Trends in Death from Circulatory Diseases in Brazil Between 1979 and 1996

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Objective - *To analyze the trends in mortality due to circulatory diseases in men and women aged ≥30 years in Brazil from 1979 to 1996.*

Methods - *We analyzed population count data obtained from the IBGE Foundation and mortality data obtained from the System of Information on Mortality of the DATASUS of the Ministry of Health.*

Results - *Circulatory diseases, ischemic heart disease, and cerebrovascular disease were the major causes of death in men and women in Brazil. The standardized age coefficient for circulatory disease in men aged ≥30 years ranged from 620 to 506 deaths/100,000 inhabitants and in women from 483 to 383 deaths/100,000 inhabitants for the years 1979 and 1996, respectively. In men, the mean coefficient for the period was 586.25 deaths with a significant trend towards a decrease (P<0.001) and a decline of 8.25 deaths/year. In women, the mean coefficient for the period was 439.58 deaths, a significant trend towards a decrease (P<0.001) and a rate of decline of 7.53 deaths/year. The same significant trend towards a decrease in death (P<0.001) was observed for ischemic heart disease and cerebrovascular disease. Risk of death from these causes was always higher for men of any age group (P<0.001). Cerebrovascular disease was the primary cause of death in women.*

Conclusion – *Although circulatory diseases have been the major cause of mortality in men and women in the Brazilian population, with a greater participation by cerebrovascular diseases, a trend towards a decrease in the risk of death from these causes is being observed.*

Key-words: circulatory disease, ischemic heart disease, cerebrovascular disease, mortality, trends

Circulatory diseases are the major causes of morbidity and mortality in more developed, and in a great number of developing, countries. In the most developed countries an important reduction in the incidence of these diseases has been detected. In the USA, a progressive tendency towards reduction in mortality due to circulatory diseases has been observed from the middle 1960s onward; in the 1980s, the annual reduction in ischemic heart disease was around 3.5% for both sexes [1]. A recent report [2] showed that in 1997 mortality due to heart disease in the USA was practically the same as that observed for malignant neoplasms, followed by deaths from external causes, overtaking the incidence of cerebrovascular diseases. The same decrease in mortality due to circulatory diseases took place in the more developed countries of Europe, but with a lower annual reduction in coronary artery disease of 2.7% in men and 2.1% in women [3]. A similar response is being recorded for cerebrovascular disease in both sexes in the more developed countries [4]. Many factors have contributed to this reduction in mortality, the most important probably being the control of major risk factors.

In Brazil, although being the major cause of mortality from the 1960s onwards, because of the availability of population and mortality data, we are not unaware of the trends in mortality due to circulatory, ischemic heart, and cerebrovascular disease in the general-male and female populations. Yet, we are not in possession of results of recent studies comparing mortality standardized for age with that of the populations of other countries. Earlier studies of the trends in mortality from these diseases in the Brazilian population only analyzed them for regions, cities, or specific diseases [5-9]. Comparisons with the mortality in populations from other countries also remained restricted to some Brazilian cities [10]. Thus, the monitoring of mortality in Brazil as a whole becomes very important, by possibly facilitating the definition of a public health policy over the short- and long-term.

Methods

Population estimates as of July 1 for the years from

1979 to 1996 were calculated by interpolation according to Lagrange [11] and were based on census data for 1970 [12], 1980 [13], 1991 [14] and 1996 [15], for each age range and sex.

Mortality ratios were obtained from the Mortality Information System (SIM), the official source of the Ministry of Health [16,17]. Deaths that occurred between 1979 and 1995 were classified according to CID-9, 9th Conference of the Revision of the International Disease Classification, 1975, and adopted by the 20th World Health Assembly [18]. Mortality data for the year 1996 were obtained from the 10th Revision of the International Disease Classification [19]. Circulatory diseases are grouped by codes 390 to 459, ischemic heart disease by codes 410 to 414, and cerebrovascular diseases by codes 430 to 438, of the 9th Revision of the International Classification of Disease for the population of Brazil for years 1979 to 1995. Mortality for the year 1996 was classified by the 10th Revision of the International Disease Classification. Circulatory diseases are grouped by codes 110 to 182.9, ischemic heart disease by codes 120 to 125, and cerebrovascular diseases by codes 160 to 169.

