Tendency of Mortality in Acute Myocardial Infarction in Curitiba (PR) in the period of 1998 to 2009

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Abstract

Background: Acute Myocardial Infarction (AMI) is the single leading cause of death among non-transmitted chronic diseases in Brazil. The knowledge of mortality trends is necessary for planning prevention strategies.

Objective: To evaluate trends in mortality from myocardial infarction in the period from 1998 to 2009 in Curitiba (PR), their distribution by gender, age and their impact in reducing the absolute number of deaths from this disease in this period.

Methods: Demographic data were obtained from the Brazilian Institute of Geography and Statistics (IBGE) and death data were obtained from the Mortality Information System of the Ministry of Health, considering gender, age and residence. From the fit of a Poisson regression model we estimated mortality rates and expected number of deaths that were not observed.

Results: We found significant downward trend ($p < 0.001$) in the period. The estimated average reduction in death rate from AMI each year was 3.8% (95% CI: 3.2% - 4.5%). There was no significant difference between genders ($p = 0.238$), although the evolution of age-specific standard mortality rates differed significantly between the groups ($p = 0.018$). It is estimated that the annual reduction of 3.8% in the mortality rate has resulted in 2,168 deaths below the number expected given the mortality rate observed in 1998 and projecting that number on the population growth occurred during the study period.

Conclusion: Although it remains an important cause of death, mortality from AMI decreased significantly during the evaluation period (Arq Bras Cardiol 2012;98(3):211-217)

Keywords: Myocardial infarction/mortality; epidemiology; mortality/trends; demograhic data.

Introduction

Cardiovascular diseases (CVD) remain the leading cause of death in developed countries and developing countries[1], although in recent decades there was a decline of that mortality rate[2,3]. However, there is evidence of important differences in this decrease in relation to geographic distribution, age, gender, ethnicity and socioeconomic level[4,5].

In Brazil, the CVD mortality rates showed an increase that accompanied industrialization in the country since the 1930s. Within the large group of CVD, Ischemic Heart Disease (IHD) are the most occurring causes of death, and the Acute Myocardial Infarction (AMI) the sole cause of death in men and women[6]. However, there was a decrease in the risk of death from CVD adjusted for age from the 1990s in the South, Southeast and Midwest and some capital from the North and Northeast, with some differences between genders[7].

Maintaining the trend of decline, however, seems to be questionable, since the prevalence of some risk factors like obesity and diabetes mellitus has increased[8,9]. Large population studies show that the risk attributed to these factors is significant[10,11]. In turn, analysis of the impact that controls other risk factors, whether in primary or secondary prevention, shows that the control of these factors is crucial to the reduction in cardiovascular mortality that has been observed[3,12,13]. In the United States, half of the reduction in cardiovascular mortality in two decades could be explained by a better control of risk factors, while the other half was attributed to specific treatment of specific diseases[14].

In the city of Curitiba (PR), acute myocardial infarction has been the single leading cause of death in the last 10 years[15], however, the mortality rate adjusted for age and gender in the same period is not described. A previous study on ischemic heart disease in that locality during the period from 1980 to 1998 showed significant differences

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between genders and ages[16] in relation to mortality by AMI. In this sense, local evaluation of the evolution in the trend of mortality in subsequent years is critical to the planning of public health policies and planning of health promotion and prevention to be implemented by public and private entities.

The aim of this study was to assess the rate of mortality from acute myocardial infarction in the period from 1998 to 2009 in Curitiba, as well as the distribution of mortality by gender, age and its impact on the absolute number of deaths due to AMI in that period.

Methods

In this ecological observational study, the data on causes of deaths in the period from 1998 to 2009 were obtained from the Mortality Information System (SIM) of the Department of the Unified Health System (Datasus) / Ministry of Health (MS).

For the extraction of data on cause of death we considered the cause CID BR-10 coded 068.1 equivalent to the code I-21 of CID-10[17]. The age groups analyzed were from 20-49 years, 50-59 years, 60-69 years, 70-79 years and 80 years or older. The mortality data were collected by place of residence[6].

Demographic data were obtained from the Brazilian Institute of Geography and Statistics (IBGE)[18], and the denominator of rate calculations corresponding to the population by gender and age according to the data for the period from 1998 to 2009.

