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# Prevalence of back pain, functional disability, and spinal postural changes

*Dor nas costas, incapacidade funcional e alterações posturais na coluna vertebral*

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## Abstract

**Objective**: To evaluate the prevalence of back pain, disability, and postural changes in the spines of adults of different ages and with different levels of body mass index (BMI). **Methodology**: A total of 534 users of the Brazilian Public Health System in Porto Alegre, Brazil, were included in the study. An evaluation of the thoracic and lumbar spine was performed using the Flexicurve instrument. Data was analyzed using descriptive statistics and the calculation of prevalence ratios (PR) and their respective confidence intervals of 95% (CI 95%). Three analyses were performed with the dependent variables pain, functional disability, and posture. **Results**: A significant association between pain and female gender (p = 0.000), and pain and change in the lumbar spine (p = 0.014) were found. The variable disability was associated with BMI (p =

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0.004) and age (p = 0.001). When we analyzed postural change, an association was found only with age group (p = 0.032). **Conclusion**: These findings highlight the need for prevention and primary care educational programs aimed at reducing postural aberrations in the adult population.

**Keywords**: Epidemiology. Spine. Evaluation. Back Pain. Functioning.

***Resumo***

***Objetivo****: Avaliar a prevalência de dor nas costas, incapacidade funcional e alterações posturais na coluna vertebral em indivíduos adultos de diferentes faixas etárias e com diferentes níveis de IMC.* ***Metodologia****: Participaram da pesquisa 534 usuários de um distrito do Sistema Único de Saúde (SUS) da cidade de Porto Alegre, Brasil. A avaliação da coluna vertebral torácica e lombar foi realizada utilizando-se o instrumento flexicurva. A dor nas costas e a incapacidade foram avaliadas por questionário. Os dados foram analisados a partir de estatística descritiva e do cálculo das Razões de Prevalência (RP) e seus respectivos intervalos de confiança de 95% (IC95%). Foram realizados três tipos de análises com as variáveis dependentes: dor, incapacidade funcional e postura.* ***Resultados****: Foi encontrada associação significativa entre dor e sexo feminino (p = 0,000) e dor e alteração na coluna lombar (p = 0,014). A variável incapacidade esteve associada com o IMC (p = 0,004) e com a idade (p = 0,001). Quando se analisou a alteração postural, encontrou-se associação significativa somente com a idade (p = 0,032).* ***Conclusão****: Estes achados evidenciam a necessidade de prevenção e inserção na atenção primária de programas de educação postural visando à redução desses acometimentos na população de adultos.*

***Palavras-chave****: Epidemiologia. Coluna vertebral. Avaliação. Dor nas costas. Funcionalidade.*

## Introduction

A full appreciation of body posture should consider biomechanical, psychosocial, and psychological parameters or a combination of these. The conformation of backbone structures is not only determined by genetics; rather, posture is constructed and can be changed throughout life according to postural habits and the lifestyle of the individual (1). In this sense, there are many factors that can influence postural changes, and these are present in all age groups (2). In our study, we choose to focus on the incorrect postures adopted for long periods of time when people are in school, at work, and at leisure (3). Indeed, sedentary lifestyles are highly prevalent in modern society and can cause decreased strength and muscle shortening, which usually generate postural compensations and obesity. Physical inactivity influences posture due to decreased stability and the increased requirement for mechanical adaptations (4).

A wide range of studies highlight the postural characteristics of children and adolescents, although there are fewer studies regarding the elderly (5). Moreover, information about the posture of adults is scarce in the literature and, when found, makes references to specific situations, such as the influence of the use of high-heeled shoes on posture (6) or postural changes due to pregnancy (7). The effects of postural changes appear to be one of the leading causes of disability retirement in Brazil according to the National Institute of Social Security (INSS) (8). Furthermore, musculoskeletal system diseases were the leading cause of sickness benefits granted to workers in Porto Alegre in 1998, followed by mental disorders and cardiovascular disease (9). This highlights the need for research to characterize the postural profile of the economically active population so that programs or public health policies aimed at educational and preventive work can be developed. Such programs or policies would have the potential to reduce the costs associated with early retirement due to disability, absenteeism from work, and other expenses related to the treatment of postural conditions. Thus, understanding the changes that may occur in body posture, particularly with respect to the spine, in all stages of the human lifecycle represents an interesting strategy. It could help to focus the efforts of programs aimed at health promotion or the prevention of diseases, with special emphasis on their inclusion in primary health care, especially workers' health.

Therefore, this study aims to show the prevalence of pain, postural changes, and functional impairment in users of the Brazilian Public Health System (known as *Sistema Único de Saúde* – SUS) in Porto Alegre, RS, Brazil. Secondly, the study aims to show whether or not these prevalence rates are associated with different age groups and BMI classifications.

