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Socioeconomic and demographic determinants in the provision of assistance to elderly people with a fractured femur

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Abstract *Femur fracture affects the elderly with high morbidity and mortality. The purpose of the present study was to analyze the profile of the assistance given to the elderly who have femoral fractures, relating to their socioeconomic and demographic conditions, in the state of Paraná between the years 2008 to 2013. These relationships were obtained through factor analysis and the development and analysis of the following rates: PAE - the potential of primary health care to the elderly, whose variable was represented by the contribution of the elderly to the municipal GDP, PAP - the potential of the primary health care to the population, represented by GDP per capita and TE - treatment efficiency represented by the annual rate of fractures and annual rate of death per residence. The municipalities were classified according to the rate variation range. In relation to PAE, 10 municipalities were classified with low potential of care for the elderly, 357 with moderate potential and 32 had low potential. In relation to PAE, 12 municipalities were classified with low potential of primary care for the elderly, 303 with moderate potential and 84 had low potential. In relation to TE, 109 municipalities showed high treatment efficiency, 110 with moderate efficiency and 180 had low efficiency. Our conclusion was that the performance of the economy exerts significant influence on femoral fracture morbidity in the elderly*.

Key words *Femoral fractures, Aging, Socioeconomic conditions*

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Introduction

Brazil has been undergoing important demographic changes and there has been an acceleration in the aging of the population. In 2000, 5.61% of the population in the country was made up of people who were 65 years old or older and this number increased in 2010. The prediction is that it will reach 11.3% in 2025[1]. The southern region has the most amount of elderly people (14.4%) in the country and in the state of Paraná this number represents 11.21% of the population[2]. This new scenery has raised concerns and as a result, it has been the focus of public policies due to the related morbidities for this age group, which is proving costly for the health system[3].

Femoral fractures have immerged as one of the main health problems associated with an aging population[4-6]. It is responsible for the high rates of morbidity and mortality[7,8]. It has a negative effect on the quality of life of the elderly[9-11]. Although changes in the bone density due to osteoporosis[12-14] have been associated with incidents of fractures of the femur for the older people, little is known about the profile of morbidity during the different conditions.

Amongst the studies that have associated ethnic and demographic factors to fractures, particularly for older people, only a few have analyzed aspects connected to social and economic issues[15-18] and even fewer have evaluated the influence of income[19,20]. Evidence of the positive effects of wealth on the offer of services and the availability of infrastructure in health[21-23], reinforces the interference of socioeconomic development in the profile of morbidities.

In this way, we understood that health care outcomes are determined by different life cycles and constructed by one's social, economic and environment conditions impacting on a person's quality of life particularly when the individual reaches senescence[24-27]. Therefore, the purpose of this study was to analyze the profile of morbidity for femoral fractures affecting the elderly and its relationship with socioeconomic and demographic conditions in the state of Paraná between the years 2008 to 2013.

Methods

This was a quantitative study that was also retrospective and inter-disciplinary. The population in the study was made up of data on older people being 60 years old or older victims of femoral fractures resulting in a hospital admission between January 2008 and December 2013 on the Brazilian National Health System (SUS) in the municipalities of the state of Paraná. We obtained approval from the ethics committee on research at the Centro Universitário de Maringá under number 1.359.807.

The information was collected from the a public database through the program TabNet (version 3.6 of TAB for Windows), available from the SUS Information Technology Department – DATASUS[28] (http://www2.datasus.gov.br/DATASUS/index.php), which refers to hospital admissions (SIH) of elderly people on SUS. The following data was collected: age of the elderly people, year of hospital admission, classification in accordance with the code for the International Classification of Disease (ICD 10)[28], the number of deaths per residence and the number of femoral fractures per area of residence.