Statistical Analysis

In order to evaluate the mortality rates, we adjusted a Poisson Regression model considering as response-variable the number of deaths and as the explanatory-variable the time corresponding to the observed years. As an exposure variable we considered the population in each year evaluated. The link function was exponential and for evaluation adjustment, it was considered the deviance function.

The Wald test was used to evaluate the importance of the effect of time on the death rate. The same test was considered to evaluate the similarity between groups in relation to the variation in mortality rate over time. When identifying this importance, we estimated the mean variance rate of consecutive years by the model, with its range of 95% confidence.

After adjusting the Poisson model and considering the baseline (1998), it was estimated the number of AMI deaths that would be expected for the period 1999-2009, which did not occur.

P values <0.05 were considered statistically significant. The analysis was performed with the computer program SPSS v.14.0.

Results

Acute myocardial infarction remains the single leading cause of death among non-transmitted chronic diseases, with proportional mortality of 9.1% in 1998 and 6.7% in 2009. However, we emphasize that, from 2003, the AMI does not configure the first single cause, having been overcome by the deaths from external causes.

The results of the general model of AMI mortality from 1998 to 2009 indicated significant decrease in mortality rate of AMI in the study period ($p < 0.001$) and the

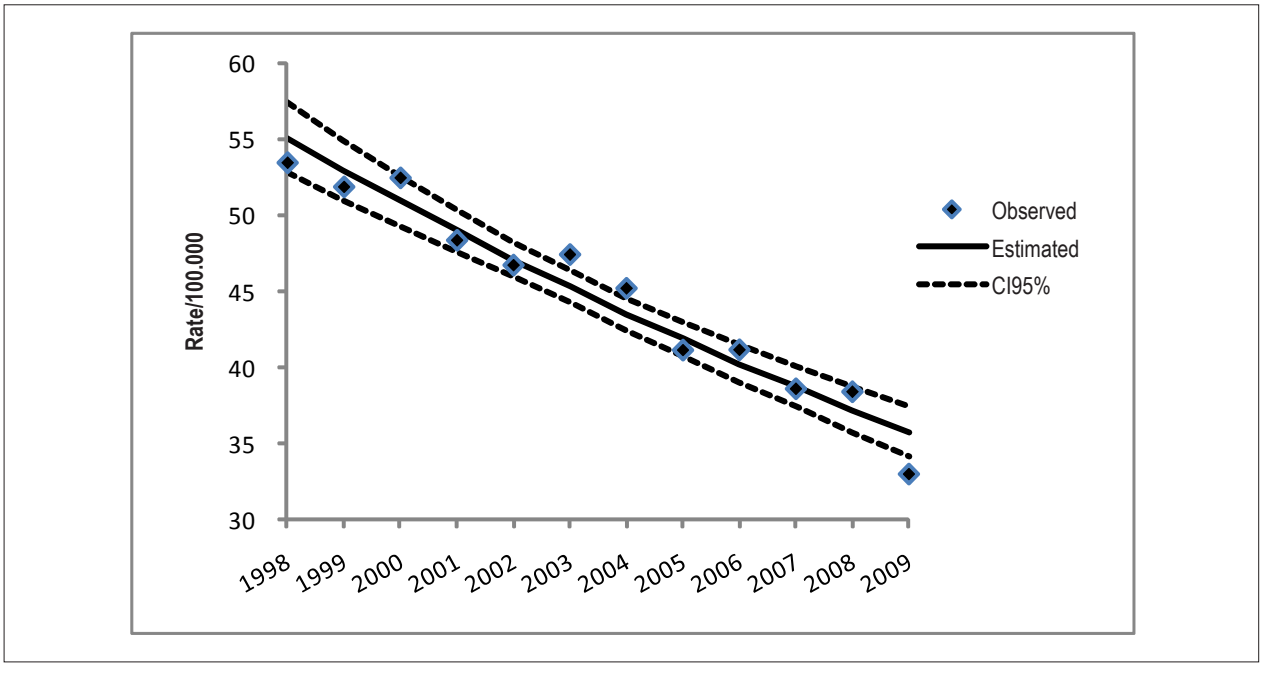

Figure 1 – *General model of AMI mortality trends in Curitiba (PR) in the period 1998 to 2009.*

estimated average reduction in this rate each year was 3.8% (95% CI: 3.2% - 4.5%).