## Methodology

### Sample

This epidemiological study was conducted among the population in the regional health district of Glória/Cruzeiro/Cristal, located in the city of Porto Alegre, Brazil, and registered with the Santa Teresa, São Gabriel, and Santa Anita Family Health Strategy (FHS) units of SUS.

A sample size calculation was performed in the stratified sampling process to determine the number of individuals who should participate in the study. This number was proportional to the number of individuals in each FHS. Thus, the proportion of the size of each part of the FHS population was maintained so that each member of the population had the same probability of belonging to the sample. The calculation was done using the software program WINPEPI and had a significance level of 0.05 and power of 95% prediction. This was based on the size of the population being assessed and the average values and standard deviation of the reported bends, thoracic, and lumbar angles. Knowing the potential for sample losses and refusals, 534 SUS users over 18 years of age of both genders were invited to participate in the study. However, the final study sample comprised 393 individuals: 135 from FHS Santa Teresa, 130 São Gabriel, and 128 Santa Anita.

Participants had to be over 18 years of age and registered with the FHS in order to be included in the study. The exclusion criteria were the inability of an individual to remain standing and any previous surgery on the spine. All participants were volunteers and signed an informed consent form (ICF). This study was approved by the Ethics Committee of the Universidade Federal do Rio Grande do Sul which is bound under number 2008218, and by the Research Ethics Committee of the Municipality of Porto Alegre.

### Data collection

The study was performed at the headquarters of the FHS Santa Teresa, Santa Anita, and São Gabriel, which belong to the regional health district Glória/Cruzeiro/Cristal, Porto Alegre, between May 2010 and May 2011.

Initially, FHS users who came to the premises of the FHS for any reason (from medical consultations to simple searches for information or patient monitoring) were invited to participate in the study. Those who agreed after having the objectives of the study explained and signing the ICF were referred to an evaluation room on the premises of the FHS.

The evaluation of the study subjects consisted of: (1) an evaluation of the spine using the a flexicurve instrument (Trident®), (2) measurement of body mass using a balance (Brand Leader, Model P180M), (3) measurement of height using a stadiometer (Brand CauMaq, portable), (4) measurement of waist and hip dimensions using a tape measure with a precision of 1 mm, (5) assessment of pain by means of a questionnaire specifically developed for this study, and (6) an evaluation of functional disability through the Roland Morris Questionnaire, previously validated for use in Brazil (10). The average assessment time per user was 15 minutes.

The Flexicurve comprises a flexible metal strip covered with plastic, which is 80 cm length and has a scale with a precision of 1 mm. It can be molded to the back of an individual in order to replicate the shape of the spinal column. Some studies have indicated the validity and reproducibility of Flexicurve protocols that involve the measurement of the thoracic and lumbar curvature of the spine (11), signifying that it is appropriate for the evaluation of large populations.

To evaluate the Flexicurve, each user was instructed to remain upright with his or her knees straight, feet parallel, and shoulder and elbow at 90° of flexion. The spinous processes of vertebrae C7, T1, T12, L5, and S1 were identified by palpation. A flexible ruler was then placed on the C7 spinous process, being molded to the shape of the curvature of the spine to the S1 spinous process (Fig. 1a). Immediately thereafter, the Flexicurve was removed and its outline was traced on graph paper (Fig. 1b), thus representing the thoracic and lumbar curvatures in the sagittal plane, with the spinous processes of interest identified (11).

This data was entered into the third order polynomials, which were adjusted to represent the shape of the thoracic and lumbar curvatures, and from the trigonometric relation, to provide the Flexicurve Angle (FA) for each curve (11).

The classification of thoracic spine parameters proposed by Bernhardt and Bridwell (1989) (12) were used in this study. Posture is considered normal when the thoracic curvature angle values vary between 20° and 60°. When the curvature value is higher than 60°, it is classified as "kyphosis posture", and when the value of the curvature is less than 20°, it is classified as "upper back straight posture". For the classification of the lumbar spine benchmarks, the normal range was between 22° and 54° (13). Therefore, we used the classification of "lordotic posture" when the curvature value was greater than 54° and "flat-back posture" when it was less than 22°. Still, in order to further statistically analyze the association between the independent and dependent variables, the classifications of spinal curvatures were grouped into two categories: (1) subjects with changes in the spine (presence of any thoracic and/or lumbar postural changes) and (2) subjects without alteration of the spine (no thoracic and/or lumbar postural changes in the spine).

Data on body mass (kg) and height (m) were used to calculate body mass index (BMI, $kg/m^2$). Data from subjects' waist (cm) and hip (cm) circumferences were used to calculate the waist-hip ratio (WHR). Using the BMI classification proposed by the World Health Organization (14), individuals were classified as slim and normal (BMI below 18.5, and between 18.5 and 24.99, respectively), overweight (BMI between 25 and 29.99), and obese (BMI at or above 30). In addition, subjects were stratified by age group according to the classification proposed by Papalia et al. (2006) (15): teenagers (18 to 20 years), young adults (between 18 and 40 years), middle-aged adults (between 41 and 60 years), and the elderly (61 years and older).