Standardized mortality coefficients were calculated by the direct method, for the population aged ≥ 30 years [20], using as a standard population sample Segi's world of 1960 [21], based on 100,000 individuals. These coefficients were calculated for each period studied, taking into account total number of deaths and, separately, those for males and females [22].

To analyze mortality trends, standardized mortality coefficients were used. Models of single linear regression were estimated [23], estimation being one of the statistical methods used for analyzing time series. In this modeling process, standardized mortality coefficients of circulatory disease, ischemic heart disease, and cerebrovascular disease were considered as dependent variables (Y) and calendar years of the study as independent variables (X). The year variable was transformed into the centralized variable (year-1987), because 1987 is the mean point of the historic series.

Thus, the estimate model $\div Y = \beta_0 + \beta_1 X$, where Y = standardized coefficient, β_0 = mean coefficient for the period, β_1 = mean annual increment, and X = year – 1987, was obtained.

Results

General mortality from all causes in the male and female population studied, standardized for age for individuals ≥ 30 years, is shown in Table I. A reduction in mortality of 4.5% was observed over the period studied. In men, the reduction was 2.2%, in women 6.6%.

The analysis of the trends in mortality coefficients from all causes standardized for age by the linear regression method showed that (Figure 1): a) the mean standardized coefficient of mortality between 1979 and 1996 was 1,338.76 deaths per 100,000 inhabitants; b) the stable tendency of the standardized coefficient in men was 1,598/100,000 in 1979, and 1,564 in 1996 (P=0.059); c) the mean standardized coefficient for the period in men was 1,652 with a decline of 6.75 deaths per 100,000 inhabitants; d) the standardized coefficient-

Table I - All cause mortality per 100.000 inhabitants, age ajusted, for subjects older than 30 years			
Year	Total	Men	Women
1979	1342.73	1598.35	1102.84
1980	1425.24	1692.15	1175.10
1981	1427.43	1699.78	1172.89
1982	1413.95	1700.27	1147.08
1983	1484.36	1788.77	1200.98
1984	1542.39	1861.37	1246.03
1985	1299.64	1602.16	1027.14
1986	1311.83	1617.15	1036.51
1987	1294.88	1589.58	1029.28
1988	1355.89	1668.89	1074.62
1989	1310,22	1610.90	1038.80
1990	1325.15	1627.07	1053.98
1991	1296.11	1595.87	1027.18
1992	1330.06	1637.10	1054.94
1993	1403.27	1723.56	1116.97
1994	1282.22	1575.80	1021.18
1995	1305.42	1587.95	1052.89
1996	1281.71	1563.83	1030.26
Fall (%)	4.5	2.2	6.6

* using A standard world population sample of 1960.

ent in women was 1,102/100,000 in 1979, and 1,030,564 in 1996 (P=0.001); e) the standardized mean coefficient for the period in women, was 1,088,93 and the decline of 8.3 deaths/100,000/year.

The mortality from circulatory disease in the general population, men and women, standardized for age of individuals ≥ 30 years, is shown in Table II.

A 19.6% reduction in mortality due to circulatory diseases in individuals ≥ 30 years, over the period studied, was observed. In men, the reduction was 18.3%, in women 20.7%.

The analysis of the trends in mortality coefficients from circulatory diseases standardized for age by the linear regression method showed that (Figure 2): a) the mean standardized coefficient of mortality between 1979 and 1996 was 509.95 deaths per 100,000 inhabitants; b) the decreasing trend in the standardized coefficient in men was 620/100,000 in 1979, and 506 in 1996 (P<0.001); c) the standardized mean coefficient for the period in men was 586.25, with a decline of 8.25 deaths per 100,000 inhabitants per year; d) the standardized coefficient in women was 483/100,000 in 1979, and 383 in 1996 (P<0.001); e) the standardized mean coefficient for the period in women was 439.58, and the decline in deaths was 7.53/100,000/year.

