Improvements in mortality rates among people aged 60 years and over, in Brazil from 1980-2006

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ABSTRACT

In Brazil, the speed of the aging process of the population has increased dramatically. At first, this process is mostly influenced by the reduction in the level of fertility, but as this tendency consolidates, the decrease in the mortality rates among people aged 60 years and over also becomes crucial for the increase in the population aging. Thus, this paper shows the pace of the decline in the mortality of the elderly in the Brazilian from 1980 to 2006. The observed reductions in mortality for people aged 60 years and more are very important, mainly for women. Focusing on the age groups separately, it was found that such reductions have been more expressive for older elderly than for younger elderly. Therefore, the mortality of the elderly in Brazil in the 80's and 90's fell far from being converged to a biological limit (if it exists) where future reductions would be difficult.

Key words: *Elderly; Mortality Rates; Health; Population Aging.*

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1 Introduction

The aim of this paper is to investigate the trends of the rates of mortality of the elderly living in Brazil, during the 1980/2006 period, especially the rhythm of decline of the mortality rates and the sex differentials.

Until recent decades, the decline of the mortality rates in the advanced ages had received little attention due to the faith that the mortality in the most advanced ages could not be substantially reduced. This, however, has proved to be a debatable assumption. Kannisto et al. (1994) studied the annual average reduction in the mortality rates in advanced ages for 27 developed countries and they observed at least three inconsistent points with the idea that the expectation of life at birth would tend to limit around 80 years.

1 - The reductions in the mortality rates in advanced ages accelerated during the whole course of the XX century, and particularly since the 1950's, consequently, if the life expectancy was approaching a limit, the declines in the mortality in advanced ages should be smaller and smaller and not bigger and bigger;

2 - The rhythm of decline of the mortality rates in the countries with low mortality has been approximately as high, in the average, as the reduction in countries with high mortality levels;

3 - The mortality rates in different countries and between men and women have not been converging the all the time. In other words, there are no indications that the levels of mortality of the different countries, and of men and women, have been converging for a final limit.

The studies involving the theme (which demands more and more importance) are scarce for developing countries, in part due to the lack of suitable or reliable information, such as the case of Brazil.

The aging process of the Brazilian population has occurred in a very accelerated path. In 1980, the census registered 7.2 million people aged 60 years and over, while in 2000, this number was of 14.5 millions. In addition, in the nineties, the aged population had an annual growth rate of 3.4%, in contrast with only 1.6%, estimated for the total population.

Initially, this aging process is influenced, above all, by the reduction in the fertility levels, but as this tendency consolidates the longevity of the population also begins to play an important role. In Brazil, for example, two phenomena are observed in relation to the longevity of the elderly population.

1 - The deaths are concentrating more and more in this segment of the population. In 1980, in the whole country, only 35% of the masculine deaths and 42% of the feminine deaths occurred among people aged 60 years and over. In 2000, that age group accounted for 49% and 64% of the deaths respectively (in the Southeast, in 2000, those proportions are of 49% and 68%, respectively).

2 - From 1980 to 2000, the life expectancy of the Brazilian population at 60 years increased and such gains were larger than those obtained by the total population.

Vaupel (1986) shows that in an aging scenery, of concentration of the deaths in the elderly segment of the population and of increase of the expectancy of the elderly' life (as it is the Brazilian case), the reductions in the mortality rates in advanced ages become crucial in the determination of the expectancy of life of the population as well as in the determination of the volume and in the proportion of the elderly. Those same elements are decisive in the elderly quality of life and they interfere, for instance, in the planning of the system of health, and in the social security (retirement system). Thus, this paper may help to throw light on the

elderly process in Brazil and to subsidize the design and implementation of public policies to improve the living condition of elderly in the whole country.

Besides this introduction, this article owns four further sections. Next, some of the factors that influence mortality and health of the elderly are discussed. The applied methodology and the sources of data are indicated in the third section. In the fourth section, the results about the mortality tendencies of the elderly population are shown between 1980 and 2006 in Brazil, according to sex, aging and great regions. Finally, the fifth section exposes the main conclusions and also points out some perspectives for future investigations.

2 LONGEVITY, QUALITY OF LIFE AND EXPENDITURES WITH THE HEALTH OF THE ELDERLY

Identifying the factors which determine the life extension of the people as well as their quality of life is a very hard task. There are several lines of research in that theme. This section scopes to revise the studies about possible factors related to the longevity and the quality of life of the elderly. To facilitate this study, these factors are divided in three lines of research.

The effects of experienced conditions before birth or during the beginning of life about mortality and health at the end of life

Studies such as Fridlizius (1984), Barker *et al.* (1989) e Fogel (1994) relate many degenerative conditions in elderly (e.g.: heart diseases, hypertension, stroke, diabetes) to poor conditions before birth and during the first years of childhood (infectious diseases, malnutrition and some other biomedical problems).These problems, according to the authors, can result in permanent physiological harm and the degeneration of functioning organs, besides having an inappropriate cellular uterus development, and in reduced immunity for other diseases all over life.

Bengtsson & Lindström (2000) investigated the mortality for specific cases between the ages of 55-80 years, in four parishes in the south of Sweden, from 1760-1894. They found out that the amount of experienced diseases during the first year of life has strong impact on morbidity and mortality at the end of life (especially in mortality for infectious diseases of the respiratory system).

The effects of experienced conditions during adult life about mortality and health at the end of life

The experienced conditions during the productive and reproductive period of life are also the source of attention of studies about elderly mortality.

Doblhammer (2000), for example investigates if the reproductive history of a woman influences her longevity. The encountered results are consistent with the hypothesis that reproduction and longevity are strongly associated. In general, women without children and women who had many children experience a significantly higher risk of death than those who had one or two babies. The early maternity is the birth pattern with higher impact over longevity.

Another studied factor is the exposure of young adults to a variety of hazards. An example is the paper of Costa (2000), which demonstrated that people who change from hard

physical work to intellectual work as well as the exposure of young adults to infectious diseases are important determiners to the decline in the rates of elderly chronicle diseases.

The authors also suggest that, due to the size of the impact of infectious diseases in the rates of chronicle diseases, these should not be necessarily recognized as common in the process of natural aging.

The effects of related factors to social demographic and economic conditions in the micro and macro levels about mortality and health at the end of life

Christenson & Johnson (1995), Freedman & Martin (1999), Kravdal (2000), Lauderdale (2001) and Cambois, Robine & Hayward (2001) show that variables as education, income and occupation have a strong impact over mortality and health at the end of life. It is observed, for example, that even after the inclusion of controls for demographic characteristics (e.g.: sex, race and age) people who are less educated have higher mortality rate.