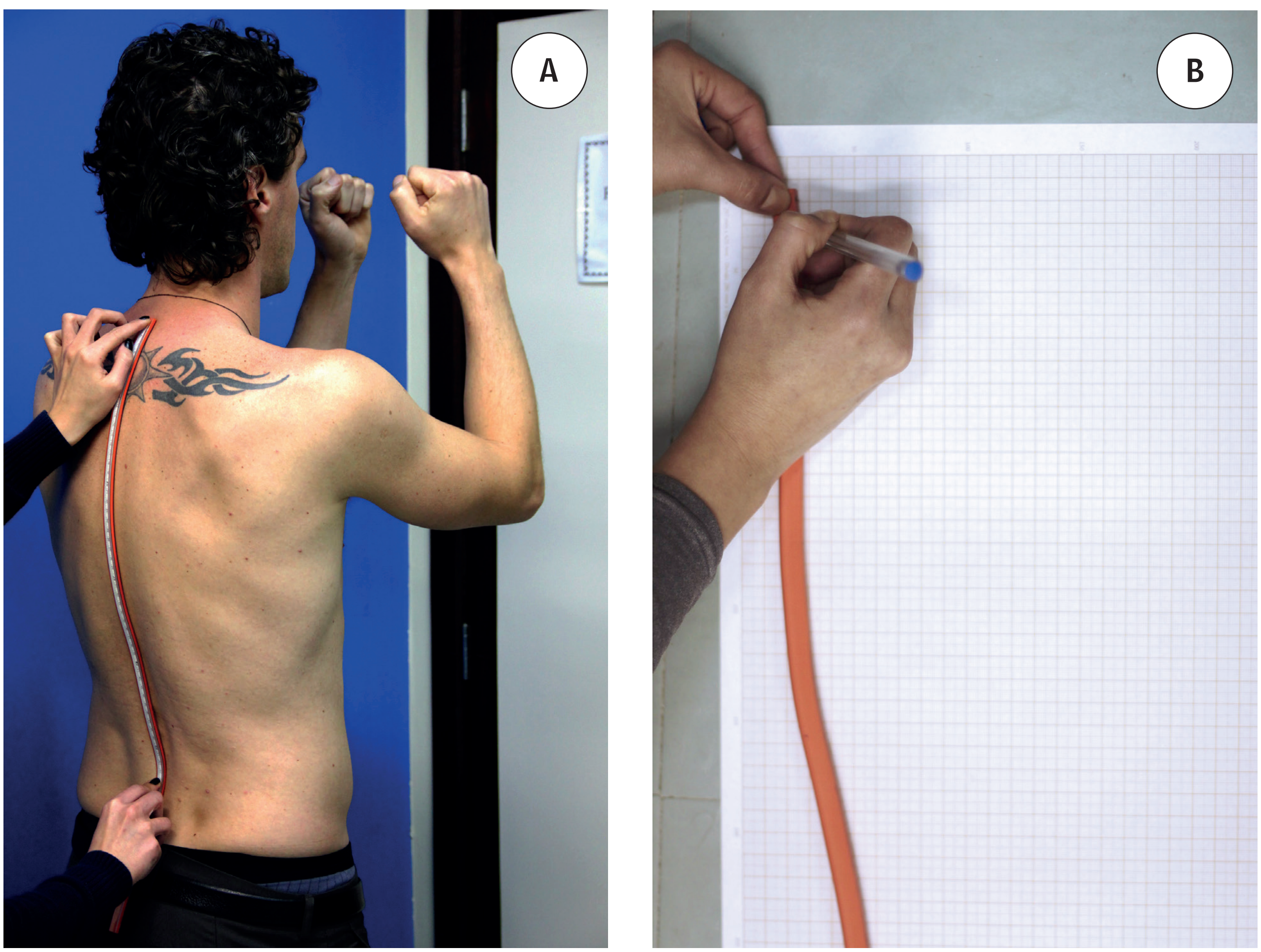


**Figure 1** - (a) Mold of the spine with the Flexicurve, (b) Flexicurve mold was traced on graph paper.

For the evaluation of back pain, subjects answered a questionnaire that sought information about the presence or absence of back pain in the previous three-month period, as well as the location of this pain as illustrated in a drawing. To evaluate functional disability, subjects responded to the Roland Morris Questionnaire, which is specific for individuals with low back pain. It consists of 24 questions related to activities of daily living, pain, and function (10). Each question scores one for each statement the subject agrees with and zero for each statement he or she disagrees with. The minimum score is zero and the maximum score attainable is 24 points. The closer the score is to the maximum score, the greater the disability. Whereas this questionnaire has a cutoff score of 14 (10), subjects were classified as having "no disability" if they presented scores below 14 and "functional disability" if their scores were greater than or equal to 14.