Figure 1 shows the mortality rates/100.000 individuals observed and the rates estimated by fitting the Poisson model with respective ranges of 95% confidence.

Rate of death by AMI: analysis by gender

Throughout the study period, the ratio of the rate of male deaths and the rate for females is 1.46.

For men, there was a downward trend ($p < 0.001$) with estimated average reduction in death rate from AMI each year from 3.5% (95% CI: 2.7% - 4.3%). Similarly, for females it tended to decrease ($p < 0.001$) with estimated average reduction in death rate from AMI each year from 4.2% (95% CI: 3.3% - 5.2%).

Additionally, we tested the parallelism between males and females in relation to the evolution of mortality rates. The results indicated that there was no significant difference ($p = 0.238$) between the genders regarding the trend, as shown in Figure 2.

Age-specific mortality rates

The age ranges from 20 to 29, 30 to 39 and 40 to 49 years were grouped into a new category from 20 to 49 years due to the small number of occurrences in some of the ages mentioned. In this category, we found a significant decrease ($p < 0.001$), with an average reduction in the rate of death from AMI of 7.4% (95% CI: 5.2% - 9.6%) per year. In the age group 50 to 59 years, the decline was also significant ($p < 0.001$), with estimated average reduction in the rate of death from AMI per year of 7.0% (95% CI: 5.5% -8.4 %).

Also in the older age groups, 60-69, 70-79 and 80 years or older, the decline was significant ($p < 0.001$). The estimated average reduction in death rate from AMI each year was 6.6% (95% CI: 5.4% -7.8%) in individuals of 60-69 years, 7, 2% (95% CI: 6.1% - 8.4%) in individuals of 70-79 years, and 4.3% (95% CI: 3.0% - 5.5%) in individuals 80 years or older.

The comparison between the ages of 20-49, 50-59, 60-69, 70-79 years and 80 years or older to the decline in mortality rates was done by testing the hypothesis of parallelism. The evolution of mortality rate in the range of 80 years or older differs significantly of this evolution for the other age groups ($p = 0.018$ for 20-49 years, $p = 0.008$ for 50-59 years, $p = 0.012$ for 60-69 years; $p = 0.002$ for 70-79 years). However, in other comparisons between age groups, no significant difference was found regarding the evolution of mortality rates from AMI (Fig. 3).

Number of deaths fewer than expected from the baseline 1998

From the Poisson model adjusted, the estimated number of deaths from AMI in the period 1998-2009, considering the adjusted rates for each year is 9065. However, if the adjusted rate for 1998 was maintained, the estimated number of deaths would be 11,233. These results indicate that keeping the average decline of 3.8% in the period of 12 years, it is estimated that 2,168 deaths would be expected, but were not observed in this period (Table 1). The evolution of the cumulative number of deaths expected and not observed in the analyzed period is shown in figure 4.

The decline in mortality from AMI may also be represented by the decreased risk of death used in life tables. In this study, the risk of death due to AMI observed in Curitiba in 2009 was 38.2% lower than in 1998.