The mortality from ischemic heart disease in the general population, men and women, standardized for age of individuals ≥ 30 years, is shown in Table III. A 12.7% reduction in mortality due to ischemic heart diseases in individuals ≥ 30 years, over the period studied, was observed. In men, the reduction was 15.3%, in women 11.6%.

The analysis of the trends in mortality coefficients from ischemic heart diseases standardized for age by the linear regression method showed that (Figure 3): a) the mean standardized coefficient of mortality between 1979 and 1996 was 151.29 deaths per 100,000 inhabitants; b) the decreasing trend in the standardized coefficient in men was 194/100,000
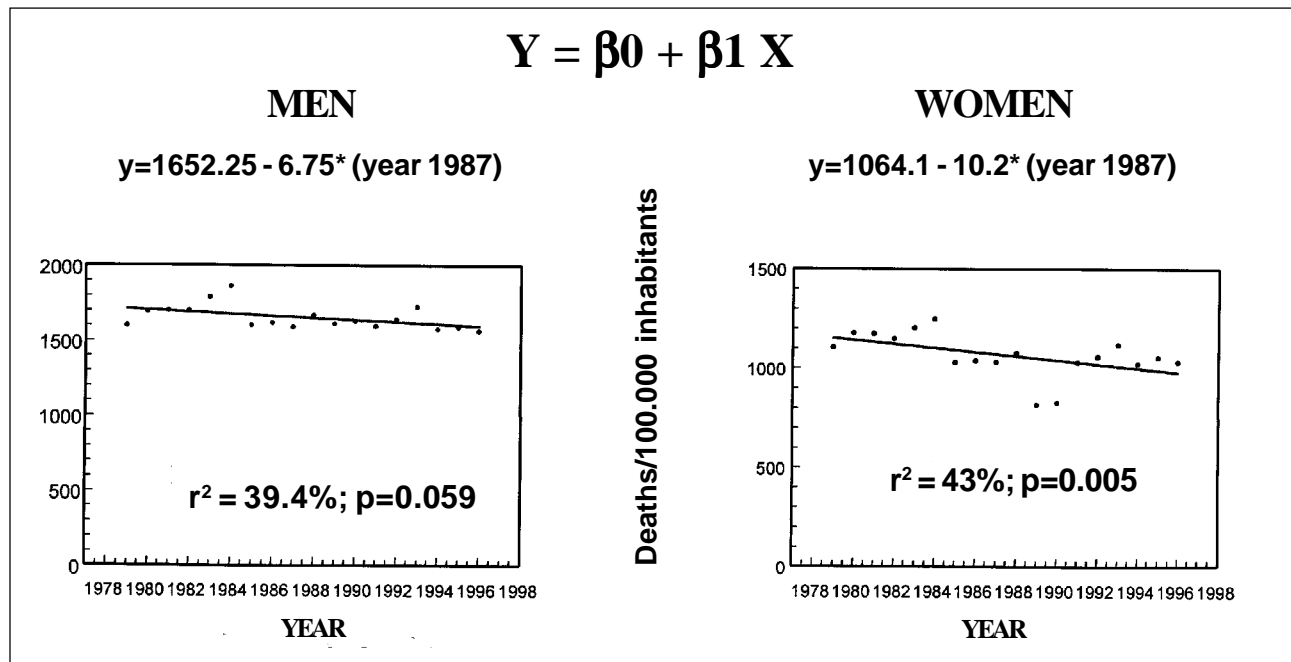
$$Y = \beta 0 + \beta 1\, X$$

MEN

y=1652.25 - 6.75* (year 1987)

