Aging and hospitalization expenditure in Public Health: a decomposition analysis for two Brazilian metropolitan areas

Cláudia Koeppel Berenstein*
Simone Wajnman**

Abstract

Changes in the population's age structure, due to population aging, lead to questions concerning health expenditures. Brazil is a country in process of population aging due to the rapid fertility decline and mortality rates now falling to the older groups. The aim of this paper is to characterize Brazilian public health expenditures for men by age group, decomposing total hospitalization expenditures into price, utilization rate, and age composition effects in 2000. In order to verify the long-term potential effect of population aging, this same decomposition is carried out simulating the effect of the age structure projected for the year 2050. Hospitalization registries to the capital cities of Curitiba and Belém are used. The choice of these cities is aimed at establishing a counterpoint between regions with very different levels of socioeconomic development and morbidity profiles.

* Graduate student at Cedeplar/ Federal University of Minas Gerais
** Professor at Cedeplar/Federal University of Minas Gerais

Introduction

Population aging leads to several questions concerning social expenditures, among which health spending is an important issue. Since the prevalence of chronic-degenerative diseases, which are usually more expensive to the health care system, tends to be much higher among the elderly[1], the increase in the proportion of older people may raise health expenditures. Evidences about the age distribution of costs show that the elderly constitute the age group that most consume services per capita, with exception of the newly born, whose medical care tends to become constantly more expensive to the system due to the use of more intensive technologies. [2] The older age groups tend to need more medication, long-term care at hospitals, and to use high cost technologies more frequently. By this means, we expect that population aging will provoke an increase in the total health expenditure due to the pure composition effect that derives from the raise in the proportion of the elderly group. Besides, population aging tends to be followed by changes in the health expenditures profile, which tends to become steeper, as expenditure for the elderly grows faster than for younger groups.[3] If the pattern of medical spending by age is changing, the composition effect of the aging can be added by a price effect caused by the increasing costs for the elderly relative to the nonelderly.

Brazil is a country in a fast process of population aging. The total fertility rate of the country decreased from 6.2 children per woman in 1960 to 2.3 in 2000, i.e. a little above the replacement level[4]. As a result, age structure is rapidly changing into an older one. On the other hand, Brazil presents considerable regional disparities, with areas of absolute poverty and

[1] By simplification we adopt here the concept of elderly as individuals who are over 60 years old.
[2] See Glennerster and Matsaganis (1994), Sassi and Béria (2001), and Nunes (1999, 2003).
[3] For some evidence, see Cutler and Meara (1998) and Bushner (2004). Sheiner (2004) presents another perspective arguing that countries with the most technologically intensive health sectors spend relatively less on the oldest old compared to the younger old.
[4] The replacement level corresponds to a fertility rate of approximately 2.1 children per woman, which assures zero population growth. For evidences of recent fertility tendencies in Brazil see Berquó and Cavenagui (2004) .

underdevelopment coexisting with highly industrialized regions in which income and consumption levels are similar to the levels of more developed countries. This regional heterogeneity leads to an uneven supply of health services, affecting both the population's access to them, and the health status of those who look for assistance. Consequently, the morbidity profile, as well as the health expenditure structure, varies according to socioeconomic status and health services available in each region (Veras 1991).

Thus, this paper has two goals. The first one is to decompose the difference in health expenditures for the male population in Brazil in 2000 between different cities with distinct levels of socioeconomic development and different stages of the aging process. The decomposition divides the difference in expenditures in three possible effects: (i) *price effect*, given by the difference of the average costs of health services per age between each place under analysis; which heavily depends on the supply of health services; (ii) *rate effect*, given by the difference between utilization rates of the hospitalization system per age, which depends on the demand side, and is influenced both by the population's morbidity profile and by the local availability of health services; and (iii) *composition effect*, given by the differences between population's age structures. By adding up these three effects, the difference between total health expenditures in both cities is obtained.