On the other hand social and economic resources extend life and shorten the period lived with incapacity. It is inferred that these factors can influence the quality of diagnose of diseases as well as it establishes differences in the type, the quality, and the accuracy of treatments.

However, Kravdal (2000) reminds that it is also possible to observe the opposite, because the higher wealthy status of people can help them develop less healthy eating habits, for example.

There are also studies which emphasize that differentials of mortality between social demographic groups are, at least partially influenced by forces which operate beyond the individual level, such as health services or good quality medical care, basic sanitation systems, environment and social political context (Hummer, Rogers e Eberstein, 1998).

Some papers still highlight the importance of behavioral variables over adult mortality. Some examples are drug abuse like cigarettes and alcoholic drinks, eating habits, practice of physical exercises, religious practice, and marital status.

Pampel (2002), Waldron (1986), Miller & Gerstein (1983) and Preston (1970), for example point out the differential in the use of tobacco by men and women as the most accurate explanation to describe the differential of mortality between both sexes in adult and elderly age.

Rogers (1995) even after the inclusion of controls for demographic characteristics (e.g.: sex, race and age) related that widow and divorced people present probability of death twice higher than married people. Therefore, it was demonstrated that those which never married had three times as much of death than married.

Studies such as Berkman & Syme (1979), Hummer et al. (1999), Seeman, Kaplan & Knudsen et al. (1987), Zuckerman, Kasl & Ostfeld (1984) and Jarvis & Herbert (1987) demonstrated that those who never attended a church presented higher mortality risks than those who attended the church once or more during the weak.

Additional considerations

Despite the increases in life expectancy, the reports that register worse states in elderly health as well as those which register improvement are seen with suspicion. In both of the cases the skepticism comes from two sources: the quality of available data and the lack of clarity about the magnitude of change in healthy associated with determined changes in mortality (Crimmins, Hayward & Saito, 1994). Regardless of the applied methodology for

the estimation of effects of intervenient factors, what can be observed is that studies show, indeed, that changes in longevity and quality of life alter the expenditures with health.

Thus, to elaborate public politics that allow the offer of adequate health and welfare conditions for elderly it is necessary to calculate the magnitude or the standard of the mortality levels. On this paper the attempt in this direction has focused on the elderly living in Brazil. The methodology used and some considerations about data base will be discussed in the next section.

3 DATA BASE AND METHODOLOGY

In the first and second parts of this chapter, the data bases are shown and their qualities and limitations are discussed. At the third section the methodology used to calculate the reduction of elderly mortality in the great regions of Brazil is demonstrated.

Data Bases

Deaths

In Brazil there are two systems which supply information about mortality: the Mortality Information System (Sistema de Informação sobre Mortalidade - SIM) that is coordinated by the Health Ministry; and Vital Statistics System (Sistema de Estatísticas Vitais) that is coordinated by the IBGE.

It is important to emphasize that according to Vasconcelos (2000), the states in the South and the Southeast, in the 80's and 90's, the differences in the two systems are very slight. Being these two regions the ones with higher representation of the elderly population in the country this paper has chosen the use of SIM data, although for some states in other regions this can not be the best coverage system.

Population

The population data base has been provided by Demographic Censuses of 1980, 1991 and 2000 (micro data). For the years referent to the censuses as well as for the years between the censuses, the populations for the first of July of each year were obtained by log-linear interpolation.

Problems with data bases and their consequences

The sub registration of deaths

Although it has presented expressive improvement in the last decades, the quality of death statistics constitutes one of the main barriers for studies of mortality levels in Brazil. Altmann & Ferreira (1982), Hakkert (1996), Paes (1996 & 2002) and Vasconcelos (1998 & 2000) show that in Brazil there is a close relation between the socioeconomic and regional economic level of the population and the quality of statistics in obit. These studies point out, for example, that the problems with sub registration in rural areas are much more serious than in the urban areas; that the sub registration rates of the population with a low level of instruction are much higher than those of the population with a university degree; and yet that the coverage rates are much higher in the developed regions of the country like the southeast,

the south and the Federal District, and more precarious in the states of the north and the northeast regions.

However, the statistics of obit in Brazil (particularly in the south and southeast regions) were in a comfortable situation during the 80's and 90's in terms of utilization for estimation of mortality tendencies and standards (Paes, 2000).

There are several forms of evaluating and correcting the sub registration of obit, but results can be differentiated depending on the hypotheses in which the correction techniques are based (Moreira, 1982). In this study the correction factors adopted for the 1980-2006 period were originated from interpolations carried out based on factors provided by IBGE/DPE (Department of Population and Social Indicators) and by the National Public Health School of Osvaldo Cruz Foundation (Fensptec - Projeto Carga de Doença) (see annex).

It is important to emphasize that for obtaining the estimation of death numbers these factors have been applied only in obits for natural cases having been lately added the obit for external causes without any correction. This procedure has been adopted based on the premise that obits for external causes have a relatively high coverage in relation to other causes (IBGE/DPE, 2006).

The error in age declaration

Amazingly low mortality rates in advanced ages are frequently registered in populations that live in poor material conditions with mortality rates comparatively high in young and intermediate ages of life.

Some studies have attributed this relation to the fact that in poorest regions there is an elimination of weakest members at young ages, remaining solely the strongest individuals that then experience low mortality rates when elderly

Coale & Kisker (1986), Dechter & Preston (1991) and Preston, Elo e Stewart (1999) point out that low mortality rates in elderly ages at poorest regions can be explained by errors in age declaration. To minimize possible problems related to error in age declaration this study worked with age groups (60-69; 70-79; 80 and over).

Methodology

Based in KANNISTO et al. (1994) the values of the annual average reduction in mortality rate were calculated as follows.

A – The annual age-specific central rate is given by $m(x,y) = \frac{D(x,y)}{N(x,y)}$ **(1)**

where D (x,y) represents the number of deaths at age *x* over the course of year *y* among men or women (the data about mortality used in this article are from the "Sistema de Informações sobre Mortalidade" – SIM, organized in Brazil by Ministério da Saúde), and N(x,y) represents the number of men or women who were *x* years old on July 1st of year *y* (the data about population in Brazil used in this article are from the census of 1980, 1991 and 2000, and the population on July 1st in each year was obtained by log-linear interpolation).