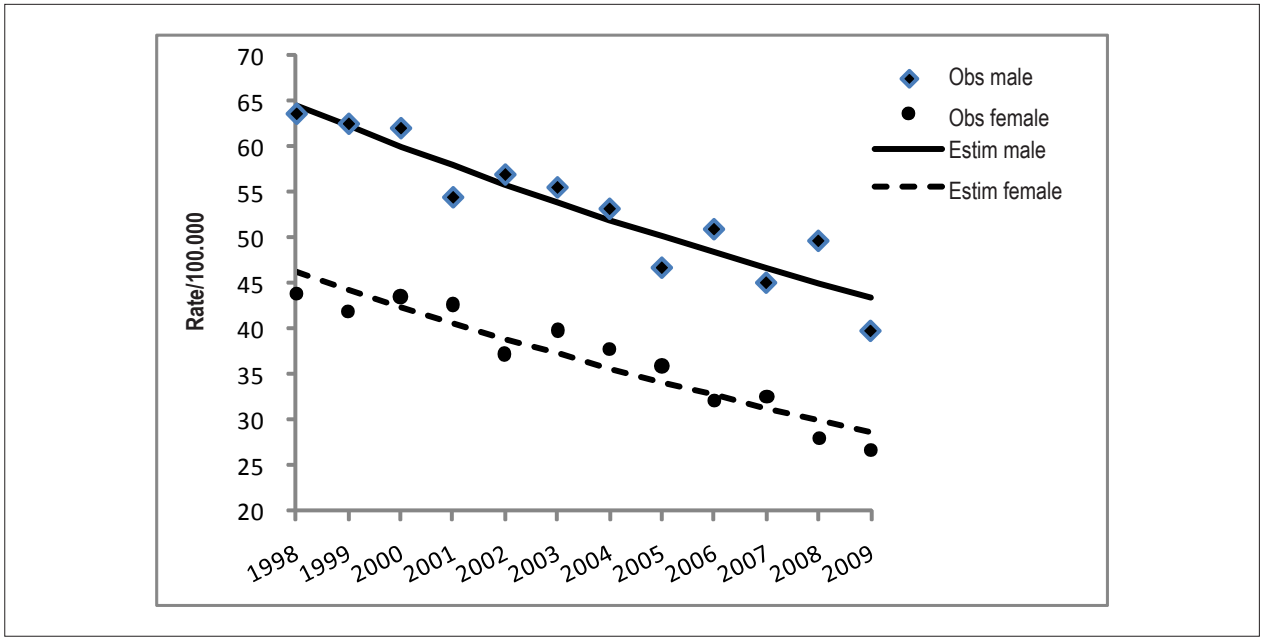

Figure 2 – *Tendência da mortalidade por IAM no período de 1998 a 2009 em Curitiba (PR) para ambos os gêneros.*

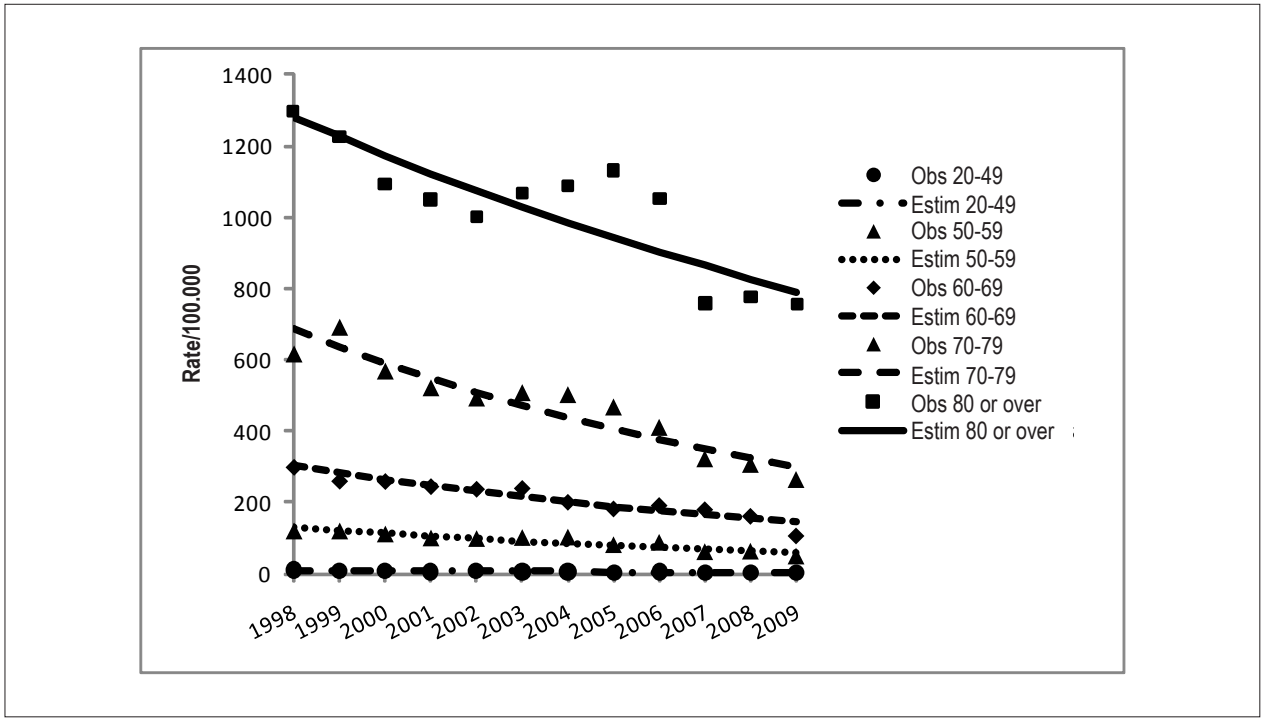

Figure 3 – *AMI mortality trends in Curitiba (PR) in the period 1998 to 2009 for different age groups.*