In order to carry out this analysis two Brazilian state capitals, exhibiting entirely distinct characteristics were chosen to be compared. The first one, Curitiba, is located in the South, one of the most developed regions of the country. Its social and economic indicators are better than the ones of the rest of the country, and its population is getting older very fast. The second one is Belém, located in the North, one of the least developed areas of the country, in which both the supply and the access to health services are very precarious. By comparing these two areas, we establish a counterpoint between regions with different socioeconomic development levels, as well as with different morbidity profiles and supply of health care to the population.

The second aim of this paper is to estimate the potential effects of population aging on the health expenditures by simulating the effect of the age structure projected for 2050 in Brazil, based on the current fertility and morbidity rates. With this exercise we try to measure the extent of the pure effect of the age structure change that will probably occur in Brazil in the next years.

In order to analyze health expenditures, we used data from Hospitalization Registries – *Autorizações de Internação Hospitalar (AIH)* – of the year 2000, provided by the Brazilian Health Ministry through the System of Hospital Information – *Sistema de Informações Hospitalares (SIH).* As this information is restricted to hospitalization procedures only, all ambulatory and medicament expenditures are not included in this analysis. It is also important to point out that the *AIH* documentation brings information only on public hospitalizations financed by the Ministry of Health through the Brazilian Public Health System - *Sistema Único de Saúde (SUS)* – leaving out any hospitalizations that occurred in the private system. However, hospitalizations financed by the public system seems to be representative of the pattern of costs and causes of population's morbidity, since 72% of the Brazilian population use public health services provided by *SUS* as the only source of health assistance (Nunes, 2004:3).

Another important observation is that we use, in this paper, expenditure information as a proxy for costs, although expenditures may be different from costs in many cases. It occurs, for instance, when *SUS* pays an amount for a medical procedure which does not correspond to its cost price, determining a fixed price for each procedure. This situation could end up revealing a system which does not pay its providers according to real costs. Although we recognize that this distinction between public expenditure and cost may be different for groups of procedures, and that it may possibly affect the proposed analysis, it is not easy to correct this difference in order to achieve the real cost of the procedures, since any adjustment would demand another research comparing the table of medical prices adopted by *SUS* and the real costs based on the market price of these procedures.

Methodology and data source

Data base

Data from Hospitalization Registries *(AIH)* for the year 2000 has been used. To calculate Utilization Rates, which uses the observed population as its denominator, we took data from the 2000 Brazilian Demographic Census.

For that year, the *AIHs* registered 115,602 hospitalizations in Belém, and 172,502 in Curitiba. Nevertheless, the capitals cities tend to attract residents of other locations – smaller and underprovided with public health care – who are searching for assistance. Because of that, and because the denominator for the utilization rate is the population who resides in the capital, we only used data related to hospitalizations of the cities' inhabitants. Hence, the universe for analysis has been reduced to 91,363 hospitalizations in Belém, and 108,612 hospitalizations in Curitiba.

The Method

The total hospitalization expenditure can be composed by three parts: ***price***, which is given by the average cost per age group; ***rate***, related to the utilization rate per age group; and ***composition***, which reflects the population distribution per age, as we see in equation 1:

$$TE = \sum_i AC_i \times UR_i \times P_i \qquad (1)$$

Where:

TE : hospitalization total expenditure;

AC_i : average hospitalization cost for each age group i;

UR_i : utilization rate for hospitalization for each age group i;

P_i : resident population for each age group i.

In that way, total expenditure differences between distinct locations, as well as changes in time, may be decomposed into *price effect*, *rate effect*, and *composition effect.* The *price effect* derives from differences in the average hospitalization costs per age group, which reflect the adopted procedures and their prices. The *rate effect* corresponds to the level of utilization of hospital services and responds to variations according to the type of assistance given to the patients. If a part of medical care that demanded patient's hospitalization becomes ambulatory, the utilization rate will probably decrease. The *composition effect* derives from variations in the population age structure, since we are considering populations standardized by size[5]. Thus, the *composition effect* reflects differences in age structure, which depend on the long term variations of fertility, mortality and migrations functions.

