per capita income in MW</b>					
< 0.5	220 (15.8)	14.6 (10.7 – 19.5)	0.9610	1	1
0.5 – 1	346 (24.2)	14.9 (10.9 – 20.9)		1.02 (0.65 – 1.60)	1.00 (0.67 – 1.56)
1 – 4	689 (48.5)	14.5 (11.9 – 17.7)		0.99 (0.67 – 1.47)	1.05 (0.69 – 1.60)
> 4	164 (11.5)	16.1 (9.0 – 27.3)		1.10 (0.53 – 2.31)	1.33 (0.67 – 2.64)
<b>Health insurance</b>					
Yes	668 (47.2)	16.6 (13.0 – 20.9)	0.0966	1	1
No	748 (52.8)	13.0 (10.6 – 15.9)		0.78 (0.58 – 1.05)	0.87 (0.65 – 1.18)

PR: prevalence ratio; 95%CI: 95% confidence interval; \*p in the  $\chi^2$ -test; MW: minimum wage.

Table 2. Osteoporosis prevalence according to behaviors associated with health in subjects aged 60 years or older. Health Survey from Campinas city, SP, 2008 – 2009.

Variables	Subjects in the sample n (%)	Osteoporosis prevalence % (95%CI)	p-value	PR (95%CI)	Adjusted PR (gender and age)
<b>Alcohol consumption</b>					
Does not consume	989 (69.2)	16.9 (14.1 – 20.1)	0.0029	1	1
1 to 4 x/month	299 (20.9)	11.7 (8.4 – 16.2)		0.69 (0.51 – 0.94)	0.89 (0.67 – 1.18)
2 or +/week	141 (9.9)	8.2 (4.8 – 13.8)		0.48 (0.27 – 0.85)	1.23 (0.69 – 2.20)
<b>Milk consumption</b>					
Every day	937 (66.3)	15.9 (13.0 – 16.2)	0.3879	1	1
1 – 6 days/week	225 (15.8)	11.0 (6.7 – 15.8)		0.06 (0.41 – 1.03)	0.36 (0.56 – 1.24)
< 1 x/week	55 (3.9)	13.2 (6.3 – 27.9)		0.77 (0.35 – 2.15)	0.95 (0.47 – 2.01)
< 1 x/month	75 (5.2)	12.4 (6.3 – 22.9)		0.50 (0.37 – 1.61)	0.92 (0.55 – 1.92)
Does not consume	126 (8.8)	14.9 (12.5 – 17.6)		0.76 (0.63 – 1.85)	0.36 (0.76 – 2.01)
<b>AUDIT</b>					
Nondependent	1371 (95.9)	15.4 (12.8 – 18.3)	0.0240	1	1
Dependent	59 (4.1)	3.6 (0.9 – 13.8)		0.23 (0.03 – 1.63)	0.73 (0.16 – 3.18)
<b>Smoking</b>					
Never smoked	963 (68.0)	15.9 (13.2 – 19.3)	0.2930	1	1
Former smoker	289 (20.4)	11.8 (8.0 – 16.9)		0.74 (0.50 – 1.09)	1.24 (0.84 – 1.84)
Current smoker	166 (11.6)	14.3 (9.2 – 21.6)		0.89 (0.55 – 1.45)	1.33 (0.84 – 2.12)
<b>Physical activity in leisure</b>					
Nonactive	954 (65.3)	14.7 (12.3 – 17.4)	0.9309	1	1
Not enough active	156 (12.6)	15.8 (10.8 – 22.5)		1.08 (0.72 – 1.60)	1.09 (0.74 – 1.60)
Active	309 (22.1)	14.8 (10.2 – 21.0)		1.01 (0.69 – 1.46)	1.20 (0.84 – 1.70)
<b>Sleeping hours</b>					
7 – 8	796 (56.5)	12.6 (9.8 – 15.9)	0.0304	1	1
< 7	318 (22.7)	19.1 (14.9 – 23.9)		1.51 (1.08 – 2.12)	1.43 (1.04 – 1.97)
≥ 9	292 (20.8)	15.7 (11.6 – 20.9)		1.24 (0.88 – 1.75)	1.22 (0.86 – 1.71)

PR: prevalence ratio; 95%CI: 95% confidence interval; AUDIT: Alcohol Use Disorder Identification Test.