The data referring to the Human Development Index (HDI), the Municipal Human Development Index (MHDI), the Gross Domestic Product (GDP) and the GDP per capita, were obtained from the Instituto Paranaense de Desenvolvimento Econômico e Social – IPARDES[29] (http://www.ipardes.gov.br/) and the Instituto Brasileiro de Geografia e Estatística – IBGE[30] – (http://www.ibge.gov.br/home/) from 399 municipalities in the state of Paraná. For this study, the GDP of the municipalities was divided by the number of elderly people resident in each one of them in order to fully understand the effect of the differences in the proportion of the elderly. In this way, the level of wealth in the municipalities represented by their GDP was obtained in such a way that so as to take into account the elderly population.

Typology of the municipalities do state do Paraná

For the construction of the typology of the homogenous groups in the municipalities, the multivariate Factor Analysis technique was primarily used (AF). The main purpose of this step was to obtain the factor scores. AF identifies the relatively small factor number that can be used to represent the relationships between many variables that are inter-related. The mathematical model is similar to the multiple regression equation; where every variable is expressed as a linear combination of non-observed factors:

$$X_1 - \mu_1 = a_{11} F_1 + a_{12} F_2 + ... + a_{1m} F_m + \varepsilon_1$$
$$X_2 - \mu_2 = a_{21} F_1 + a_{22} F_2 + ... + a_{2m} F_m + \varepsilon_2$$
$$X_3 - \mu_3 = a_{31} F_1 + a_{32} F_2 + ... + a_{3m} F_m + \varepsilon_3$$
...

$$X_p - \mu_p = a_{p1} F_1 + a_{p2} F_2 + ... + a_{pm} F_m + \varepsilon_p$$

Where:
A_{ij} = factor load;
$F_1, F_2, ..., F_m$ = common factors;
$\varepsilon_1, \varepsilon_1, ..., \varepsilon_p$ = errors or specific factors.

Although it is possible that all of the variables contribute to a determined factor, only a subgroup from them will actually characterize it. Thus the factor model assumes that the variables can be grouped by their correlations to which they belong, being the same group that is highly co-related to each other. Subsequently and based of the factor scores, we calculated the three rates: potential of care to elderly people (PAE), potential of care to the population (PAP) and efficiency of the treatment (TE). For the calculation of the index, we used the following expression:

$$\text{Index} = \frac{\text{Observed score} - \text{minimum score}}{\text{maximum score} - \text{minimum score}} \quad (1)$$

Based on the index that we created, the municipalities were classified in one of three groups. In Chart 1 the interval variation of the index for each group has been presented.

In this case, the higher the value of the obtained index, the better the classification of the municipality in relation to PAE and PAP. For the TE index, the best efficiency is shown by the lowest values. Three groups of municipalities were set out.

Characterization of the municipal groups

The description of the homogenous groups consisted of frequency tables and descriptive measures such as averages, standart deviation. The data was analyzed using the program *Statistical Analysis Software* (SAS, *version* 9.4) based on a database that was developed using the Excel[32] application.

Grouping of the municipalities

Based on the matrix data whose columns contain information of: the per capita GDP (pp2008, pp2009, pp2010, pp2011, pp2012 e pp2013), municipal GDP (pm2008, pm2009, pm2010, pm2011, pm2012 e pm2013), annual rate of fractures (%), (TFLR), the annual rate of deaths (%), (TOLR) and the survival rate (TSOB) per residency for the years 2008 to 2013 carried out the AF. We adopted the Kaiser criteria to choose the factors to retain (eigenvalue higher than 1) for choices of the factor numbers.

Chart 1. Intervals of variation for the PAE, PAP and ET rates used to classify the municipalities. Paraná, 2008-2013.