### Statistical Treatment

Data from the descriptive statistics and the calculation of prevalence ratios (PRs) and their respective confidence intervals of 95% (CI 95%) was analyzed using the Statistical Package for Social Sciences (SPSS), version 19.0. The PRs were calculated through a multivariate analysis from the Poisson regression model with robust variance. There were three tests, of which the first, the dependent variable, was pain, and the independent variables were BMI, gender, age group, and postural changes. In the second analysis, which included only subjects who reported pain, the dependent variable was functional disability, and the independent variables were BMI, gender, age group, and postural changes. In the third analysis, the dependent variable was posture, and the independent variables were BMI, gender, and age group.

## Results

The average age of the male subjects (n = 95) was 45.26 + 16.81 years with a body mass of 77.27 + 14.94 kg, height 1.70 + 0.19 m, BMI 26.43 + 3.93 kg/m$^2$ and WHR 0.89 + 0.1. The average age of the female subjects (n = 439) was 47.73 + 16.19 years with a body mass of 69.10 + 13.78 kg, height 1.56 + 0.23 m, BMI 27.14 +5.19 kg/m$^2$, and WHR of 0.85 + 0.41.

When all the subjects (n = 534) were included in the analysis, the prevalence of the presence of pain was 82.9%. In terms of BMI, approximately 60% of subjects were classified as overweight or obese. In relation to postural changes, the results showed that most subjects did not show a change in thoracic (91.5%) and lumbar (84.3%) curvature. In the first multivariate analysis, where pain was the dependent variable, it was associated with the female gender and the occurrence of changes in lumbar curvature (Table 1). Some sample loss occurred due to refusals or non-attendance on the days of collection, so there was a variation in the total sample.

**Table 1** - Results of association ($\chi^2$) and prevalence ratios for variable back pain and the following variables: BMI, gender, age group, and thoracic, lumbar, and overall posture classification

(to be continued)

| | | | Back pain | | | |
|---|---|---|---|---|---|---|
| | Variable | % | No. | % | $\chi^{2a}$ | PR (CI 95%) |
| BMI (n = 498) | | | | | | |
| Slim and normal | 200 | 40.2% | 164 | 82% | | 1 |
| Overweight | 167 | 33.5% | 134 | 80.2% | 0.243 | 0.99 (0.95 – 1.0) |
| Obese | 131 | 26.3% | 114 | 87% | | 1.03 (0.99 – 1.07) |
| Gender (n = 534) | | | | | | |
| Male | 95 | 17.8% | 63 | 66.3% | 0.000 | 1 |
| Female | 439 | 82.2% | 380 | 86.6% | | 1.12 (1.06 – 1.19) |

**Table 1** - Results of association (χ²) and prevalence ratios for variable back pain and the following variables: BMI, gender, age group, and thoracic, lumbar, and overall posture classification

(conclusion)

| | | | Back pain | | | |
|---|---|---|---|---|---|---|
| | Variable | % | No. | % | $\chi^{2a}$ | PR (CI 95%) |
| **Age group (n = 529)** | | | | | | |
| Young adults | 174 | 32.9% | 143 | 82.2% | | 1 |
| Middle-aged adults | 244 | 46.1% | 210 | 86.1% | 0.150 | 1.02 (0.98 – 1.06) |
| Elderly | 111 | 21% | 86 | 77.5% | | 0.97 (0.92 – 1.03) |
| **Thoracic classification (n = 528)** | | | | | | |
| Normal | 483 | 91.5% | 402 | 83.2% | 0.402 | 1 |
| Alteration | 45 | 8.5% | 35 | 77.8% | | 0.97 (0.90 – 1.04) |
| **Lumbar classification (n = 528)** | | | | | | |
| Normal | 445 | 84.3% | 361 | 81.3% | 0.014[b] | 1 |
| Alteration | 83 | 15.7% | 76 | 90.5% | | 1.05 (1.01 – 1.09) |
| **Overall posture classification (n = 528)** | | | | | | |
| Normal | 407 | 77.1% | 333 | 81.8% | 0.261 | 1 |
| Alteration | 121 | 22.9% | 104 | 86% | | 1.02 (0.98 – 1.06) |

Note: [a] Multivariate analysis of each variable in the model. Wald chi-square test. [b] Statistically significant association of the variable in the model ($p < 0.05$).

Functional disability was present in 27.7% (n = 123) of subjects with back pain (n = 443) who answered the Roland Morris Questionnaire. The highest prevalence of disability was found in obese subjects (38.6%), followed by overweight subjects (23.9%) and thin/normal (20.7%) subjects. Notwithstanding, the middle-aged adults presented with the highest prevalence of disability (35.7%), followed by the elderly (29.1%) and young adults (15.4%) (Table 2). With respect to the prevalence of spinal changes in subjects suffering from back pain, there was a prevalence of disability in 34.3% of the subjects with changes in thoracic curvature, 26.7% with changes in lumbar curvature, and 29.8% with changes in general posture. The results of the second multivariate analysis demonstrated that functional disability was associated with BMI (obese subjects had a higher prevalence ratio) and age group (middle-aged adults reported the most of such disability) (Table 2).