Table 3. Osteoporosis prevalence according to morbidity, health problems, fall occurrence, and health self-assessment in subjects aged 60 years or older. Health Survey from Campinas city, SP, 2008 – 2009.

Variables	Subjects in the sample n (%)	Osteoporosis prevalence % (95%CI)	p-value	PR (95%CI)	Adjusted PR (age and gender)
<b>Morbidity</b>					
Hypertension	759 (53.6)	18.4 (15.7 – 21.4)	0.0035	1.68 (1.17 – 2.42)	1.40 (0.99 – 1.98)
Diabetes mellitus	306 (21.9)	16.5 (11.8 – 22.5)	0.3983	1.15 (0.82 – 1.60)	1.09 (0.81 – 1.48)
Rheumatism/ arthritis/arthrosis	369 (26.5)	31.9 (26.6 – 37.7)	0.0000	3.59 (2.58 – 5.00)	2.82 (1.99 – 3.98)
Asthma/bronchitis/ emphysema	87 (6.2)	28.8 (18.8 – 41.3)	0.0013	2.06 (1.36 – 3.11)	1.75 (1.22 – 2.51)
Tendinitis	72 (5.3)	28.8 (19.1 – 40.9)	0.0011	2.05 (1.37 – 3.06)	1.76 (1.18 – 2.62)
<b>Number of morbidities</b>					
None	289 (20.4)	3.6 (2.1 – 6.1)	0.0000	1	1
1 – 2	706 (50.0)	13.5 (10.8 – 16.7)		3.75 (2.19 – 6.41)	3.07 (1.80 – 5.23)
≥ 3	417 (29.6)	24.7 (20.1 – 30.1)		6.88 (3.94 – 12.02)	4.83 (2.69 – 8.64)
<b>Health problems</b>					
Dizziness	272 (19.3)	21.2 (16.3 – 27.2)	0.0054	1.59 (1.15 – 2.20)	1.44 (1.05 – 1.98)
Insomnia	323 (22.9)	25.1 (20.5 – 30.2)	0.0000	2.10 (1.66 – 2.65)	1.68 (1.34 – 2.11)
<b>Number of health problems</b>					
None	384 (26.9)	6.6 (4.0 – 10.6)	0.0000	1	1
1 – 2	696 (48.8)	13.7 (11.5 – 16.3)		2.08 (1.29 – 3.34)	1.89 (1.20 – 2.99)
≥ 3	339 (24.3)	26.9 (22.3 – 32.0)		4.08 (2.49 – 6.69)	3.09 (1.97 – 4.85)
Common mental disorder (SRQ20)	232 (16.5)	24.2 (19.6 – 29.4)	0.0000	1.85 (1.45 – 2.37)	1.61 (1.25 – 2.06)
<b>BMI (kg/m<sup>2</sup>)</b>					
Eutrophic (BMI ≥ 22 and BMI ≤ 27)	643 (45.2)	11.7 (9.2 – 14.8)	0.0071	1	1
Low weight (BMI < 22)	237 (16.6)	17.1 (12.3 – 23.2)		1.45 (1.02 – 2.07)	1.21 (0.86 – 1.70)
Overweight (BMI > 27)	539 (38.2)	17.7 (14.4 – 21.5)		1.51 (1.17 – 1.94)	1.27 (1.00 – 1.61)
<b>Health self-assessment</b>					
Excellent/very good	347 (24.2)	8.8 (6.1 – 12.5)	0.0000	1	1
Good	927 (64.7)	14.4 (11.7 – 17.4)		1.63 (1.14 – 2.32)	1.50 (1.07 – 2.09)
Bad/very bad	158 (11.1)	31.7 (24.9 – 39.3)		3.59 (2.44 – 5.29)	3.43 (2.40 – 4.90)
Fall	87 (6.3)	29.9 (22.3 – 38.6)	0.0000	2.15 (1.62 – 2.85)	1.53 (1.14 – 2.05)

PR: prevalence ratio; 95%CI: 95% confidence interval; SRQ20: Self Reporting Questionnaire; BMI: body mass index.