Rates	Group I	Group II	Group III
PAE	Rates ≥ 10	5 ≤ Rates < 10	Rates < 5
PAP	Rate ≥ 20	10 ≤ Rate < 20	Rate < 10
TE	Rate < 10	10 ≤ Rate < 20	Rate ≥ 20

The AF model showed good adjustments (KMO = 0.75) and it was possible to identify three factors which explained 85.52% of the variance total for the data. In Table 1, it is possible to evaluate the three retained factors. The first eigenvalue ($\lambda_1 = 7,11$) explained 47.40% of the total variance and this is related to the PAE shown in the municipal GDP. The second eigenvalue ($\lambda_2 = 3.94$) explained 26.32% of the variation total as shown in the PAP results and this was represented by the per capita GDP in the municipality. The third eigenvalue ($\lambda_2 = 1.77$) explained the 11.80% of the total variance shown in the TE results as it was represented by the TFLR per 1000 as well as by the TOLR per 1000 and TSOB per 100%.

Results

In relation to the PAE, the municipalities were placed into three groups. The first was made up of municipalities (n = 10) that showed a high level of PEA (PAE ≥ 10). The second by municipalities (n = 357) which was moderate (5 ≤ PAI < 10) and the third (n = 32) by those being low (PAE < 5) (Figure 1).

For the PAP, three groups were also considered. The first one was made up of municipalities (n = 12) that showed a high level of PAP (PAP ≥ 20). The second by municipalities (n = 303) which were moderate (10 ≤ PAP < 20) and the third (n = 84) by those being low PAP (PAP < 10) (Figure 2).

For the TE, three groups were considered. The first was made up of municipalities (n = 109) that showed a high level of TE (TE ≥ 20). The second by municipalities (n = 110) which were moderate (10 ≤ TE < 20) and the third (n = 180) by those being low (TE < 10) (Figure 3).

Discussion

The PAE retained the municipal GDP as the main explanatory variable. The GDP represents the economic activity of the municipalities and it reflects, therefore, the production of goods and

Table 1. Eigenvalue, code and name of variable and factor load for the three first retained factors. Paraná, 2008-2013.

Retained factor	Code	Variables retained for the Eigenvalue Factor	Load
1st Eigenvalue Factor	pm08*	GDP municipal for the year 2008	0.9796
(λ1 = 7.11)	pm09*	Municipal GDP for the year 2009	0.9813
	pm10*	Municipal GDP for the year 2010	0.9909
	pm11*	Municipal GDP for the year 2011	0.9916
	pm12*	Municipal GDP for the year 2012	0.9912
	pm13*	Municipal GDP for the year 2013	0.9910
2nd Eigenvalue Factor	pp08	GDP per capita for the year 2008	0.4535
(λ1 = 3.94)	pp09	GDP per capita for the year 2009	0.7174
	pp10	GDP per capita for the year 2010	0.9567
	pp11	GDP per capita for the year 2011	0.9759
	pp12	GDP per capita for the year 2012	0.9779
	pp13	GDP per capita for the year 2013	0.9661
3rd Eigenvalue Factor	TFLR	Annual rate of fractures (‰) per area of residency	0.0717
(λ2= 1.77)	TOLR	Annual rate of deaths (‰) per area of residency	0.8416
	TSOB	Rate of survival	0.9550

* Municipal GDP divided by the elderly population in 2010.