B – The average death rate in the interval from age x through x^* and year y through y^* can be calculated by:

$$\overline{m}(x,x^*,y,y^*) = \frac{\sum_{j=y}^{y^*}\sum_{i=x}^{x^*} w(i)m(i,j)}{\sum_{j=y}^{y^*}\sum_{i=x}^{x^*} w(i)} \qquad \textbf{(2)} \qquad w(i) = \frac{\sum_{y=1980}^{2000}\left(N_m(i,y)+N_f(i,y)\right)}{\sum_{x=60}^{89}\sum_{y=1980}^{2000}\left(N_m(x,y)+N_f(x,y)\right)} \qquad \textbf{(3)}$$

The weights w are used to standardize the sex and age composition of the population so that comparisons can be made over time, across populations, and between sexes (in this paper we based the weights on the age composition of the elderly of 60 years and over of the Southeast population, men and women combined, from 1980 through 2006). The weights were calculated as in equation 3, where N_m and N_f denote men and women populations counts respectively.

C – The average annual rate of improvement in death rates from the first period to the second period is given by:

$$\rho = -\left(\left(\frac{\overline{m}_2}{\overline{m}_1}\right)^{1/\delta} - 1\right) \qquad \textbf{(4)} \qquad \delta = \frac{(y_2 + y_2{}^* + 1)}{2} - \frac{(y_1 + y_1{}^* + 1)}{2} \qquad \textbf{(5)}$$

where δ is the interval between the means of the two periods where the first period running from y_1, through y_1* and the second period from y_2 through y_2*.

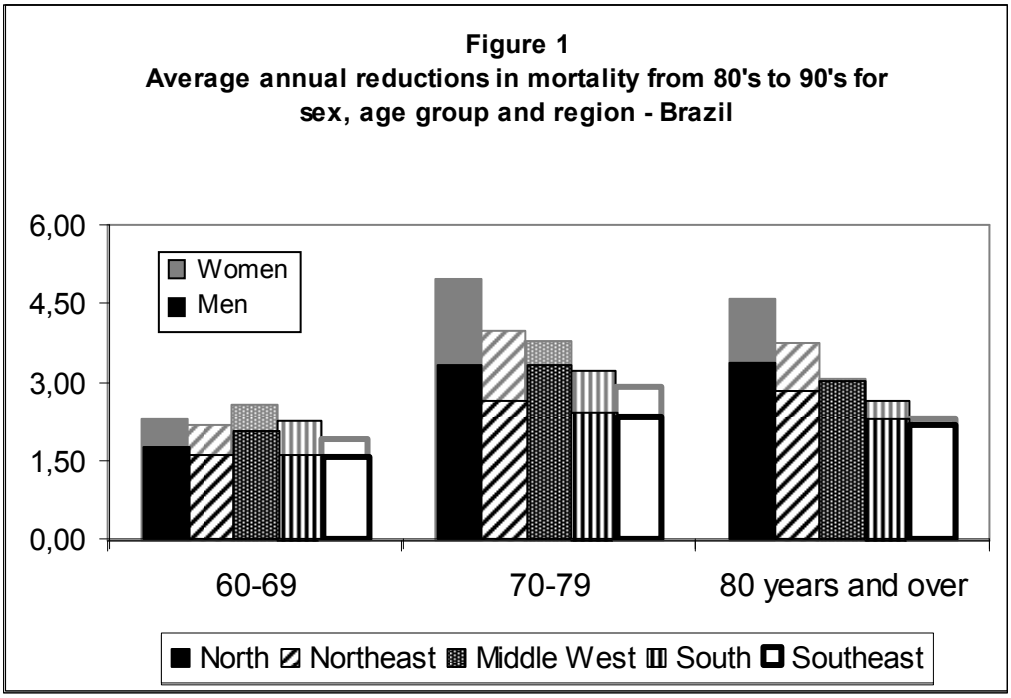
4 Mortality Tendency among Brazilian Elderly and Great Regions from 1980-2006

The first part of this section presents the reduction in the mortality rates among the elderly population at great Brazilian regions from the 80's to the 90's. The second part discusses annual improvements in mortality rates among people aged 60 years and over, in Brazil, over 1980-2006. At the end a comparative analysis of standards and tendencies is carried out in the light of Kannisto *et al.* (1994).

The reductions in mortality rates of the elderly

Figure 1 shows, the Brazilian average annual reductions in mortality rates of the elderly from the 80's to the 90's, for sex, age group and region. From the 80's to the 90's the annual reduction in mortality rates among the population aged 60 years and over, in Brazil, was higher among women than men in all regions and age groups. Also, in all regions the less expressive reductions were the ones of the group between 60-69 years. Nevertheless, the less expressive reductions were in the South and the Southeast, the regions of larger socioeconomic development of the country.

Figure 1
Average annual reductions in mortality from 80's to 90's for sex, age group and region - Brazil

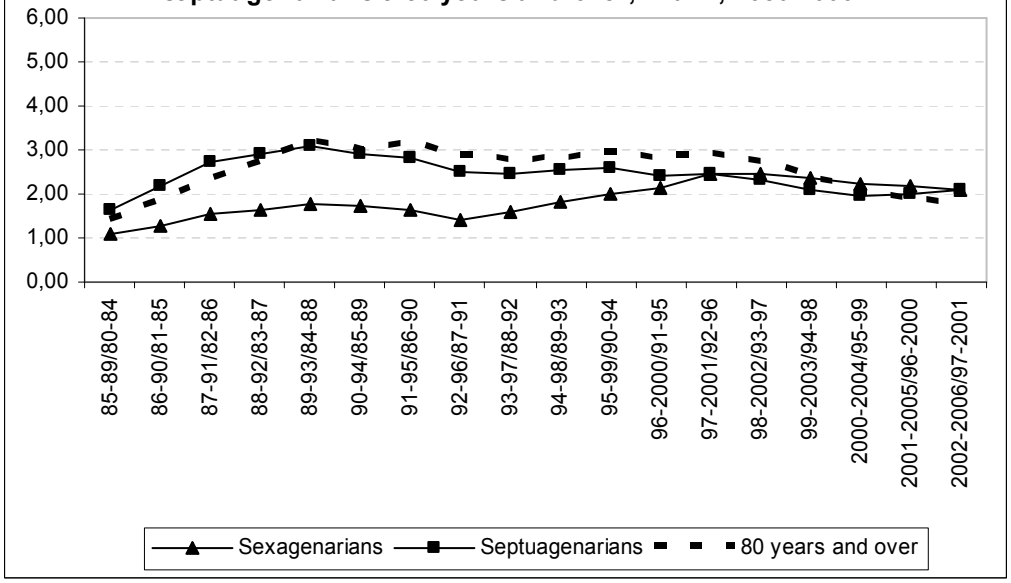


Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.