Therefore, the method applied to this paper consists, in the first place, in the analysis of the components of total expenditure per age group, i.e. average cost, utilization rate, and age structure. In second place, we decompose the total hospitalization expenditures into *price*, *rate*, and *composition* effects, in order to identify how much of the difference between hospitalization

[5] In this paper the population of Belém was standardized according to the size of the population of Curitiba, in a way that the differences observed derive only from differences in age structures.

expenditures in Belém and in Curitiba is explained by each of the effects. Finally, in order to capture the potential *composition effect* of an older age structure, we repeat this decomposition exercise taking in consideration, for Curitiba, the age structure projected for Brazil in 2050[6].

Analysis of the components of the total expenditure per age group

As the total expenditure is determined by the combination of average costs per age, utilization rates, and population age structure, we present the analysis, by sex and age group, of the following indicators:

a) Participation of the age group in the total expenditure:

Before we analyze each of the components, we verify the total hospitalization expenditures age distribution through the equation:

$$ {}_{n}\%TE_{x} = \frac{\sum {}_{n}HE_{x}}{\sum HE} \qquad (2) $$

Where:

${}_{n}\%TE_{x}$ is the percentage of the total expenditure in age group x a x+n;

$\sum {}_{n}HE_{x}$ is the sum of hospitalization expenditures in age group x a x+n;

$\sum HE$ is the sum of hospitalization expenditures in all age groups.

The other indicators correspond to the components of the total expenditure per age, which are:

b) Average cost per age group, given by:

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[6] The Brazilian age structure for 2050 was projected by *Instituto Brasileiro de Geografia e Estatística (IBGE)*, review of 2004.

$$ {}_{n}AC_{x} = \frac{{}_{n}HE_{x}}{{}_{n}N_{x}} \qquad (3) $$

Where:

${}_{n}AC_{x}$ is the average cost in age group x a x+n;

${}_{n}HE_{x}$ is the hospitalization expenditure in age group x a x+n;

${}_{n}N_{x}$ is the number of hospitalizations in age group x a x+n;

The analysis of the average cost age profiles allows the identification of the groups which present the highest cost procedures. The *price effect*, which will be analyzed subsequently, varies according to the average cost variations.

c) Utilization rate per age group:

The utilization rate shows the frequency of hospitalizations in each age group, indicating which groups most used hospitalization services during the analyzed period. The *rate effect*, which will be analyzed subsequently, is determined by the variations of the utilization rate.

$$ {}_{n}UR_{x} = \frac{{}_{n}N_{x}}{{}_{n}P_{x}} \qquad (4) $$

${}_{n}\mathrm{UR}_{x}$ is the utilization rate in age group x a x+n;

${}_{n}N_{x}$ is the number of hospitalizations in age group x a x+n;

${}_{n}P_{x}$ is the total population in age group x a x+n;

d) Population's age structure, given by:

$$ {}_{n}CI_{x} = \frac{{}_{n}P_{x}}{P} \qquad (5) $$

${}_{n}CI_{x}$ is the proportion of the population in age group x a x+n;

${}_{n}P_{x}$ is the population observed in age group x a x+n;

P is the total population observed.

The *composition effect* that we intend to measure derives from its possible variations.

<u>Decomposition of the Total Expenditure</u>

The decomposition of the total expenditure aims to identify the relative participation of each one of the components described above. This decomposition may be used in order to evaluate the effects of the components both in the time cost variations and in the regional ones. Nevertheless, in this paper we chose to take the comparison between two Brazilian cities exhibiting different levels of socioeconomic development in the year 2000 as a proxy for the effect of period changes which are supposed to come with the development.