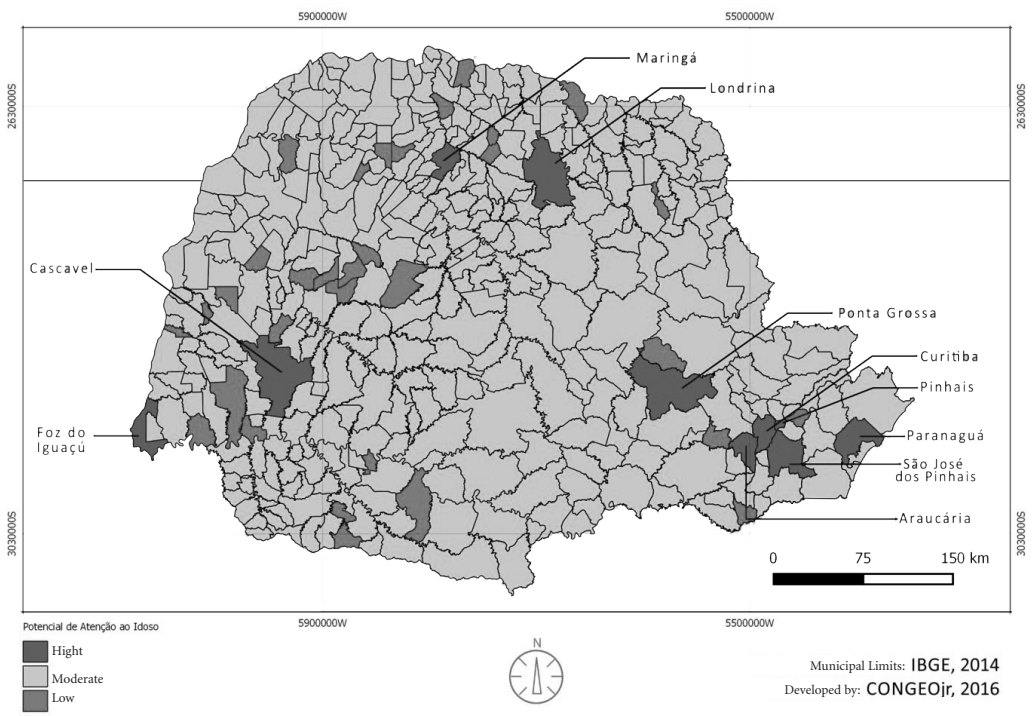

Figure 1. Map of the potential of primary health for elderly people with femoral fractures per resident municipality. Paraná, 2008-2013.

services for each of them in monetary terms[29]. It is one of the most used indicators in the area of economics to measure economic activity in a region, such as the higher the GDP, higher is the generated wealth of the municipality, state or country. Theoretically, there is the assumption that the municipal GDP represents the resources that the municipality has and can be used in