The rhythm of decline in mortality rates of the elderly

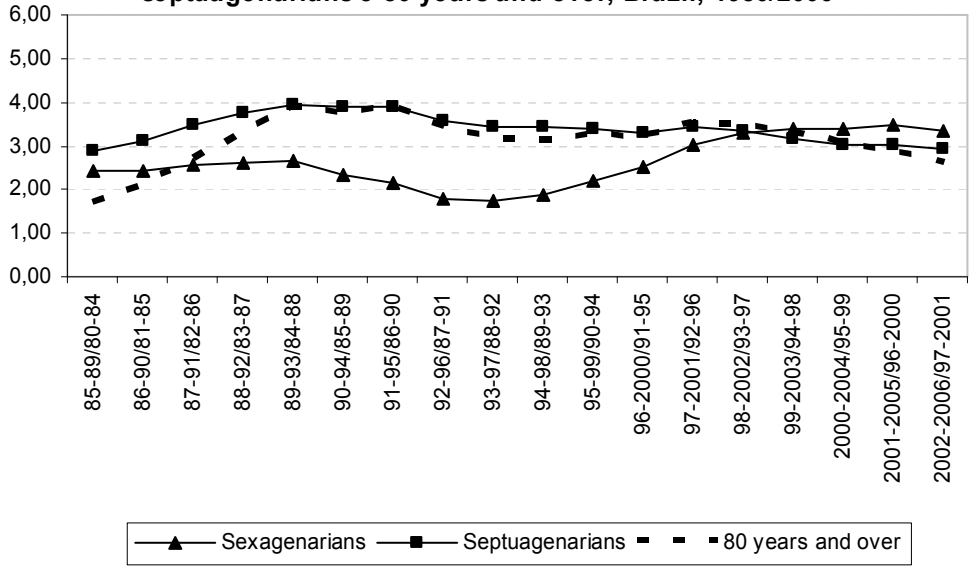
Figures 2 and 3 present, over 1980-2006, the average annual reductions in mortality rates between successive five-year periods for men and women respectively. For example, for men aged 80 and over, the average reduction in the mortality rates from 1980 to1984 and from 1985 to 1989 was 1.4% a year. But from 1997 to 2001 and 2002 to 2006 period (last analyzed pair) the average reduction in the mortality rates was 2.1% a year. The values for women were 1.7% and 2.6% a year (Figure 3).

Figure 2
Average annual reductions in mortality rates between successive five-year periods, for male sexagenarians, septuagenarians e 80 years and over, Brazil, 1980/2006



Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.

Figure 3
Average annual reductions in mortality rates between successive five-year periods, for female sexagenarians, septuagenarians e 80 years and over, Brazil, 1980/2006

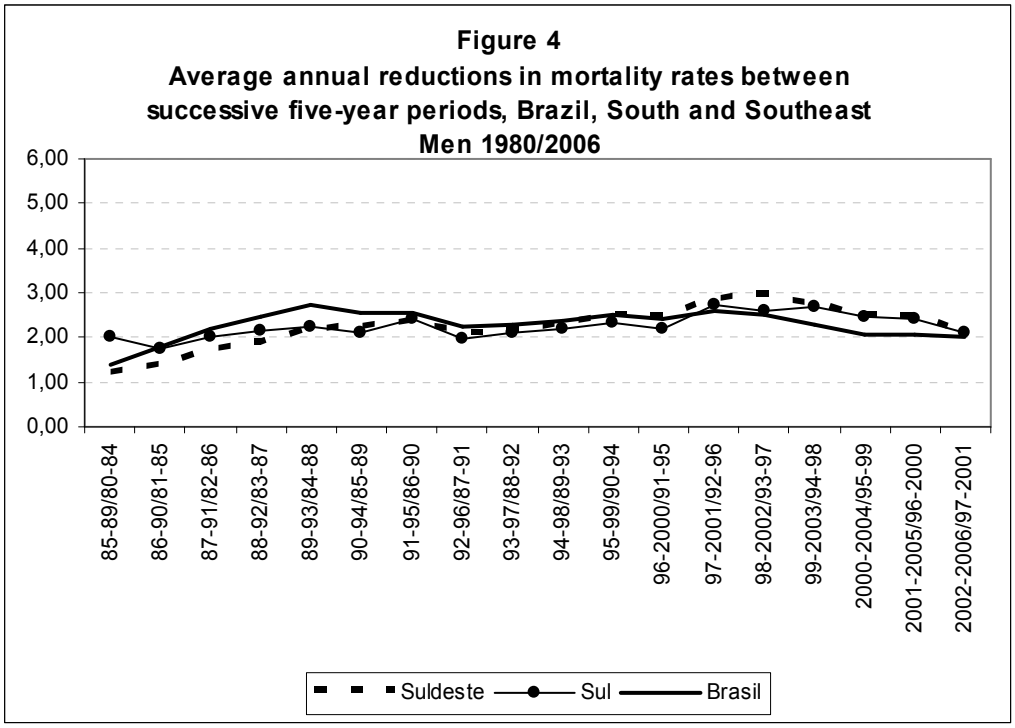


Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.

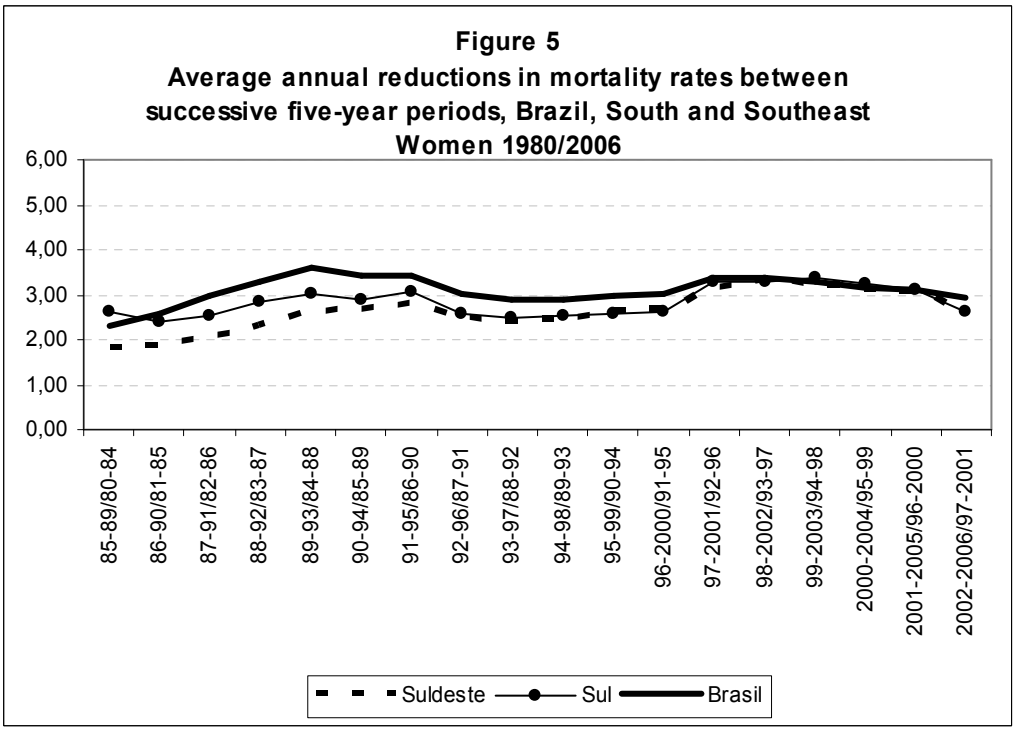
In Figures 2 and 3 it is also observed that the groups of septuagenarians and of 80 years and over presented average reductions in the mortality rates, which were more expressive than those of the sexagenarians. At the end of the period, the levels of reduction in mortality among the age groups presented a certain convergence.