Postural change was found in 22.7% (n = 120) of subjects, and of these, 86% (n = 104) complained of back pain. The highest prevalence of postural changes was found in lean and normal individuals (26.4%), followed by overweight (22.4%) and obese (20.2%) subjects. Women showed more postural changes (27.4%) than men (21.8%), and in terms of age, the elderly had a higher prevalence of abnormalities (32.1%). In the third multivariate analysis in which postural change was the dependent variable, there was only an association with age group in that the elderly had a higher prevalence (32.1%) compared to the other age groups (Table 3).

**Table 2** - Results of association ($\chi^2$) and prevalence ratios for variable disability and the following variables: BMI, gender, age group, and thoracic, lumbar and overall posture classification

| Variable | No. | % | Disability | | $\chi^{2a}$ | PR (CI 95%) |
|---|---|---|---|---|---|---|
| | | | No. | % | | |
| **BMI (n = 412)** | | | | | | |
| Slim and normal | 164 | 39.8 | 34 | 20.7 | | 1 |
| Overweight | 134 | 32.5 | 32 | 23.9 | 0.004[b] | 1.02 (0.94 – 1.11) |
| Obese | 114 | 27.3 | 44 | 38.6 | | 1.14 (1.05 – 1.24) |
| **Gender (n = 443)** | | | | | | |
| Male | 63 | 14.2 | 15 | 23.8 | 0.402 | 1 |
| Female | 380 | 85.8 | 108 | 28.4 | | 1.04 (0.94 – 1.13) |
| **Age group (n = 439)** | | | | | | |
| Young adults | 143 | 32.6 | 22 | 15.4 | | 1 |
| Middle-aged adults | 210 | 47.8 | 75 | 35.7 | 0.001[b] | 1.17 (1.09 – 1.26) |
| Elderly | 86 | 19.6 | 25 | 29.1 | | 1.12 (1.02 – 1.22) |
| **Thoracic classification (n = 437)** | | | | | | |
| Normal | 402 | 92 | 110 | 27.4 | 0.386 | 1 |
| Alteration | 35 | 8 | 12 | 34.3 | | 1.05 (0.93 – 1.19) |
| **Lumbar classification (n = 437)** | | | | | | |
| Normal | 362 | 82.8 | 102 | 28.2 | 0.811 | 1 |
| Alteration | 75 | 17.2 | 20 | 26.7 | | 0.98 (0.91 – 1.07) |
| **Overall posture classification (n = 437)** | | | | | | |
| Normal | 333 | 76.2 | 91 | 27.3 | 0.601 | 1 |
| Alteration | 104 | 23.8 | 31 | 29.8 | | 1.02 (0.94 – 1.11) |

Note: [a] Multivariate analysis of each variable in the model. Wald chi-square test. [b] Statistically significant association of the variable in the model ($p < 0.05$).

**Table 3** - Results of association ($\chi^2$) and prevalence ratios for variable posture changes and the following variables: BMI, gender, and age group

(to be continued)

| Variable | No. | % | Postural alteration | | $\chi^{2a}$ | PR (CI 95%) |
|---|---|---|---|---|---|---|
| | | | No. | % | | |
| **BMI (n = 491)** | | | | | | |
| Slim and normal | 197 | 40.1% | 52 | 26.4% | | 1 |
| Overweight | 165 | 33.6% | 37 | 22.4% | 0.399 | 0.98 (0.933 – 1.01) |
| Obese | 129 | 26.3% | 26 | 20.2% | | 0.97 (0.93 – 1.01) |

**Table 3** - Results of association ($\chi^2$) and prevalence ratios for variable posture changes and the following variables: BMI, gender, and age group

(conclusion)

| Variable | No. | % | Postural alteration No. | Postural alteration % | $\chi^{2a}$ | PR (CI 95%) |
|---|---|---|---|---|---|---|
| **Gender (n = 527)** | | | | | | |
| Male | 95 | 18% | 26 | 27.4% | 0.26 | 1 |
| Female | 432 | 82% | 94 | 21.8% | | 0.98 (0.93 – 1.02) |
| **Age group (n = 522)** | | | | | | |
| Young adults | 172 | 33% | 41 | 23.8% | | 1 |
| Middle-aged adults | 244 | 46.7% | 46 | 18.9% | 0.032 [b] | 0.98 (0.94 – 1.01) |
| Elderly | 106 | 20.3% | 34 | 32.1% | | 1.04 (0.99 – 1.09) |

Note: [a] Multivariate analysis of each variable in the model. Wald chi-square test. [b] Statistically significant association of the variable in the model ($p < 0.05$).