Among the analyzed diseases, we found a significantly higher prevalence for those subjects diagnosed with rheumatism/arthritis/arthrosis, asthma/bronchitis/emphysema, and tendinitis even after adjustment by age and gender.

With regard to the reported health problems, significant associations were seen for dizziness and insomnia, even after adjustments. The CMD, which is also presented in this Table, and the BMI > 27 kg/m<sup>2</sup> category presented a PR = 1.61 (95%CI 1.25 – 2.06) and PR = 1.27 (95%CI 1.00 – 1.61) after adjustments by age and gender (Table 3).

The occurrence of falls in the last 12 months and health self-assessment also presented significant associations after adjustments. Subjects who assessed health as bad/very bad presented a PR = 3.43 (95%CI 2.40 – 4.90), and, in those who reported falls, the PR = 1.53 (95%CI 1.14 – 2.05) (Table 3).

Another analyzed aspect was the total amount of chronic morbidity and of reported health problems. It was seen that the OP prevalence increases based on the higher number of reported morbidity and health problems (Table 3).

## DISCUSSION

Results showed in this study are based on the self-report of an aged subject, who claims being diagnosed with OP by a physician or other health professional. The highest prevalence of the disease was found in older female subjects who self-reported being white-skinned, on aged subjects with rheumatism/arthritis/arthrosis, asthma/bronchitis/emphysema, tendinitis, dizziness, insomnia, CMD, and overweight (BMI > 27 kg/m<sup>2</sup>), and in those who reported sleeping less than 7 hours per day.

The growing increase of OP prevalence with aging found in this study was also seen in the investigations of Martini et al.<sup>6</sup> and Baccaro et al.<sup>12</sup>. It is known that, throughout life, the human skeleton suffers a continuous process of reabsorption and renovation of the bone tissue called bone remodeling, which is directly related to homeostasis of calcium and phosphorus<sup>19</sup>. Children and adolescents present a gradual increase of the bone tissue with predominance of bone formation regarding reabsorption. Around 20 years old, swaying between bone loss and formation changes, people start to lose more bone mass than to form it. In the midlife, this speed of bone loss becomes even higher, thus contributing to the OP development<sup>19</sup>.

Women presented an OP prevalence much higher compared with men. It is known that menopause is a determining factor. After menopause, the circulating estrogen hormone levels decrease, which lead to an activation of bone remodeling cycles, with predominance in the phases of reabsorption regarding formation, with consequent decrease of bone mass<sup>20</sup>.

Another association was between self-reported skin color and OP. Black-colored subjects presented a lower prevalence of the disease compared with white-colored ones. This fact might be associated with a higher renal reabsorption of calcium and a higher resistance to the reabsorption action of the parathyroid hormone (PTH) that is present in black-colored

subjects, which contributes to a higher accumulation of bone mass<sup>21</sup>. Some studies also point out that factors related to bone geometry and muscle strength could also be associated with lower occurrence of OP<sup>22,23</sup>. Nelson et al.<sup>23</sup> report that black women in general have a longer and narrower femur and smaller medullary cavities than white women, which contributes to higher bone mineral deposition and higher mechanic resistance.

Among the analyzed diseases, higher OP prevalence was found among subjects diagnosed with rheumatism/arthritis/arthrosis<sup>24</sup>. About 30 to 50% of the patients with rheumatoid arthritis develop OP, thus the result is an important increase in the number of fractures. The OP pathogenesis in the rheumatoid arthritis is multifactorial, and the factors that cause its appearance include the reduced mobility that these patients commonly present, time of disease, use of corticosteroids, and the lack of estrogen in women or of testosterone in men of older ages<sup>25</sup>. The persistent inflammatory activity also causes a higher bone reabsorption secondarily to the effects of IL-1 and IL-6, and TNF- $\alpha$  proinflammatory cytokines present in larger amounts in arthritis patients<sup>26</sup>.

Subjects with asthma/bronchitis/emphysema also showed a higher significant prevalence of OP in this study. Clinical and population-based studies also evidenced this association<sup>27,28</sup>. However, OP causative factor in patients with chronic obstructive pulmonary disease is complex, and many factors, such as low pulmonary function and use of corticosteroids, might contribute to its pathogenesis<sup>29</sup>.