$r^2 = 39.4\%$; p=0.059

1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998
YEAR

WOMEN

y=1064.1 - 10.2* (year 1987)

$r^2 = 43\%$; p=0.005

1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998
YEAR

Deaths/100.000 inhabitants

Fig. 1 -All cause mortality coefficient trends (linear regression)

Table II - Vascular disease mortality*			
Year	Total	Men	Women
1979	549.99	619.55	483.36
1980	570.84	642.71	502.06
1981	568.43	640.20	500.19
1982	554.53	632.46	481.19
1983	571.60	650.93	496.98
1984	583.32	665.66	506.12
1985	492.95	575.99	417.72
1986	488.59	569.49	415.00
1987	479.68	556.49	409.75
1988	508.44	592.66	432.37
1989	490.72	572.69	416.45
1990	485.93	563.75	415.86
1991	463.90	538.96	395.93
1992	474.27	551.94	404.00
1993	493.44	573.00	421.61
1994	447.51	520.61	381.23
1995	441.05	504.96	381.63
1996	442.01	506.20	383.24
Queda(%)	19.6	18.3	20.7

* as in table I.

in 1979 and 164 in 1996 (P<0.001); c) the standardized mean coefficient for the period in men was 187.78, with a decline of 2.94 deaths per 100,000 inhabitants per year; d) the standardized coefficient in women was 119/100,000 in 1979 and 105 in 1996 (P<0.001); e) the standardized mean coefficient for the period in women was 115.83 with a decline in deaths of 1.67/100,000 inhabitants/year.

The mortality from cerebrovascular disease in the general population, men and women, standardized for age of individuals ≥30 years, is shown in Table IV. A 20.7% reduction in mortality due to cerebrovascular diseases in individuals ≥30 years, over the period studied, was observed. In

men, the reduction was 18.6%, in women 22.6%.

The analysis of the trends in mortality coefficients from cerebrovascular diseases standardized for age by the linear regression method showed that (Figure 4): a) the mean standardized coefficient of mortality between 1979 and 1996 was 175.08 deaths per 100,000 inhabitants; b) the decreasing tendency of the standardized coefficient in men was 200/100,000 in 1979 and 164 in 1996 (P<0.001); c) the standardized mean coefficient for the period in men was 195.10 with a decline of 2.50 deaths per 100,000 inhabitants per year; d) the standardized coefficient in women was 168/100,000 in 1979 and 130 in 1996 (P<0.001); e) the standardized mean coefficient for the period in women was 155.48 with a decline of 2.78 deaths /100,000 inhabitants/year.