The decomposition of the total expenditure is made by using a similar method to the one described in Preston, Heuvelline, and Guillot (2001) in order to explain the proportion of the differences in the crude mortality rates attributed to the composition effect and to the rate effect[7]. By this means, we define the difference observed between total expenditures in both cities (1 and 2)[8] as:

$$\Delta = TE^{2} - TE^{1} = \sum_{x=0}^{80+} {}_{n}AC_{x}^{2} \times {}_{n}UR_{x}^{2} \times {}_{n}P_{x}^{2} - \sum_{x=0}^{80+} {}_{n}AC_{x}^{1} \times {}_{n}UR_{x}^{1} \times {}_{n}P_{x}^{1} \qquad (7)$$

We have ${}_{n}UR_{x}^{2} \times {}_{n}P_{x}^{2} = {}_{n}X_{x}^{2}$ and ${}_{n}UR_{x}^{1} \times {}_{n}P_{x}^{1} = {}_{n}X_{x}^{1}$, so:

[7] See Preston, Heuvelline and Guillot (2001, p28)
[8] We define Belém as population 1 and Curitiba as population 2.

$$\Delta = TE^2 - TE^1 = \sum_{x=0}^{80+} {}_nAC_x^2 \times {}_nX_x^2 - \sum_{x=0}^{80+} {}_nAC_x^1 \times {}_nX_x^1 \tag{8}$$

By dividing these two terms into two equal parts, and by adding up other terms, maintaining the difference unchanged, we have:

$$\Delta = \frac{\sum_{x=0}^{80+} {}_nAC_x^2 \times {}_nX_x^2}{2} + \frac{\sum_{x=0}^{80+} {}_nAC_x^2 \times {}_nX_x^2}{2} - \frac{\sum_{x=0}^{80+} {}_nAC_x^1 \times {}_nX_x^1}{2} - \frac{\sum_{x=0}^{80+} {}_nAC_x^1 \times {}_nX_x^1}{2}$$

$$+ \frac{\sum_{x=0}^{80+} {}_nAC_x^2 \times {}_nX_x^1}{2} - \frac{\sum_{x=0}^{80+} {}_nAC_x^2 \times {}_nX_x^1}{2} + \frac{\sum_{x=0}^{80+} {}_nAC_x^1 \times {}_nX_x^2}{2} - \frac{\sum_{x=0}^{80+} {}_nAC_x^1 \times {}_nX_x^2}{2} \tag{9}$$

By combining now the eight terms of Δ into four terms, and then into two, we have:

$$\Delta = \sum_{x=0}^{80+} {}_nAC_x^2 \times \left(\frac{{}_nX_x^2 + {}_nX_x^1}{2} \right) - \sum_{x=0}^{80+} {}_nAC_x^1 \times \left(\frac{{}_nX_x^2 + {}_nX_x^1}{2} \right)$$

$$+ \sum_{x=0}^{80+} {}_nX_x^2 \times \left(\frac{{}_nAC_x^2 + {}_nAC_x^1}{2} \right) - \sum_{x=0}^{80+} {}_nX_x^1 \times \left(\frac{{}_nAC_x^2 + {}_nAC_x^1}{2} \right) \tag{10}$$

$$\Delta = \sum_{x=0}^{80+} \left({}_nAC_x^2 - {}_nAC_x^1 \right) \times \left(\frac{{}_nX_x^2 + {}_nX_x^1}{2} \right) + \sum_{x=0}^{80+} \left({}_nX_x^2 - {}_nX_x^1 \right) \times \left(\frac{{}_nAC_x^2 + {}_nAC_x^1}{2} \right) \tag{11}$$

But $\sum_{x=0}^{80+} \left({}_nX_x^2 - {}_nX_x^1 \right) = \sum_{x=0}^{80+} {}_nUR_x^2 \times {}_nP_x^2 - \sum_{x=0}^{80+} {}_nUR_x^1 \times {}_nP_x^1$