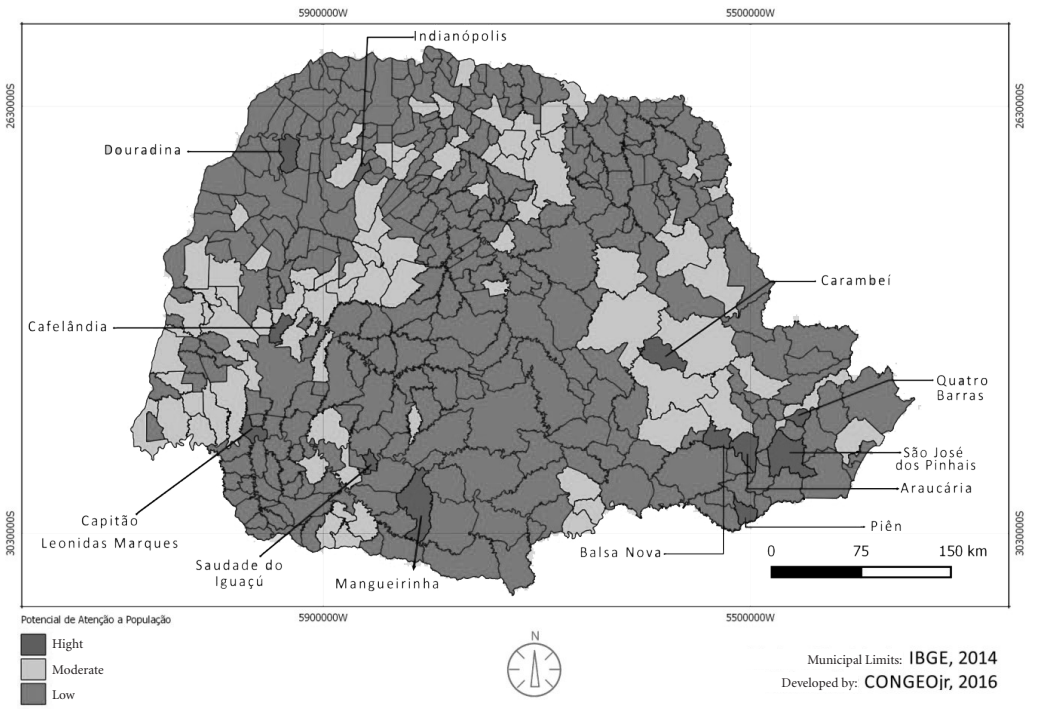

Figure 2. Map of the potential of primary health to the population by municipality residence. Paraná, 2008-2013.

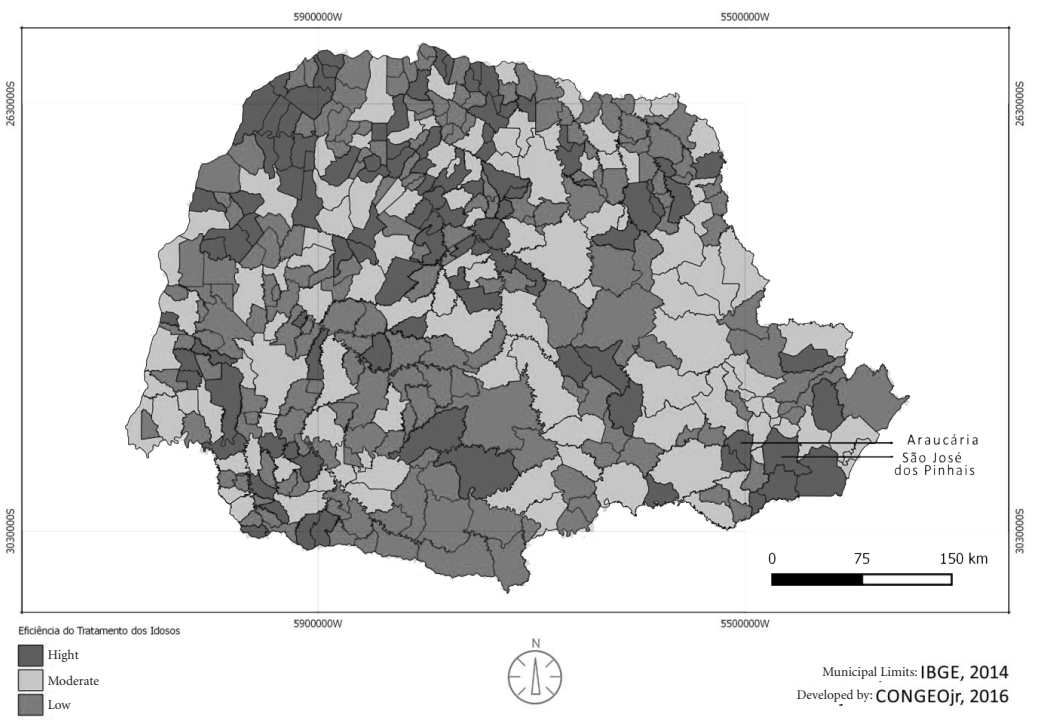

Figure 3. Efficiency map of the treatment of femoral fractures affecting older people by municipal residence, in Paraná, 2008-2013.

investments and actions directed towards the elderly[30].

In group I, there is a list of the most developed municipalities in terms of economic activity, showing the highest demographic density and it represented, in its majority, the highest values of the municipal GDP in the state. These municipalities occupy primary positions in the state *ranking:* 1st Curitiba, 2nd São José dos Pinhais, 3rd Londrina, 4th Araucária, 5th Maringá, 6th Ponta Grossa, 7th Foz do Iguaçú, 8th Cascavel, 9th Paranaguá and 10th Pinhais[33]. The most populous municipalities have better infrastructure and are less dependent on the state or the union because they have a greater capacity to generate their own income[34].