Figures 4, 5, 6 and 7 present to people from 60 years and over that during the first part of the period the less expressive reductions were in the South and the Southeast, though the situation was reversed at the end. Also, it is observed that in the end of the period, the levels of reduction of the mortality among the regions present a certain convergence.

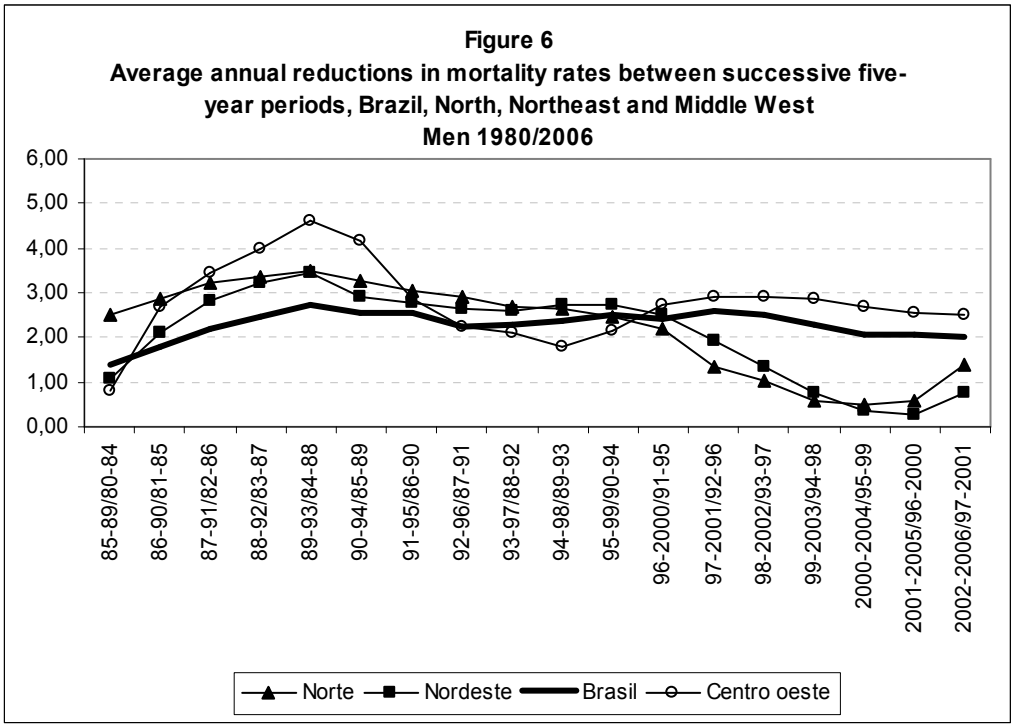
In general it can be observed that reductions in the mortality rates in Brazil have defined standards by the South and the Southeast regions, but the other regions are the ones that show the major variations between 1980-2006.



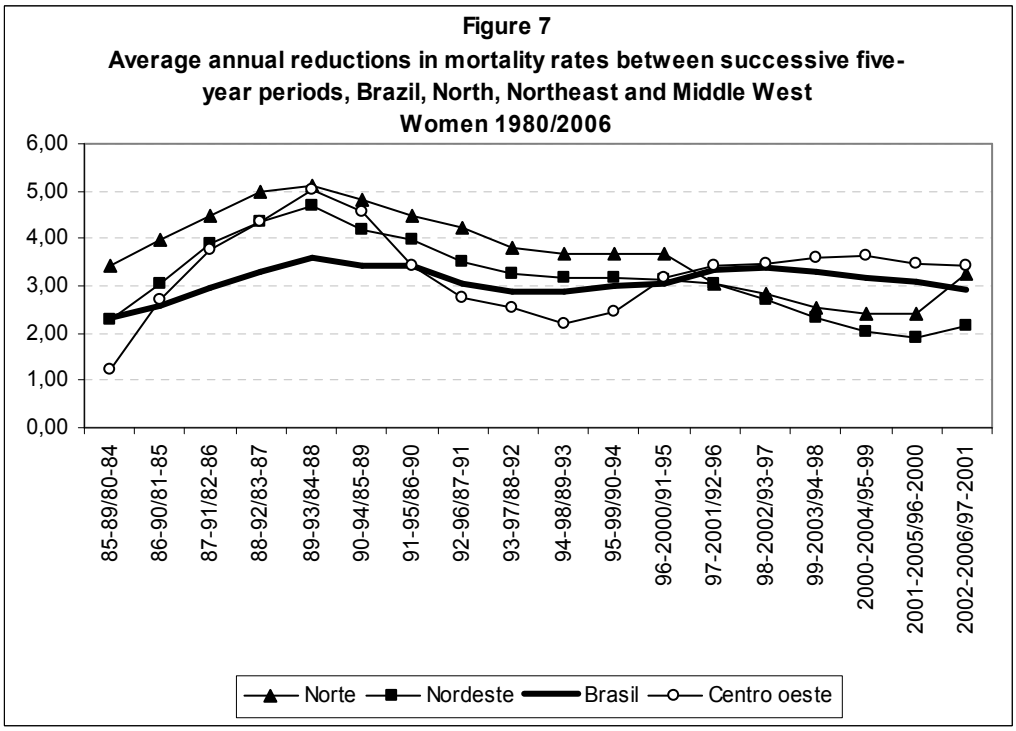
Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.



Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.