## Discussion

The results are discussed in the following three sections: (1) Prevalence of back pain and associated factors, (2) Prevalence of disability and associated factors, and (3) Prevalence of postural changes and associated factors.

### Prevalence of back pain and associated factors

The prevalence of back pain identified in this research was high and of a similar level to that found in a study by Schneider et al. (2005) (16), which was independent of BMI classification. The association between BMI and pain in the lower back is not well documented, although it can be speculated that people with a high body mass tend to have an excessively increased risk for pain as a result of changed posture to offset additional body mass. Nevertheless, the current evidence points to a conflict as to whether or not there is an association between lumbar pain and body mass. Leboeuf (2000) (17) reported increased pain among obese subjects while Tuzun et al. (1999) (18) and the present study found no association between these variables. The high prevalence of pain can be associated with other factors related to the multiple of the same, as it is subjective and depends not only on the biomechanical factors related to overweight.

With regard to the presence of back pain related to gender, there was a predominance of pain in female subjects (86.6%) compared to males (66.3%), showing a significant association between pain and gender (Table 1). Similar results were found by Wynne-Jones et al. (2008) (19). This can be explained by the fact that women are subject to hormonal influences because they work double shifts and have a more fragile state of health, a higher body fat percentage, lower income, and less education than men.

Although the findings of this study have shown that young and middle-aged adults had a higher prevalence of pain than the elderly, there was no statistically significant association between pain and age groups (Table 1), which corroborates the findings of Tuzun et al. (1999) (18). Pain in the lumbar region has been referred to as the most common cause of activity limitation in people younger than 45 years (19) and the second most frequent reason for visits to the doctor (20). Accordingly, it seems plausible that the highest prevalence was found in the subjects belonging to the age groups young and middle-aged adults who are mostly likely to be working. Work stress has been strongly associated with psychological factors and the occurrence of back pain (16).

With regard to changes in the spine, the literature has not consistently demonstrated the existence of an association between the presence of postural misalignments and back pain (22-24). Visscher et al. (2002) (23), like the present study, found no significant association between postural and musculoskeletal pain. Nevertheless, with respect to the lumbar spine, the results point to the existence of a significant association (Table 1) between changes in the lumbar spine and back pain, probably because of the increased load in this region. Similar results were also found by Christie et al. (1995) (24) where only the most severe postural abnormalities presented a significant increase in the incidence of pain ($p < 0.05$). The high prevalence of pain in the lumbar spine (90.5%) may be related to the fact that the lumbar region is the main section of the spine responsible for the support of static and dynamic loads (25).

## Prevalence of disability and associated factors

Obesity is empirically related to functional limitations; however, its etiology and mechanical effects are not fully elucidated. Among several, one possible explanation for this relationship lies in poor postural stability (21), reduced range of motion, and balance disorders (26). The results of this study show that disability increases with increasing BMI, with the highest prevalence found in obese (38.6%) and overweight (23.9%) individuals, followed by slim/normal (20.7 %) subjects. Nevertheless, the association between disability and BMI (Table 2) does not corroborate the results of Lucio et al. (2011) (27) who found that values above normal BMI have no association with functional capacity.

With regard to the relationship between disability and gender, the present study found no significant association between these variables (Table 2). Although there is high prevalence of disability in women, there is much disagreement on the matter, since the variable failure seems to depend on other factors, such as cardiopulmonary diseases, age, and BMI, and not just gender.

Has been reported that in countries like the United States, annual losses are close to 149 million days of work, costing approximately $28 billion in lost productivity (18). The main reason for the absence from work is related to complaints of back pain, possibly because it is the most common cause of activity limitation in young people, i.e., those below 45 years of age (19), thereby having implications for the labor market. In this study, disability was significantly associated with age (Table 2) and was more common among middle-aged subjects, followed by the elderly. In part, these results are consistent with other studies that relate increased age with a higher frequency of disability (18).

Kyphosis is largely found in the elderly because physical limitations alter the biomechanics of the spine and functional limitations become evident due to restrictive lung disease. In addition to being a risk factor for falls, kyphosis is associated with significant morbidity and mortality, which results in the consumption of more healthcare resources by elderly patients than those in any other age group (28). Nevertheless, there is still controversy about the influence of postural changes on functional disability despite, for example, the biomechanical stress caused by kyphosis. Ettinger et al. (1994) (29), like the present study (Table 2), found no association between changes in the thoracic spine and functional disability.

Postural and functional limitations are not inevitable consequences of aging and therefore the realization of preventive programs, the elimination of risk factors, and the adoption of healthy lifestyle habits are the determinants of healthy aging. Thus, the 29.1% prevalence of disability found in the elderly in this study can be explained by the aging process itself, which has been linked to chronic diseases and functional disability.

## Prevalence of postural changes and associated factors

The lack of a significant association between postural changes of the spine in individuals classified with a high BMI (Table 3) confirmed the findings of Lang-Tapia et al. (2011) (22) and Youdas et al. (2006) (30). On the other hand, some authors have suggested that lordosis and sacral inclination are greater with an increasing BMI, whereas other studies have found that lordosis and kyphosis increase with age (2,4,18).