Table 1 – Deaths expected from the baseline of 1998 and not seen in the period 1998 to 2009

Year	Population	Estimated deaths	Expected deaths with no decay (1998 rate)	Deaths expected and not observed with the decline (CI 95%)
1998	1.550.315	854	-	-
1999	1.584.232	839	872	34 (28 - 40)
2000	1.587.315	808	874	66 (55 - 78)
2001	1.620.221	793	892	99 (84 - 115)
2002	1.644.599	774	906	131 (113 - 151)
2003	1.671.193	756	920	164 (143 - 186)
2004	1.697.703	739	935	196 (174 - 219)
2005	1.757.903	736	968	232 (211 - 255)
2006	1.788.560	720	985	265 (245 - 286)
2007	1.818.950	704	1.002	298 (280 - 316)
2008	1.828.092	680	1.007	326 (311 - 343)
2009	1.851.213	662	1.019	357 (344 - 370)
Total	20.400.296	9065	11.233	2168 (1988 – 2359)

Discussion

The study of mortality is used as a measure of population health parameters, and the design of ecological study is characterized by the determination of the geographic population studied[19]. It is known that this type of study does not propose the analysis at the individual level nor to establish causal relationships. What appears, however, it is the timeline of a cause of mortality for the population of Curitiba, which should not be inferred to other populations, but can be compared with other populations and it may also be based on longitudinal studies of causal relationships. It was observed that mortality by acute myocardial infarction showed a significant reduction in the assessed period. The reduction was consistent over the years in both genders and all age groups below 80 years. This reduction resulted, at the end of the period evaluated in 2,168 fewer deaths than it would be expected by projecting the mortality rate of 1998 and taking into account population growth over the same period. It is noteworthy that the reduction occurred despite the increased rates of hospital admissions for AMI in the period. This phenomenon was also demonstrated in a study of similar methodology conducted in another Brazilian capital[20]. The population over 20 years living in the city of Curitiba grew 19.5% during the study period (1998 to 2009) and rates of hospitalizations for AMI by SUS increased 35%.

The annual decline in mortality rates for ischemic heart disease has been described in Brazilian capitals[21,22]. A previous study which analyzed trends in mortality from acute myocardial infarction and ischemic heart disease in Curitiba between 1980 and 1998[16] already demonstrated a tendency

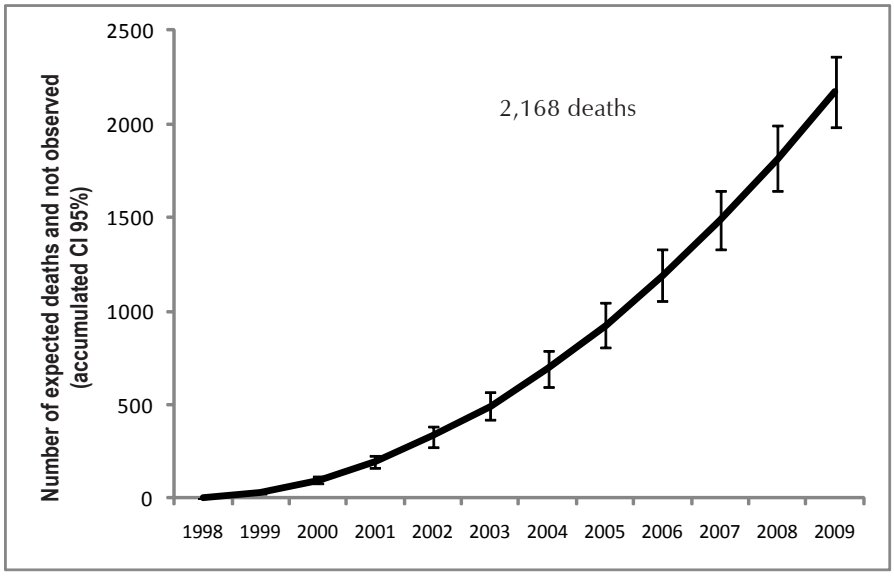

Figure 4 – *Cumulative deaths expected and not observed from the baseline between 1998 and 2009 in Curitiba (PR).*