Discussion

The present study shows that although circulatory diseases are still the primary cause of death in Brazil, such deaths are decreasing in number. Using the simple linear regression method, mortality reduction was noted for circulatory diseases, ischemic heart disease, and cerebrovascular disease in both sexes; ischemic heart disease reduction was noted to be almost twice as high in men (-2.94 deaths/year) compared with that in women (-1.67 deaths/year). Cerebrovascular diseases decreased by nearly three deaths/year for both sexes. Circulatory disease in general had a reduction of around 8 deaths/year in both sexes, suggesting that other diseases participated in the reduction in mortality from circulatory diseases, not just ischemic heart diseases and cerebrovascular diseases. However, this reduction was only observed from the year of 1985 onwards, but in developed
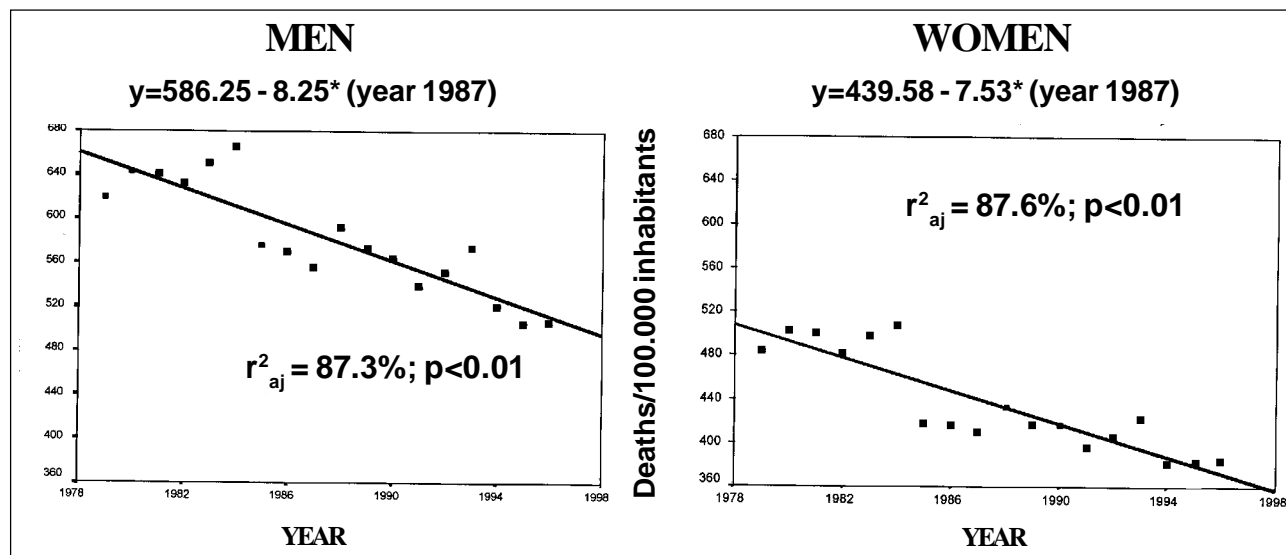
MEN

y=586.25 - 8.25* (year 1987)

$r^2_{aj} = 87.3\%; p<0.01$

WOMEN

y=439.58 - 7.53* (year 1987)

$r^2_{aj} = 87.6\%; p<0.01$

Deaths/100.000 inhabitants

YEAR

Fig. 2 - Circulatory disease mortality coeficient trends

Tabela III - Ischemic heart disease mortality*			
Year	Total	Men	Women
1979	155.26	193.85	118.71
1980	166.10	205.23	128.96
1981	166.56	204.72	130.43
1982	161.09	201.05	123.4
1983	171.05	211.56	132.98
1984	173.00	216.21	132.66
1985	148.53	189.54	111.48
1986	146.42	186.04	110.50
1987	147.71	187.04	112.05
1988	154.58	196.67	116.56
1989	148.94	188.45	113.15
1990	145.55	177.74	110.58
1991	140.53	170.56	107.63
1992	139.89	170.26	106.61
1993	142.46	173.60	108.48
1994	130.27	159.67	99.05
1995	130.63	157.31	101.59
1996	135.57	164.09	104.97
Queda(%)	12.7	15.3	11.6

* as in table I.

countries it had been noted since the 1960s. The reasons for this difference are unknown; it has been speculated that better control of circulatory disease risk factors, improved socioeconomic conditions, technical and scientific progress, and a better understanding of the physiopathology of these diseases may be associated with more adequate diagnosis and treatment [24].

Mortality in Brazil was compared with that in other countries, mostly European, making up countries analyzed by Uemura and Pisa with data from the World Health Organization [25]. In the majority of the more developed countries in Europe, a progressive reduction in mortality from circulatory, ischemic heart, and cerebrovascular diseases was observed. Although in the more developed countries (Western

block) of Europe, a tendency towards a gradual decrease has been observed since 1970, mortalities due to these diseases showed a discrete increase between 1980 and 1985 in Brazil, in a manner similar to that observed in countries in the European Oriental block, in particular, Poland, Rumania, Hungary, Bulgaria, and Yugoslavia, as well as in Greece and Spain, in the period from 1970 to 1985.