By repeating the same previous procedure, we have:

$$\sum_{x=0}^{80+} \left({}_nX_x^2 - {}_nX_x^1 \right) = \frac{\sum_{x=0}^{80+} {}_nUR_x^2 \times {}_nP_x^2}{2} + \frac{\sum_{x=0}^{80+} {}_nUR_x^2 \times {}_nP_x^2}{2} - \frac{\sum_{x=0}^{80+} {}_nUR_x^1 \times {}_nP_x^1}{2} - \frac{\sum_{x=0}^{80+} {}_nUR_x^1 \times {}_nP_x^1}{2}$$

$$+ \frac{\sum_{x=0}^{80+} {}_nUR_x^2 \times {}_nP_x^1}{2} - \frac{\sum_{x=0}^{80+} {}_nUR_x^2 \times {}_nP_x^1}{2} + \frac{\sum_{x=0}^{80+} {}_nUR_x^1 \times {}_nP_x^2}{2} - \frac{\sum_{x=0}^{80+} {}_nUR_x^1 \times {}_nP_x^2}{2} \tag{12}$$

By combining again the eight terms of the equation into four terms, and then into two:

$$\sum_{x=0}^{80+}\left({}_nX_x^2-{}_nX_x^1\right)=\sum_{x=0}^{80+}{}_nUR_x^2\times\left(\frac{{}_nP_x^2+{}_nP_x^1}{2}\right)-\sum_{x=0}^{80+}{}_nUR_x^1\times\left(\frac{{}_nP_x^2+{}_nP_x^1}{2}\right)$$

$$+\sum_{x=0}^{80+}{}_nP_x^2\times\left(\frac{{}_nUR_x^2+{}_nUR_x^1}{2}\right)-\sum_{x=0}^{80+}{}_nP_x^1\times\left(\frac{{}_nUR_x^2+{}_nUR_x^1}{2}\right)\qquad(13)$$

$$\sum_{x=0}^{80+}\left({}_nX_x^2-{}_nX_x^1\right)=\sum_{x=0}^{80+}\left({}_nUR_x^2-{}_nUR_x^1\right)\times\left(\frac{{}_nP_x^2+{}_nP_x^1}{2}\right)+\sum_{x=0}^{80+}\left({}_nP_x^2-{}_nP_x^1\right)\times\left(\frac{{}_nUR_x^2+{}_nUR_x^1}{2}\right)\qquad(14)$$

By replacing in equation (11) the terms ${}_nX_x^2$ and ${}_nX_x^1$, and the term $\left({}_nX_n^2-{}_nX_x^1\right)$ for the one obtained in equation (14) we have:

$$\Delta=\sum_{x=0}^{80+}\left({}_nAC_x^2-{}_nAC_x^1\right)\times\left(\frac{\left({}_nUR_x^2\times{}_nP_x^2\right)+\left({}_nUR_x^1\times{}_nP_x^1\right)}{2}\right)+$$

$$\left[\sum_{x=0}^{80+}\left({}_nUR_x^2-{}_nUR_x^1\right)\times\left(\frac{{}_nP_x^2+{}_nP_x^1}{2}\right)+\sum_{x=0}^{80+}\left({}_nP_x^2-{}_nP_x^1\right)\times\left(\frac{{}_nUR_x^2+{}_nUR_x^1}{2}\right)\right]\times\left(\frac{{}_nAC_x^2+{}_nAC_x^1}{2}\right)$$

(15)

Note that equation (15) may be read as the sum of the three components entitled *price, rate, and composition effects*. That is:

$$\underbrace{\sum_{x=0}^{80+}\left({}_nAC_x^2-{}_nAC_x^1\right)}\times\underbrace{\left(\frac{\left({}_nUR_x^2\times{}_nP_x^2\right)+\left({}_nUR_x^1\times{}_nP_x^1\right)}{2}\right)}\;=\;\textit{price effect}$$