to decrease mortality due to AMI, but at a lower rate of decline than the 3.8% per year demonstrated here. Although that study has used another method of analysis for the trend, our estimates of annual percentage decrease were carried out in relation to the immediately preceding year showing a declining trend even higher than that found in the previous period. Another aspect to be considered is the limitation of intercensal population projections. Our study used data from the 2010 Census which corrected earlier projections and showed the overestimation of the data presented above.

Regarding gender differences, the proportion of male/female deaths found in our study, was an average of 1.46, while the proportion found in that study was 1.6. Other studies carried out in Brazilian capitals have also evidenced that the downward trend in mortality from AMI in a similar period point out to the differences between the genders[23]. INTERHEART[11] study data showed that women tend to suffer a first heart attack later than men, but this phenomenon does not seem to be reflected in the trend of declining mortality. In our study, the decrease was similar between genders, as evidenced by parallel test suggesting that major downward trend in male mortality from AMI reported previously seems to have been directed to a parallel in relation to female mortality in the last decade.

Comparing age groups, the older ages (60-69 and 70-79 years) had a higher proportion of decline compared to younger ages (20-49 years) indicating that the decrease of the tendency of AMI mortality observed in this study seems to move to the fourth stage of the epidemiological transition model adapted to cardiovascular diseases described by Yusuf et al[24]. In this phase, efforts aimed at diagnosing and treating cardiovascular disease mortality can delay mortality in the older ages. This finding suggests an epidemiologic cardiovascular disease transition phase to Curitiba if the same phenomenon is observed in other causes of cardiovascular death, unlike the findings of other metropolitan areas in Brazil[25] and closer to the proportions found in developing countries[26].

Also in relation to age, the inadequacy of the range of 80 years or older in the comparisons between this track and the others to the Poisson distribution appears to have been the effect of erratic behavior in some years of the period, however there is a tendency to decline. In addition to the predicted rise in risk stratification, it is interesting to note that especially in this age group, socioeconomic factors seem to be more related to the greater difficulty of decline in CVD mortality as it has been described[21,27]. Nonetheless, it is known that this phenomenon may be influencing the behavior of the trend of mortality; this association was not analyzed in this work. We must also consider the age of 80 years or older is not included in the Brazilian List of Preventable Deaths, since the methodology that list is based on is the life expectancy of the population being 75 years, the age limit of the present list[28].

This study was restricted to the analysis of data from death, and the causes remain unclear and the decline in mortality from AMI. A significant portion of the risk of AMI and cardiovascular diseases is associated with modifiable factors widely known[29,30]. According to the data of the INTERHEART[11] study, globally it can be attributed 90% risk of a first myocardial infarction to the presence of six risk factors (dyslipidemia, hypertension, smoking, diabetes, abdominal obesity and psychosocial factors) or absence of three "protective" factors (daily consumption of fruits and vegetables, physical activity and mild alcohol consumption). Population studies that assessed the factors related to the decline in cardiovascular mortality, either in primary or secondary prevention demonstrate that control of these

risk factors, and not only the improvement in the treatment of acute syndrome, accounts for a significant portion in the context of declining of mortality[12,13,31].

In this sense, the calculation of the number of fewer deaths than expected from the 1998 baseline serves as a starting point for analysis models to assess the weight of the control of risk factors and impact of effective therapies for broadly precognized guidelines for treatment of AMI without supradeppression[32] and with supradeppression of the ST-segment[33]. Some studies suggest the number of deaths averted from fibrinolytic therapy[34] in the management of AMI, however, the combination and strength of currently recommended therapies such as thrombolysis, antiplatelet, beta-blockers, angiotensin-converting enzyme inhibitors and angioplasty in the number of lives saved is not clear. In our midst, these components have not yet been analyzed simultaneously. The lack of recorded data, from the public and private services, on the prevalence of several modifiable risk factors over the years, puts in doubt the possibility of such an analysis being performed reliably on a large scale in our country.