Compared with the (MONICA - Monitoring Trends and Determinants in Cardiovascular Disease) project, mortality due to ischemic heart disease standardized by age in both sexes of the Brazilian population was similar to that of the more developed countries of Europe. In men, the ratio was similar to that observed in France, Italy, Spain, and Switzerland, the lowest observed in Europe. In women, the result observed was not the same as that in men, but even so, it was closer to the ratios recorded in the countries of Western Europe, which on average were lower that those of the Eastern countries. The reduction in mortality from ischemic heart disease reported in the MONICA project was greater in men, a result similar to that reported for the Brazilian population [26].

In relation to cerebrovascular diseases, studies in the more developed countries have been demonstrating a significant reduction in mortality from 1950 onwards in the USA and from 1970 onwards in European countries [4]. However, in some countries of Eastern Europe, the incidence of the disease has been increasing and is directly related to a high prevalence of arterial hypertension [27]. In Brazil, an increase in mortality due to circulatory, ischemic heart, and cerebrovascular diseases in men and women in the 35-64 year range group was observed between 1979 and 1984. Following this period, reduction was significant and progressive in both sexes. This reaction was similar to that observed in the majority of the countries in the MONICA project in the period from 1985 to 1990 [28]. However, mortality due to cerebrovascular diseases in men and women in Brazil was always lower than the values reported for the countries composing the MONICA project.

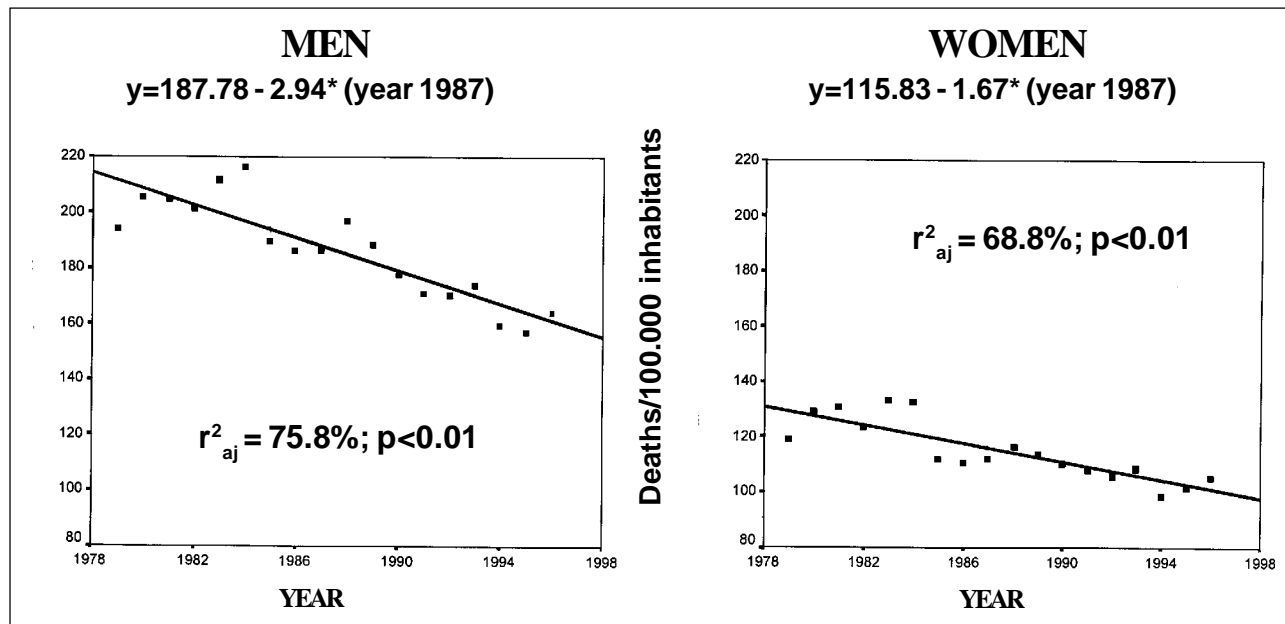In relation to mortality from ischemic heart disease in

MEN

y=187.78 - 2.94* (year 1987)

$r^2_{aj} = 75.8\%; p<0.01$

WOMEN

y=115.83 - 1.67* (year 1987)

$r^2_{aj} = 68.8\%; p<0.01$

Deaths/100.000 inhabitants

YEAR

YEAR

Fig. 3 - Ischemic heart disease mortality coefficient trends (linear regression).