The association between CMD and OP was also confirmed in other population-based studies<sup>30,31</sup>. Cizza et al.<sup>32</sup> suggest that many endocrine alterations that were seen during the depressive condition induce to bone loss. Schweiger et al.<sup>33</sup> emphasize this association might be owing to a hormone dysregulation of the hypothalamic-pituitary adrenergic system.

Subjects with sleeping disorders such as insomnia and short sleep (less than 7 hours a day) also showed a higher prevalence of OP in this study, even after adjustments by gender and age. Fu et al.<sup>34</sup>, in their study on the association between sleep duration and bone mineral density in Chinese women, also proved this association. It is known that an inappropriate sleep affects a healthy aging; however, the specific effects of this kind of sleep regarding bone metabolism are still unknown and limited<sup>34,35</sup>.

Dizziness as an isolated factor was also analyzed in this study. It was associated with OP, similarly to what was seen in other studies<sup>36,37</sup>. According to Jeong et al.<sup>36</sup>, the cause might be related to the decrease in the absorption of calcium, which is a nutrient used to form calcium carbonate crystals that move sensors inside the internal ear and are responsible for balance perception.

Overweight (BMI > 27 kg/m<sup>2</sup>), traditionally seen as an OP protective factor<sup>38,39</sup>, showed to be associated with higher OP prevalence in this study. Recent studies indicate that excessive fat might not protect human beings from OP, and it is indeed associated with low bone mineral density<sup>40,41</sup> and increases the risk of fractures<sup>40,42</sup>. Researchers report that a possible explanation for this association is the fact of derivation of osteoblasts (bone-making cells) and adipocytes (energy storage cells) being from the same mesenchymal staminal cell<sup>43</sup> and that the increase of fat content in the bone medulla would make the bone weaker<sup>44</sup>.

Bredella et al.<sup>45</sup> investigated the associations between the ectopic lipid levels, the serum lipid levels, and the bone medulla fat in obese men and women and found a positive correlation regardless the BMI, age, insulin resistance, and exercise status (number of hours of vigorous exercise per week).

Another studied association was health self-assessment. It was seen that those who considered health as bad and very bad presented a higher prevalence of OP. It is worth mentioning that health self-assessment is a valid and relevant indicator of the health condition of subjects and populations. It produces a global self-classification of the subject, considering signals and symptoms of diseases (diagnosed or not by health professionals), besides assessing the impact of such conditions on the physical, mental, and social welfare<sup>46</sup>.

The association seen among subjects with OP and the occurrence of falls was also observed in this study and in another research<sup>11,47</sup>. According to Arnold et al.<sup>48</sup>, this association is associated with the consequences created by OP, such as decrease of trunk musculature strength, kyphosis, alteration of movement amplitude and motor coordination, situations that favor falls, fractures<sup>49</sup>, and limitation of everyday activities.

The results of this study showed the high prevalence of OP in aged subjects from Campinas, São Paulo and the association of the disease with several health morbidities, problems, and conditions. Comprehension and discussion of results should consider some limitations.

The first one refers to the information about the presence of OP being referred without confirmation of bone densitometry examination diagnosis, which might have underestimated the disease prevalence. Another limitation lies on the fact that this is a cross-sectional study, which does not allow inferring about the association causality.

We should also consider that this study used data from a health survey with wide thematic scope, which is not specifically directed to the OP theme; therefore, there are not more details regarding the disease and some factors such as sun exposure and fractures. Brazilian population-based studies involving prevalence and associated factors with OP in aged subjects are still rare in literature; thus, it does not enable better discussions.

## CONCLUSION

This study, through the identification of OP-associated factors, points some segments of aged subjects who are more susceptible to the disease. Among them, some stand out, such as: female gender, white-colored skin, older subjects, those with rheumatism/arthritis/arthrosis, asthma/bronchitis/emphysema, tendinitis, dizziness, CMD, and other less studied and seen in this study such as short sleep, insomnia, and overweight (BMI > 27 kg/m<sup>2</sup>).

The presence of these characteristics should warn health professionals, caregivers, and relatives to give a special attention to control OP and its consequences. It is worth mentioning that, by identifying these factors associated with OP, this study contributes to a better planning of public policies and health programs to the aged population.

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