In conclusion, the trend of decline in mortality from AMI in Curitiba (PR) in the period 1998 to 2009 was significant; showing a decrease of 38.2% in the risk of death from acute myocardial infarction in individuals aged 20 years or older. This decrease resulted in 2,168 deaths expected and not observed in the period. A detailed analysis of factors associated with this reduction would be necessary for future action planning at different levels of health care in our midst.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

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Study Association

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References

1. Levi F, Lucchini F, Negri E, La Vecchia C. Trends in mortality from cardiovascular and cerebrovascular diseases in europe and other areas of the world. Heart. 2002;88(2):119-24.
2. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: part I: general considerations, the epidemiologic transition, risk factors, and impact of urbanization. Circulation. 2001;104(22):2746-53.
3. Naidoo BT, Chunterpurshad I, Mahyoodeen AB, Pather G. The use of a soy isolate based formula in the treatment of infantile diarrhoea. J Int Med Res. 1981;9(5):232-5.
4. Gerber Y, Jacobsen SJ, Frye RL, Weston SA, Killian JM, Roger VL. Secular trends in deaths from cardiovascular diseases: a 25-year community study. Circulation. 2006;113(19):2285-92.
5. Ruff CT, Braunwald E. The evolving epidemiology of acute coronary syndromes. Nat Rev Cardiol. 2011;8(3):140-7.
6. Ministério da Saúde. Datasus. Sistema de Informação sobre Mortalidade (SIM). [Acesso em 2011 ago 10]. Disponível em http://www.tabnet.datasus.gov.br/tabela/sim/dados/cid10_indice.htm
7. Araujo DB, Bertolami MC, Ferreira WP, Abdalla DS, Faludi AA, Nakamura Y, et al. Pleiotropic effects with equivalent low-density lipoprotein cholesterol reduction: comparative study between simvastatin and simvastatin/ezetimibe coadministration. J Cardiovasc Pharmacol. 2010;55(1):1-5.
8. Ministério da Saúde. Inquérito domiciliar sobre comportamentos de risco e morbidade referida de doenças e agravos não transmissíveis. Brasil. 2003. [Acesso em 2011 ago 10]. Disponível em http://www.se.gov.br/userfiles/arquivos/216
9. Sartorelli DS, Franco LJ. [trends in diabetes mellitus in Brazil: the role of the nutritional transition]. Cad Saude Publica. 2003;19(Suppl 1):S29-36.
10. Tunstall-Pedoe H, Kuulasmaa K, Mahonen M, Tolonen H, Ruokokoski E, Amouyel P. Contribution of trends in survival and coronary-event rates to changes in coronary heart disease mortality: 10-year results from 37 WHO MONICA project populations. Monitoring trends and determinants in cardiovascular disease. Lancet. 1999;353(9146):1547-57.
11. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364(9438):937-52.
12. Laatikainen T, Critchley J, Vartiainen E, Salomaa V, Ketonen M, Capewell S. Explaining the decline in coronary heart disease mortality in Finland between 1982 and 1997. Am J Epidemiol. 2005;162(8):764-73.
13. Capewell S, Beaglehole R, Seddon M, McMurray J. Explanation for the decline in coronary heart disease mortality rates in Auckland, New Zealand, between 1982 and 1993. Circulation. 2000;102(13):1511-6.
14. Ford ES, Ajani UA, Croft JB, Critchley JA, Labarthe DR, Kottke TE, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980–2000. N Engl J Med. 2007;356(23):2388-98.
15. Secretaria Municipal de Saúde. Curitiba. Mortalidade geral no município de Curitiba - 1979 - 2007. [Acesso em 2011 jun 30]. Disponível em http://sistemas.curitiba.pr.gov.br/saude/
16. Daniel E, Germiniani H, Nazareno ER, Braga SV, Winkler AM, Cunha CL. [Mortality trend due to ischemic heart diseases in the city of Curitiba--Brazil, from 1980 to 1998]. Arq Bras Cardiol. 2005;85(2):100-4.
17. Organização Mundial da Saúde. OMS. CID - Classificação Estatística Internacional de Doenças. 7ª ed. São Paulo: EDUSP; 2008.
18. Instituto Brasileiro de Geografia e Estatística (IBGE). [Acesso em 2011 jun 10]. Disponível em http://www.ibge.gov.br
19. Bonita R, Beaglehole R, Kjellstrom T. Basic epidemiology. Geneva (Switzerland): World Health Organization; 2006.
20. Rosa ML, Giro C, Alves Tde O, Moura EC, Lacerda Lda S, SantAnna LP, Macedo Rde A, Leal SB, Garcia KS, Mesquita ET. Analysis of mortality and hospitalization for cardiovascular diseases in Niteroi, between 1998 and 2007. Arq Bras Cardiol. 2011;96(6):477-83.
21. Bassanesi SL, Azambuja MI, Achutti A. Mortalidade precoce por doenças cardiovasculares e desigualdades sociais em Porto Alegre: da evidência à ação. Arq Bras Cardiol. 2008;90(6):370-9.