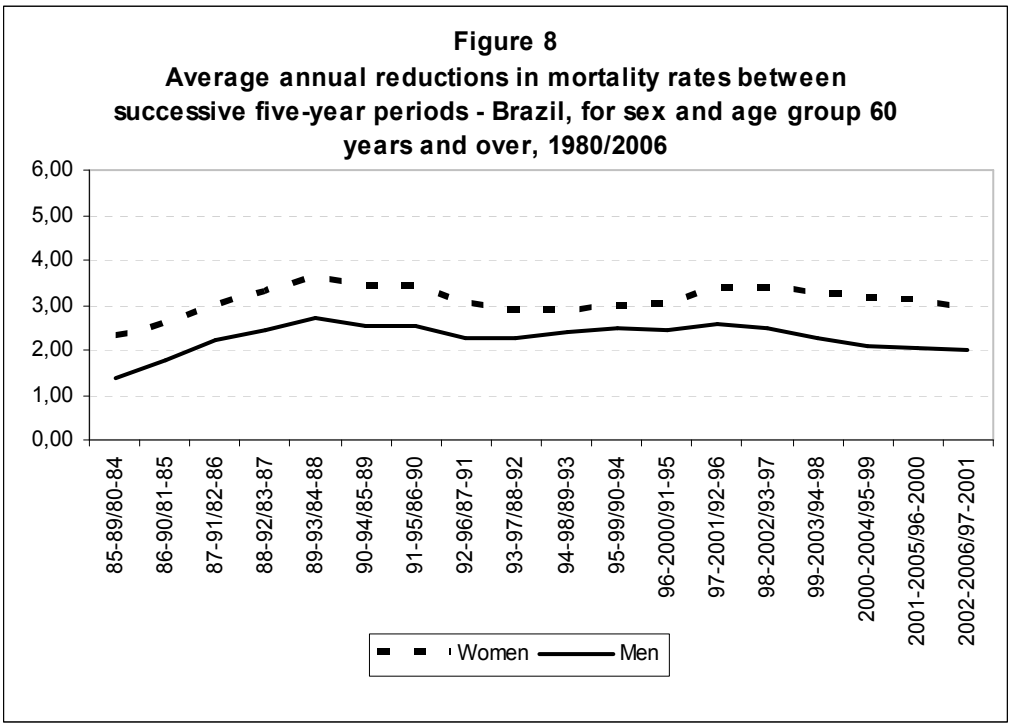
Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.



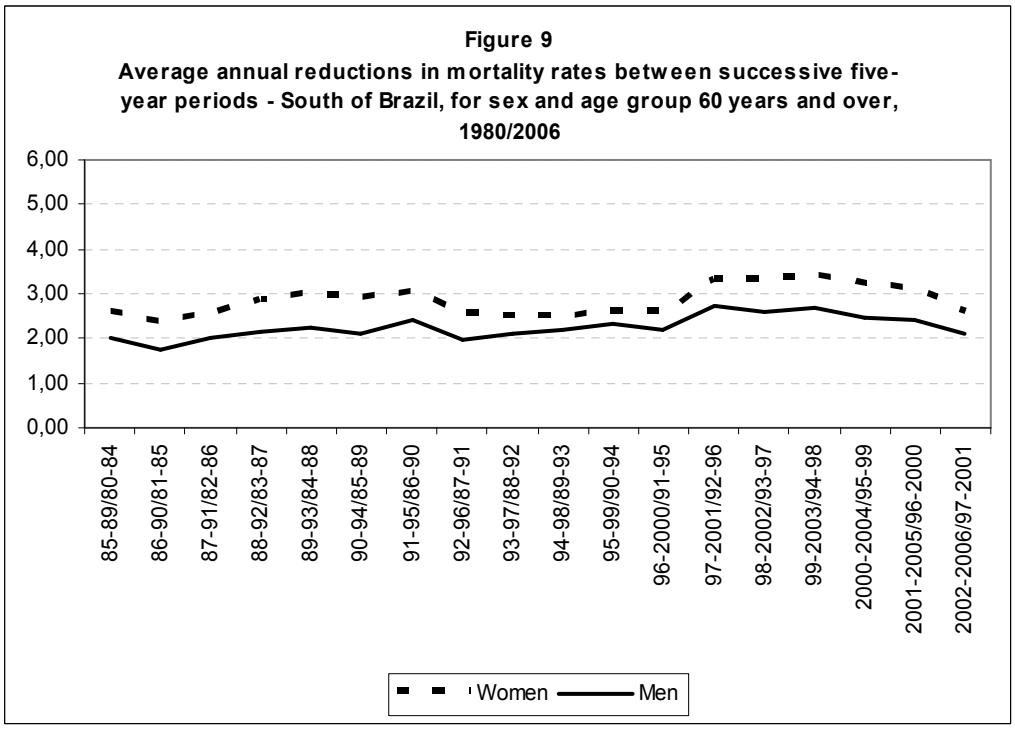
Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.

The Figures 8, 9, 10, 11, 12 and 13 allow the comparison among the sexes in Brazil and the South, the Southeast, the North, the Northeast and the Middle West regions. It shows that the pace of decline is higher among women than it is among men. It can also be observed that, overall (Figure 8), the pace of reductions increased during the first part of the period, tends to decrease in the middle part and to stabilize at the end, for the both sexes. It can be observed that in poorest regions (North and Northeast) the lines for men and women are more distant. In the North region, at the least analyzed period pair, for example, the reduction in the

mortality rate was 0,6% and 2,5% a year for women and men respectively, an almost 2% difference. The same numbers to the Southeast region are 2,7% and 3,3% a year, an only 0,6% difference.

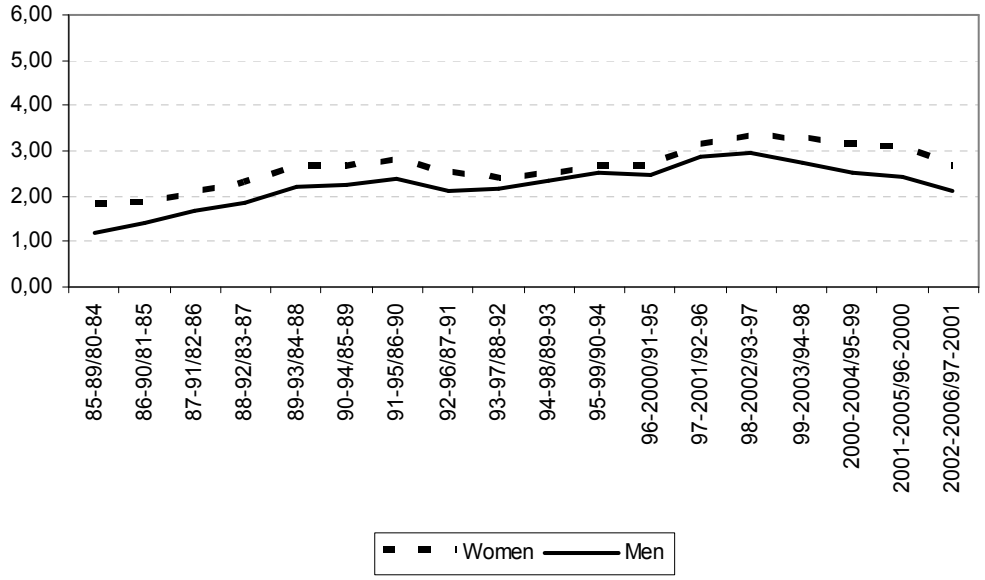


Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.