The lack of consensus hinders the establishment of a pattern of relationship between an increase in body mass and changes in spinal curvature. In this sense, it is understood that further studies are needed regarding this relationship. It is however also important to be cognizant of methodological uniformity because the disparities between the results of the studies may be due to differences ranging from the interpretation of the definition of overweight and obesity to the instruments of curvature measurement, which often depend on the examiner's experience and/or the validity of the assessment tool (concurrent validity and reproducibility). This results in variability in the attainment of reliable data and the characterization of the real postural condition of the population in question.

The relationship between postural changes and gender has not been established in this study (Table 3), unlike the results of Lang-Tapia et al. (2011) (22) who found differences between men and women, i.e., more concavity in women and more kyphosis in men. In general, the higher rate of lordosis in women is explained genetically by the shape and positioning of the pelvis (30).

Analysis by age group showed that there was a higher prevalence of postural change in the elderly (Table 3). In fact, given the passage of time coupled with inactivity of the body, there is a reduced ability to sustain a muscular body, which allows the accentuation of spinal curves (31). Moreover, on its own, an increased kyphosis angle over the years really does seem to be a part of the natural aging process (22).

### Limitations and practical implications

The main limitation of this study was the method of measurement of spinal curvature, which depends on the experience of the evaluators since it requires palpation of some spinous processes. In contrast, it is believed that the use of a Flexicurve to quantitatively evaluate the most relevant curvature has led to scientific studies that provide reliable data expressive of a sample and determined by sample calculations.

Given the growing concern with the characterization of body posture in children and adolescents, it is also necessary to characterize posture over the remaining lifecycles in order to gain a better understanding of the transformations that occur over time in different age groups. If postural education requirements are known, it would allow for greater investment in targeted education. Armed with this kind of knowledge, various programs grounded in the traditional postural school methodology could be created since education material regarding posture is widespread in the literature. Demonstrative positive results would not only provide physical improvement for the participants, but also enhanced quality of life for these individuals. Furthermore, this type of educational method has the advantage of being low cost with minimal expenditure required on treatments and reduced staff absences, which are otherwise a consequence of postural complaints (32).

In short, musculoskeletal disorders of the spine, especially back pain and postural changes, which may result in reduced functionality, are important public health problems; thus intervention strategies should be formulated to control this morbidity. The main practical implication of this study therefore lies in the opportunity for the provision of subsidies for the development of educational programs regarding posture in order to minimize the prevalence of these issues in the adult population with back pain.

In summary, the prevalence of back pain in this study was 82.9%, and functional disability was present in 27.7% of subjects who had back pain. Postural changes of the spine were present in 22.7% of subjects, with the elderly having a higher prevalence compared to the other age groups.,Back pain was present in all age groups and BMI categories, although it was not associated with age or BMI. However, pain was significantly associated with female gender. Functional disability was associated with increased BMI and age group in that middle-aged adults reported greater disability in performing daily tasks. Postural changes in the lumbar spine showed no association with BMI and gender; however, they were associated with back pain and age, with the elderly being the most affected. These results maybe considered preliminary and should be used with caution by healthcare providers wishing to offer postural education at a primary healthcare level, especially those focused on worker health. Nevertheless, the results of this study will assist in the understanding of the relationship between gender, age, and body mass and spinal curvatures in the sagittal plane, as well as back pain reported by the adult population.

## References

1. Vieira ER, Kumar S. Working postures:a literature review. J Occup Rehabil. 2004;14(2):143-59.

2. Hoseinifar M, Ghiasi F, Akbari A. The relationship between lumbar and thoracic curves with body mass index and low back pain in students os Zahedan University of Medical Sciences. J Med Sci. 2007;7(6): 984-90.

3. Shehab DK, Al-Jarallah KF. Nonspecific low-back pain in Kuwaiti children and adolescents: Associated factors. J Adolesc Health. 2005;36(1):326.

4. Souza SAF, Faintuch J, Valezi AC, Sant'Anna AF, Gama-Rodrigues JJ, de Batista Fonseca IC, de Melo RD. Postural changes in morbidly obese patients. Obes Surg. 2005;15(7):1013-6.

5. Balzini LPT, Vannucchi L, Benvenuti F, Benucci M, Monni M, Cappozzo A, Stanhope SJ. Clinical characteristics of flexed posture in elderly women. J Am Geriatr Soc. 2003;51(10):1419-26.

6. Franklin F, Chenier TC, Brauninger L, Cook H, Harris S. Effect of positive heel inclination on posture. J Orthop Sports Phys Ther. 1995;21(2):94-9.

7. Moore K, Dumas GA, Reid JG. Postural changes associated with pregnancy and their relationship with low-back pain. Clin Biomech. 1990;5:169-74.