22. de Souza MdeF, Alencar AP, Malta DC, Moura L, Mansur A de P. Análise de séries temporais da mortalidade por doenças isquêmicas do coração e cerebrovasculares, nas cinco regiões do Brasil, no período de 1981 a 2001. Arq Bras Cardiol. 2006;87(6):735-40.

23. Passos LC, Lopes AA, Lessa I, Sanches A, Santos-Jesus R. Tendência da mortalidade por infarto agudo do miocárdio (1981 a 1996) na cidade de Salvador, Brasil. Arq Bras Cardiol. 2000;74(4):329-31.

24. Yusuf S, Reddy S, Ounpuu S, Anand S. Global burden of cardiovascular diseases: part II: variations in cardiovascular disease by specific ethnic groups and geographic regions and prevention strategies. Circulation. 2001;104(23):2855-64.

25. Mansur A de P, Souza M de F, Timermann A, Ramires JA. Tendência do risco de morte por doenças circulatórias, cerebrovasculares e isquêmicas do coração em 11 capitais do Brasil de 1980 a 1998. Arq Bras Cardiol. 2002;79(3):269-84.

26. Avezum A, Piegas LS, Pereira JC. [Risk factors associated with acute myocardial infarction in the Sao Paulo metropolitan region: a developed region in a developing country]. Arq Bras Cardiol. 2005;84(3):206-13.

27. Godoy MF, Lucena JM, Miquelin AR, Paiva FF, Oliveira DL, Augustin JL Jr, et al. Mortalidade por doenças cardiovasculares e níveis socioeconômicos na população de São José do Rio Preto, Estado de São Paulo, Brasil. Arq Bras Cardiol. 2007;88(2):200-6.

28. Malta DC, Duarte EC. [Causes of avoidable mortality through effective healthcare services: a review of the literature]. Cien Saude Colet. 2007;12(3):765-76.

29. Lanas F, Avezum A, Bautista LE, Diaz R, Luna M, Islam S, et al. Risk factors for acute myocardial infarction in Latin America: the INTERHEART Latin American study. Circulation. 2007;115(9):1067-74.

30. O'Donnell M, Xavier D, Liu L, Zhang H, Chin S, Rao-Melacini P, et al. Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): a case-control study. Lancet. 2010;376(9735):112-23.

31. Critchley J, Liu J, Zhao D, Wei W, Capewell S. Explaining the increase in coronary heart disease mortality in Beijing between 1984 and 1999. Circulation. 2004;110(10):1236-44.

32. Nicolau JC, Timerman A, Piegas LS, Marin Neto JA, Rassi A Jr / Brazilian Society of Cardiology. Guidelines for unstable angina and non-ST-segment elevation myocardial infarction. Arq Bras Cardiol. 2007;89(4):e89-e131.

33. Brazilian Society of Cardiology.IV Guidelines of Brazilian Society of Cardiology for treatment of acute myocardial infarction with ST-segment elevation. Arq Bras Cardiol. 2009;93(6 Suppl. 2):e179-264.

34. Avezum A, Carvalho ACC Mansur AP, Timerman A, Guimarães AC, Bozza AE / Sociedade Brasileira de Cardiologia. III Diretriz sobre tratamento do infarto agudo do miocárdio. Arq Bras Cardiol. 2004;83(supl. 4):1-86.