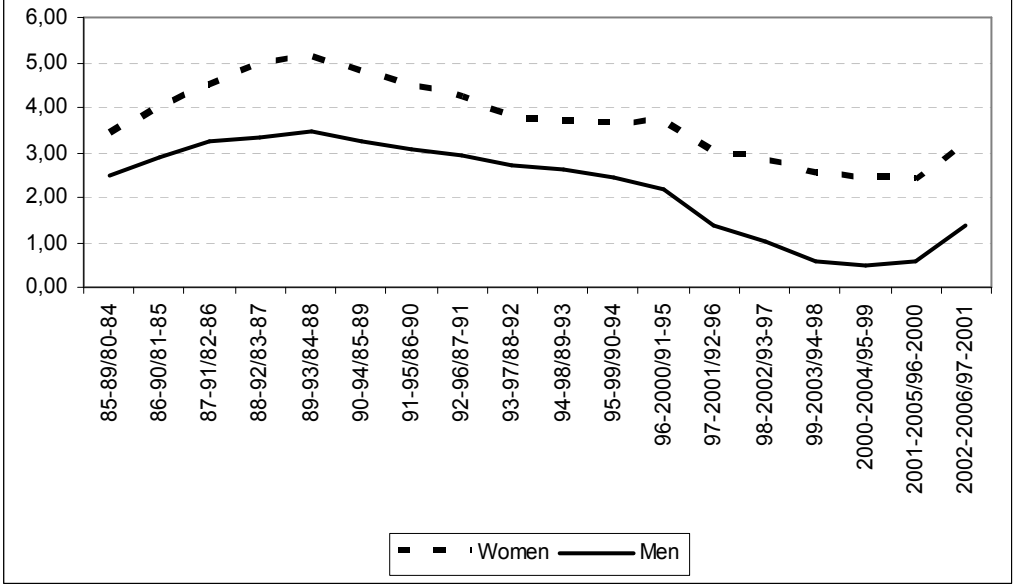
Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.

Figure 10
Average annual reductions in mortality rates between successive five-year periods - Southeast of Brazil, for sex and age group 60 years and over, 1980/2006

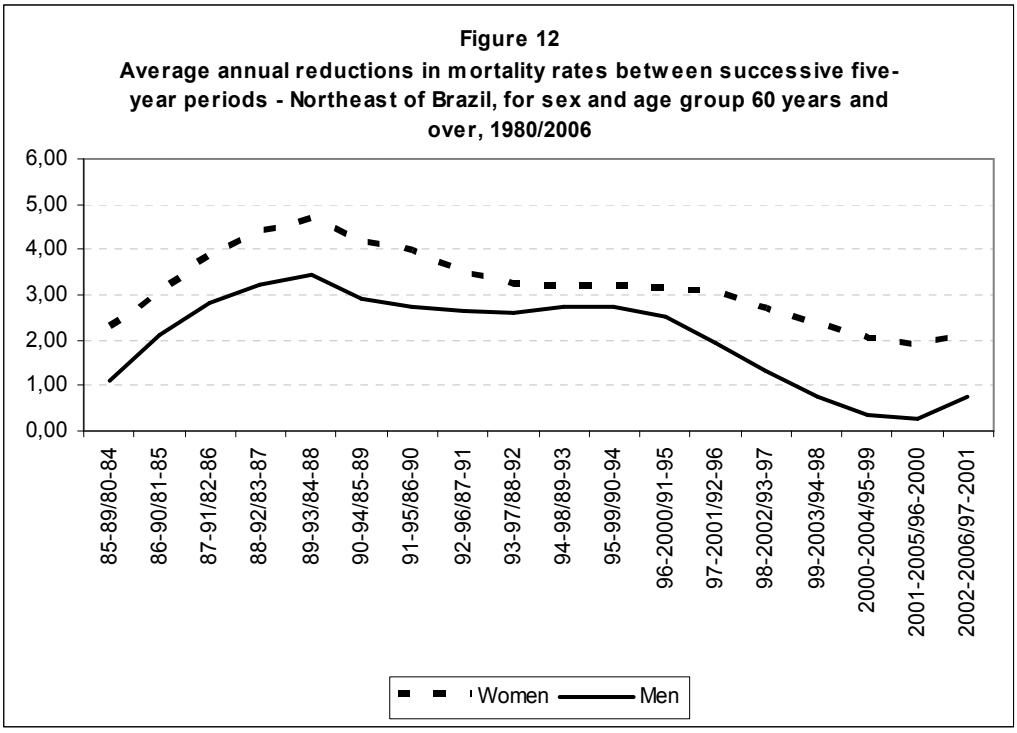


Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.