8. Binder MCP, Wludarski SL, de Almeida IM. Occupational accidents in Botucatu, São Paulo, recorded by the social security system from 1995 to 1999. Cad. Saúde Pública. 2001;17(4):915-24.

9. Meziat Filho N, Silva GA. Disability pension from back pain among social security beneficiaries, Brazil. Rev Saúde Pública. 2011;45(3):494-502.

10. Nusbaum L, Natour J, Ferraz MB, Goldenberg J. Translation, adaptation and validation of the Roland-Morris Questionnaire – Brazil Roland-Morris. Braz J Med Biol Res. 2001;34(2):203-10.

11. de Oliveira TS, Candotti CT, La Torre M, Pelinson PPT, Furlanetto TS, Kutchak FM, Loss JF. Validity and reproducibility of the measurements obtained using the flexicurve instrument to evaluate the angles of thoracic and lumbar curvatures of the spine in the sagittal plane. Rehabilitation research and practice. 2012 doi:10.1155/2012/186156

12. Bernhardt M, Bridwell KH. Segmental analysis of the sagittal plane alignment of the normal thoracic and lumbar spines and thoracolumbar junction. Spine. 1989;14(7):717-21.

13. Propst-Proctor SL, Bleck EE. Radiographic determination of lordosis and kyphosis in normal and scoliotic children. J Pediatr Orthop. 1983;3(3):344-6.

14. OMS [website]. [Cited in]. Available from: http://www.who.int/eportuguese/publications/pt/

15. Papalia DE, Olds S, Feldman R. Human development. Artmed, Brasil, 2001.

16. Schneider S, Schmitt H, Zoller, Schiltenwolf M. Work place stress, lifestyle and social factors as correlates of back pain: a representative study of the German working population. Int Arch Occup Environ Health. 2005;78:253-69.

17. Leboeuf-Yde C. Body weight and low back pain. A systematic literature review of 56 journal articles reporting on 65 epidemiologic studies. Spine. 2000;25: 226-37.

18. Tuzun C, Yorulmaz I, Cindas A, Vatan S. Low back pain and posture. Clin Rheumatol. 1999;18:308-12.

19. Wynne-Jones , Dunn KM, Main CJ. The impact of low back pain on work: a study in primary care consulters. Eur J Pain. 2008;12:180-8.

20. Gunnar BJA. Epidemiological features of chronic low-back pain. The Lancet. 1999;354(9178):581-5

21. Taylor VM, Deyo RA, Cherkin DC, Kreuter W. Low-back pain hospitalization: recent United States trends and regional variations. Spine. 1994;19:1207-13.

22. Lang-Tapia M, España-Romero V, Anelo J, Castillo MJ. Differences on spinal curvature in standing position by gender, age and weight status using a noninvasive method. J Appl Biomech. 2011;27:143-50.

23. Visscher CM, De Boer W, Lobbezoo F, Habets LL, Naeije M. Is there a relationship between head posture and craniomandibular pain? 2002;29(11):1030-6.

24. Christie H J, Kumar S, Warren SA. Postural aberrations in low back pain. Arch Phys Med Rehabil. 1995; 76:218-24.

25. McGraw B, McClenaghan BA, Williams HG, Dickerson J, Ward DS. Gait and postural stability in obese and nonobese prepubertal boys. Arch Prhys Med Rehabil. 2000;81:484-9.

26. Cruz-Gómez NS, Plascencia G, Villanueva-Padrón LA, Jáuregui-Renaud K. Influence of obesity and gender on the postural stability during upright stance. Obes Facts. 2011;4:212–7.

27. Lucio A, Bezerra MJC, Sousa SA, Miranda MLJ. Characteristics of functional capacity and its relationship with BMI in elderly patients enrolled in a program of Physical Education. R Bras Ci e Mov. 2011;19(2):13-8.

28. Stevens JA, Corso PS, Finkelstein EA, Miller TR. The costs of fatal and nonfatal falls among older adults. Inj Prev. 2006;12:290-5.

29. Ettinger B, Black DM, Palermo L, Nevitt MC, Melnikoff S, Cummings SR. Kyphosis in older women and its relation to back pain, disability and osteopenia: the study of osteoporotic fractures. Osteoporosis Int . 1994;4:55-60.

30. Youdas JW, Hollman JH, Krause DA. The effects of gender, age, and body mass index on standing lumbar curvature in persons without current low back pain. Physiotherapy Theory and Practice. 2006;22(5):229-37.

31. Akima H, Kano Y, Enomoto Y, Ishizu M, Okada M, Oishi Y et al. Muscle function in 164 men and women aged 20-84 yr. Med Sci in Sports Exerc. 2001; 33(2):220-6.

32. Cardon G, De Clercq D, De Bourdeaudhuij I. Effects of back care education in elementary schoolchildren. Acta Paediatrica. 2000;89(8):1010-7.

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