Difference in the average cost structure

Weighted by the average of the utilization rates structure multiplied by the age structure of both locations

$$+\sum_{x=0}^{80+}\left({}_nUR_x^2 - {}_nUR_x^1\right)\times\left(\frac{{}_nP_x^2 + {}_nP_x^1}{2}\right)\times\left(\frac{{}_nAC_x^2 + {}_nAC_x^1}{2}\right) = \textit{rate effect}$$

Difference in the structure of the utilization rates — Weighted by the average of the age structure and of the average costs of both locations

$$+\sum_{x=0}^{80+}\left({}_nP_x^2 - {}_nP_x^1\right)\times\left(\frac{{}_nUR_x^2 + {}_nUR_x^1}{2}\right)\times\left(\frac{{}_nAC_x^2 + {}_nAC_x^1}{2}\right) = \textit{composition effect}$$

Difference in age structures — Weighted by the average of the utilization rates structure and the average costs of both locations

Thus, the difference between total expenditures observed in “1” and “2” (Δ) may be decomposed into: (i) contribution of the difference of average cost to the difference of total expenditures, i.e. price effect; (ii) contribution of the difference of utilization rate to the difference of total expenditures, i.e. rate effect; (iii) contribution of the difference of age structure to the difference of total expenditures, i.e. composition effect.

Simulation of Total Expenditure based on the Brazilian Age Structure in 2050

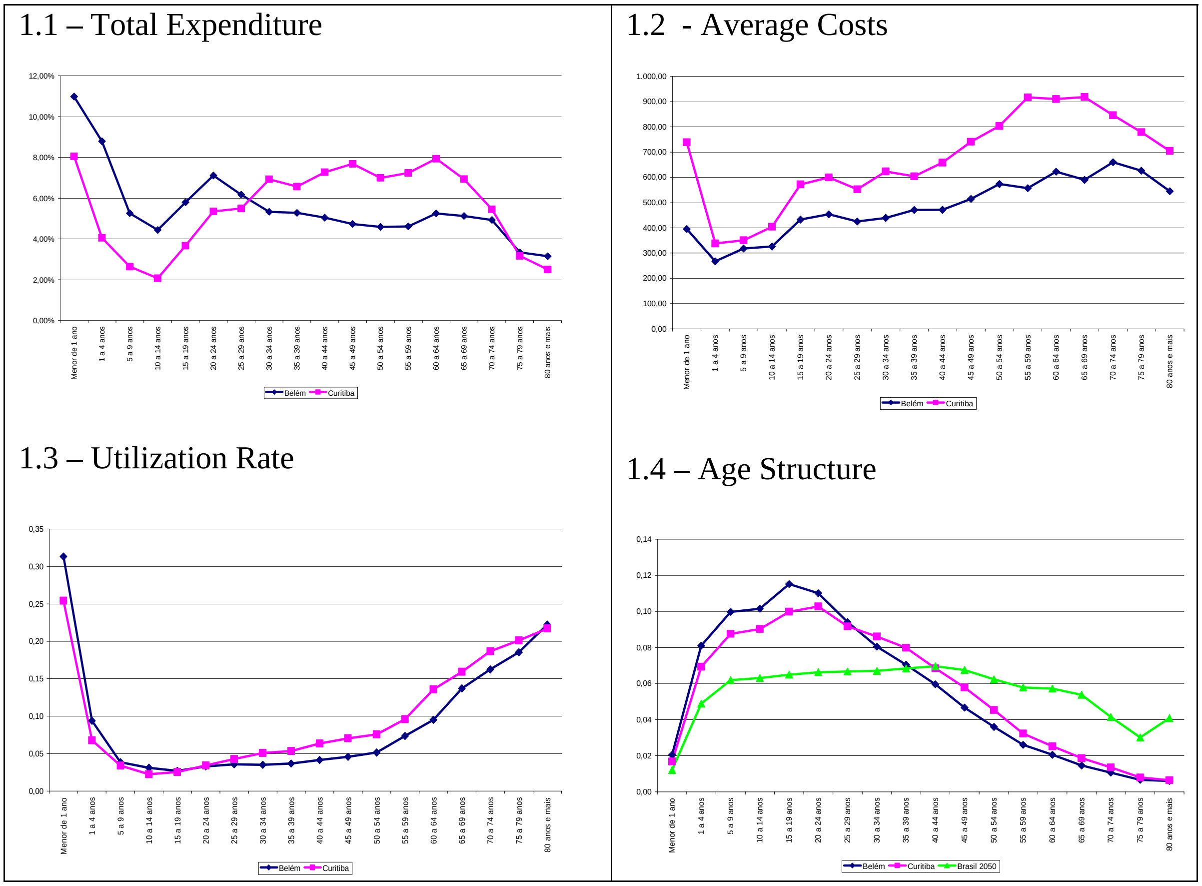
In order to measure the potential composition effect derived from population aging in the total expenditures, we suppose the age structure of Curitiba to be equivalent to the age structure of Brazil in 2050, and again we decompose costs in the same way as the previous section. Through this exercise we are able to measure the potential pure effect of the age structure that Brazil is expected to have in 2050, when its demographic transition will be probably completed.