In group II for the moderate PAE, we observed that the majority of the municipalities are situated around those with the most amount of economic activity. The supposition is that the population take advantage of the infrastructure and services in the exiting health system in the municipalities of group I which has favorable repercussions on the state of the health of the elderly population in group II[35,36].

The association between health and income was discussed in a Preston[37] article that identified a strong correlation between life expectancy and the per capita national income, showing a positive relationship between the variables. The richest countries have higher life expectancy in comparison to the poorest ones. This shows the benefits of economic growth on health [38-40].

In addition to wealth, access to basic goods for investment in infrastructure and the surrounding areas which includes: the provision of clean water, sanitation, electricity, pavements, communication lines, urban planning, transport, and markets are essentials for promotion of a healthy life style[41]. Data shows that the actions of SUS do not have a direct relationship with the low income of the municipality and its mico-regions[22]. It was notable that the low level of development of a population does not necessarily reflect the scarcity of financial resources. If this were the case, all of the areas of need in the municipality would no longer be in need due to economic growth[42,43].

According to the results that were found referring to PAE, income constitutes an important explanatory factor as a socioeconomic variable in femoral fractures. In spite of not being able to attribute this just to any direct relationship, the supposition is that growth and economic performance contribute in a decisive way, to the well-being and health of the elderly. This may occur in a tangible way in the construction of physical structures through the facilitation of access to various environments or through consolidated primary health which takes the form of the provision of information, explanations and empowerment amongst other things. These are all essential for facilitating access to these universal actions.

An elevated GDP provides the possibility for the widening of investments in health on the part of the municipalities, which is legally backed by the Constitutional amendment 29 of 13 September 2000 which establishes the co-participation of the Union, states and municipalities in financing SUS. The participation of the Union is connected to the performance of the GDP and the municipalities allocate a part of their tax receipts that come from the property tax for public actions and services in health[44] .

The positioning of the municipalities in the different groups of the PAP, manifets their economic activity and inter-relations (GDP) as well as the number of their inhabitants. This being the case, a greater population relative to the generation of wealth, spreads itself and puts the large and richest municipalities in an inferior position in the groups[45]. Going beyond a certain level of the per capita GDP, the way of the distribution of wealth has become more important for explaining the health situation of the population[46]. This finding came from Preston[37] affirming that at higher levels of income generation that supersedes certain limits, there is little correspondence between life expectancy and the national income[47-49].

The social cohesion and political participation policies are factors that have impacts on the health situation of the population. Major income inequalities cause low levels of social cohesion and low political participation which results in less investment in human capital and social support networks. These are considered primordial elements for the promotion and protection of health[46]. In this way, the association between democratic governance and health suggests that the political situation of the societies can be an important determinant for the health of the population[50].

The municipalities with moderate TE in addition to having a greater proportion of elderly people probably receive people from neighboring metropolitan cities that are small for health treatment. In these localities we find a greater concentration of elderly people in absolute numbers (above 80 years old)[33]. Population longevity increase the femur fractures [51] and the higher the age, the higher the risk of fractures in elderly people.

Conclusion

The profile of assistance given to the femoral fractures in Paraná for elderly is associated with the production of wealth, represented by the municipal older people GDP and by the per capita GDP. This has led us to the conclusion that economic factors play a significant role in the health of the population particularly for elderly people. In relation to the efficiency of the treatment of femoral fractures, indicates that the presence of long-lived elderly people carry on some influence on this factor.

Collaborations

JG Madeiras worked on the concept, scoping and drafting of this paper. ES Silva worked on the methodology and the results of this paper. MU Yamaguchi, CKF Costa and MP Bernuci worked on correcting the final version of this paper. SMMG Bertolini worked on the concept this paper. HK Christofel worked on collecting the data and the methodology of this paper. EM Massuda worked on the concept, scope, analysis and corrections of this paper.

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