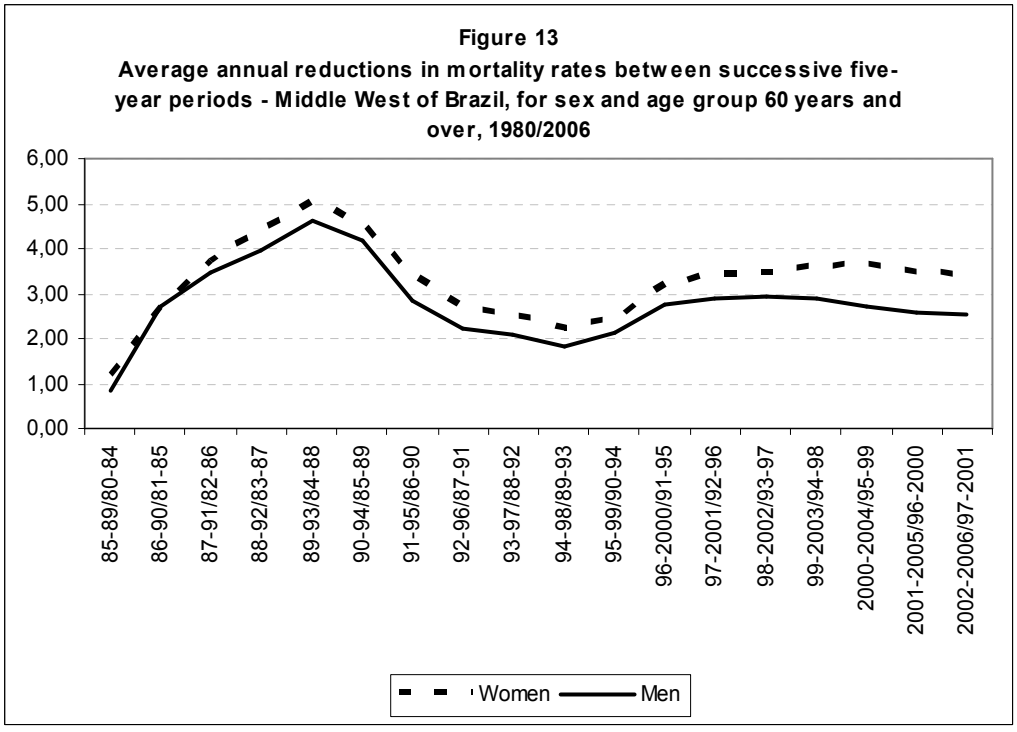
Figure 11
Average annual reductions in mortality rates between successive five-year periods - North of Brazil, for sex and age group 60 years and over, 1980/2006



Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.



Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.



Source: SIM (1980-2006) and Demographic Census of 1980, 1991 and 2000.

5 CONCLUSIONS

Despite of distinctions in many aspects the results showed in here can be compared with Kannisto's results.

The scenery of expressive reductions in the elderly mortality in all regions of the country (especially higher reductions at the final period in more developed regions), more expressive reduction for elderly of 70 years and over than for the "youngest-older" and the most expressive improvement for women than for men show that, during the 1980-2006 period, the elderly mortality in Brazil was far from converging for a limit where future reductions would be difficult.

Even without evaluating the trends in the factors that affect the elderly mortality, there are no reasons to believe that future reductions in the elderly mortality in Brazil are a hypothesis to be discarded. Thus, the process of aging of the population in the region will be influenced, in the next years, not only by the reduction in the fertility levels, but also, and even more, by reductions in the elderly mortality itself. These results raise important implications, at least in two levels: It is necessary that the population projections adopt strategies that take into account the reduction in the mortality among the elderly under the risk of underestimating the volume of the elderly population. Given that there would be space for larger reductions of the mortality among the elderly population it is necessary the adoption of health policies and social security system that guarantee appropriate life conditions for the elderly. Studies evaluating the rhythm of decline of the mortality among the elderly should also focus, in order to subsidize the population projection and the formulation of appropriate public policies.

6 ANNEX

Correction factors for obits with natural causes – age one and over – from 1980 to 2006 for Brazilian and great regions according to sex

	North		Northeast		Southeast		South		Middle West		BRAZIL	
Year	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
1980	1,74	2,32	2,17	2,72	1,21	1,26	1,31	1,38	1,53	1,64	1,48	1,70
1981	1,72	2,26	2,14	2,66	1,20	1,25	1,29	1,36	1,50	1,61	1,46	1,67
1982	1,70	2,21	2,11	2,60	1,19	1,23	1,27	1,33	1,47	1,58	1,44	1,64
1983	1,69	2,15	2,09	2,54	1,18	1,22	1,26	1,31	1,45	1,55	1,43	1,61
1984	1,67	2,10	2,06	2,48	1,16	1,21	1,24	1,29	1,42	1,52	1,41	1,59
1985	1,65	2,05	2,03	2,43	1,15	1,19	1,22	1,27	1,39	1,49	1,39	1,56
1986	1,63	2,00	2,00	2,37	1,14	1,18	1,21	1,25	1,37	1,46	1,38	1,53
1987	1,62	1,95	1,97	2,32	1,13	1,17	1,19	1,23	1,34	1,43	1,36	1,50
1988	1,60	1,91	1,95	2,27	1,12	1,16	1,18	1,22	1,32	1,40	1,34	1,48
1989	1,58	1,86	1,92	2,22	1,11	1,14	1,16	1,20	1,30	1,37	1,33	1,45
1990	1,57	1,81	1,90	2,17	1,10	1,13	1,15	1,18	1,27	1,35	1,31	1,43
1991	1,55	1,77	1,87	2,12	1,09	1,12	1,13	1,16	1,25	1,32	1,30	1,40
1992	1,53	1,73	1,84	2,07	1,08	1,11	1,12	1,14	1,23	1,29	1,28	1,38
1993	1,52	1,69	1,82	2,03	1,07	1,10	1,10	1,12	1,21	1,27	1,27	1,35
1994	1,50	1,64	1,80	1,98	1,06	1,08	1,09	1,11	1,18	1,24	1,25	1,33
1995	1,49	1,60	1,77	1,94	1,05	1,07	1,07	1,09	1,16	1,22	1,24	1,31
1996	1,47	1,57	1,75	1,89	1,04	1,06	1,06	1,07	1,14	1,20	1,22	1,28
1997	1,46	1,53	1,72	1,85	1,03	1,05	1,04	1,06	1,12	1,17	1,21	1,26
1998	1,44	1,49	1,70	1,81	1,02	1,04	1,03	1,04	1,10	1,15	1,19	1,24
1999	1,42	1,45	1,68	1,77	1,01	1,03	1,02	1,02	1,08	1,13	1,18	1,22
2000	1,41	1,42	1,65	1,73	1,00	1,02	1,00	1,01	1,06	1,11	1,16	1,20
2001	1,40	1,38	1,63	1,69	1,00	1,01	1,00	1,00	1,04	1,08	1,15	1,18
2002	1,38	1,35	1,61	1,65	1,00	1,00	1,00	1,00	1,02	1,06	1,14	1,16
2003	1,37	1,32	1,59	1,62	1,00	1,00	1,00	1,00	1,00	1,04	1,14	1,15
2004	1,35	1,29	1,57	1,58	1,00	1,00	1,00	1,00	1,02	1,00	1,13	1,13
2005	1,34	1,25	1,55	1,55	1,00	1,00	1,00	1,00	1,00	1,00	1,12	1,12
2006	1,32	1,22	1,52	1,51	1,00	1,00	1,00	1,00	1,00	1,00	1,12	1,11

Source: In this study the correction factors adopted for the 1980-2006 period were originated from interpolations carried out based on factors provided by IBGE/DPE (Department of Population and Social Indicators) and by the National Public Health School of Osvaldo Cruz Foundation (Fensptec)

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