Results

In the description of the total hospitalization expenditures profile in the first graph of figure 1, the curve for Curitiba is shifted to the right of the profile for Belém. This pattern can be explained by observing the next three graphs. Average costs (graph 1.2) are higher in Curitiba as a result of its health system, which is technologically more equipped than Belém's. Better developed areas tend to present higher costs especially for the newly born and for older age groups due to a broader offer of services and to a better infrastructure of hospitals. As for the utilization rate (graph 1.3), among all age groups the ones who make greater use of the hospitalization services are those under one year old and the elderly. Children under one year old represent 2.05% of the population of Belém, and 1.68% of the population of Curitiba. Nevertheless, the proportion of total expenditures attributed to this age group is rather much higher, achieving approximately the rates of 11% and 8% for Belém and Curitiba respectively. A similar fact occurs with the elderly, but the burden of their expenditures is much higher. Although in Belém they correspond to 5.84% of the population, they represent almost 22% of the total expenditure. In Curitiba 26% of the total expenditure is attributed to people who are over 60 years old; however, these people represent 7.18% of the total population.

Since Brazil still presents a relatively young population, the expenditure for those under one year old is rather very expensive to the system. However, due to population aging, the share of older groups is growing very fast, leading to a raise in expenditures. Graph 4.1 shows that the age structure of Curitiba is a little older than the one of Belém. Yet, both are still very young if compared to the one projected for Brazil in 2050, that is, when they have already completed the demographic transition as it is expected.

Figure 1 – Percentage of the hospitalization total expenditure, average costs, utilization rates per age groups, and age structures for Belém and Curitiba in 2000.



Source: AIH, 2000

By decomposing the cost into price, rate, and composition effects (table 1) in 2000 the difference of average costs between the two capitals – price effect – is the main responsible for the difference in the total expenditure, explaining 64% of this difference. If the average costs per age group were the same, the difference in total expenditures would be of only one third of the value observed. The proportion attributed to the rate effect is much lower, representing 25%, and the composition effect is responsible for a rather low pressure, 11.1%, since the age structure is similar in both cities. Hence, we conclude that the main difference in the total expenditures standardized by the population size derives from the difference between the structures of hospital assistance in both cities, where the most developed capital presents much higher average costs in extreme groups.

Table 1 – Results for the decomposition of the total expenditures for Belém and Curitiba, with the age structure observed in 2000, and supposing the age structure of Curitiba as same as the projection for Brazil in 2050.

	Age Structure Observed in 2000	**Age Structure in Curitiba the same as Brazil in 2050**
Initial Difference in Total Expenditure	12,306,015.19	28,550,328.63
Price Effect	7,871,073.25	10,148,866.72
Rate Effect	3,072,456.46	4,289,349.48
Composition Effect	1,362,485.49	14,112,112.42
Proportion of the difference explained by the price effect	63.96%	35.55%
Proportion of the difference explained by the rate effect	24.97%	15.02%
Proportion of the difference explained by the composition effect	11.07%	49.43%

Source: AIH 2000, IBGE (projected population - review of 2004)

In order to estimate the potential effect of population aging on hospitalization expenditures, we simulated the total expenditure for Curitiba adopting the age structure projected for Brazil in 2050, when the transition is expected to be completed. The results show that the proportion of the difference explained by the composition effect raises to 49.43%, while the other effects decrease, as showed in table 1. The price effect, despite playing an important role, decreases to almost half of the value obtained in the previous exercise. However, it is important to notice that the simulation presently carried out considers only the pure effect of the age structure. Obviously, there is no reason to believe that population aging would not be followed by a high increase on average costs related to the elderly, especially if the current health model, based on curative treatments instead of preventive treatments, is maintained.

Conclusion

Our analysis shows that, as occurs in many countries, the groups that make the greatest use of hospitalization services in Brazilian public health are the children under one year old and the elderly. Moreover, in Curitiba, the curve for the age profile of hospitalization average costs tends to be shifted to the right, exhibiting expressive value increase with aging, what does not happen in Belém. However, the same curve does not continue to raise until the end of life cycle, decreasing from 60 years old on, and confirming Nunes's (2004) findings to the entire country. The fact that the average cost decreases when population achieves approximately 70 years old may be explained by the growing risks associated to the invasive procedures applied to older individuals. By analyzing the case of men in São Paulo – the Brazilian capital with the biggest level of per capita income – Berenstein (2005) states that, until the age of 70 invasive procedures such as surgical myocardial revascularization with cardiopulmonary bypass (CPB) are highly frequent, and represent a big share of the total value of expenditures in this age group. Nevertheless, as age raises, such procedures tend to represent a smaller share, both in frequency and in cost, giving place to simpler procedures which, most of the times, do not demand surgical treatment. However, we expect that this curve might change its profile due to the development of specific technology aimed at treating diseases common in elderly groups. Also, based on the example of developed countries, we understand that this curve might continue rising until older ages. As the elderly are the age group who proportionally most grows in Brazil, the increase of the average costs associated to their diseases is followed by the concern about the impact of this tendency in health expenditures.

The Brazilian health care system is certainly much more based on curative services than on preventive ones, given that people, either for social, cultural, or financial reasons, tend to look for health services only when they are already sick. In this manner, if this model of illness care - more than health care - is maintained, hospitalization expenditures will probably raise following the pace of the growth of the elderly participation in the population and of the development of new curative technologies.

In this paper we state that Curitiba, which presents a higher developmental level, a better supply of health assistance, and an older population than Belém, shows higher total expenditures in older age groups. Belém has presented a cost structure of decrease with aging. This indicates that the epidemiologic transition, which features the change in a morbidity profile into a greater incidence of chronic-degenerative diseases, provokes a right shift of the age curve of average costs. In order to change this situation a considerable effort directed to the prevention of diseases is needed, especially of those strongly associated to unhealthy habits throughout life cycle.

When we decompose the total expenditure into price effect, rate effect, and composition effect, we verify that the price effect plays a dominant role in the differences of total expenditure between regions exhibiting different developmental levels. The difference in costs derives from the technological levels offered by health services to the population, as well as from the differences in morbidity, given that Belém is behind Curitiba in the epidemiologic transition. By expanding the composition effect adopting the Brazilian age structure in 2050, the participation of the price effect falls, giving place to a greater influence from the composition effect.

Nevertheless, due to population aging and regional development, the prices of treatments tend to raise, especially for the older age groups, which demand more complex treatment as well as more hospitalization time. Hence, the increase in the proportion of elderly tends to generate an explosion in health expenditures for society, although preventive actions and technologies that aim at cost reduction may contain this perspective.

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