Table IV - Cerebrovascular disease mortality*			
Year	Total	Men	Women
1979	183.81	200.44	167.87
1980	192.73	209.82	176.38
1981	192.83	210.22	176.31
1982	193.55	209.95	171.93
1983	194.58	215.19	175.25
1984	203.11	223.63	183.83
1985	180.18	194.26	150.00
1986	169.90	192.10	148.24
1987	164.90	185.63	146.16
1988	172.70	195.07	152.66
1989	168.58	192.09	147.49
1990	167.84	190.67	147.57
1991	159.20	181.47	139.25
1992	164.52	187.01	144.39
1993	170.57	193.56	150.03
1994	153.44	174.03	134.89
1995	149.00	171.02	131.49
1996	145.68	163.10	129.93
Queda(%)	20.7	18.6	22.6

the USA, in the period between 1980 and 1994, a progressive reduction of around 3% per year has been observed between 1980 and 1988 and of 2.6% per year between 1990 and 1994 [29-31]. Between 1990 and 1994, mortality due to ischemic heart disease decreased by 10.3%, from 416.3 to 373.6 deaths per 100,000 inhabitants. However, mortality decreased more rapidly for Caucasians and for men. Annual reduction in mortality was 2.9% for Caucasian men, 2.5% for Caucasian women, 2.3% for black men, and black women 1.6%. Among the Brazilian population, a discrete increase was reported in mortality from ischemic heart disease in the period from 1979 to 1984 followed by a progressive reduction until the year 1995. The annual reduction was lower than

that observed in the USA, between 1985 and 1990 and from 1990 to 1995, being respectively 1.6% and 2.0%. Mortality was reduced from 157.24 in 1990 to 140.96 deaths/100,000 inhabitants in 1995. Mortality reduction in Brazil was also greater in men. Although ischemic heart disease is one of the major causes of death in the Brazilian population, death from it was 2.6 times higher in the USA, probably a reflection of an important difference in the incidence of circulatory disease in the populations. In Brazil, the participation of other diseases, for instance infectious ones, must also have influenced this difference. The pronounced participation of other diseases in developing countries produces a "double load" on the public health system. Other factors that most probably influenced this result were socioeconomic, nutritional, behavioral, and medical structural in character. Studies [32-34] have shown an inverse relationship between these factors and the incidence of ischemic heart disease in developed countries. As observed for ischemic heart diseases, cerebrovascular diseases in the USA were more prevalent in black persons of both sexes, and also, had a nonuniform geographical distribution, being more prevalent in the southeastern part of the USA [35]. Socioeconomic inequalities appear to play a fundamental role in the incidence and regional distribution of cerebrovascular diseases [36].

In Latin-American countries, in particular Argentina, Chile, Colombia, Uruguay, and Venezuela, between 1969 and 1986, a reduction in circulatory diseases in men and women has also been observed. It varied from 1.1% in Colombia to 27.2% in Chile. However, in regards to ischemic heart and cerebrovascular diseases, and contrary to that in other countries, which had over a 20% reduction, Colombia had increases in ischemic heart of 24.4% and in cerebrovascular of 11%. Between 1979 and 1984, Brazil showed a similar tendency as that - observed in Colombia in the period

MEN

y=195.10 - 2.50* (year 1987)

$r^2 = 82.8\%; p<0.01$

WOMEN

y=155.48 - 2.78* (year 1987)

$r^2 = 87.3\%; p<0.01$

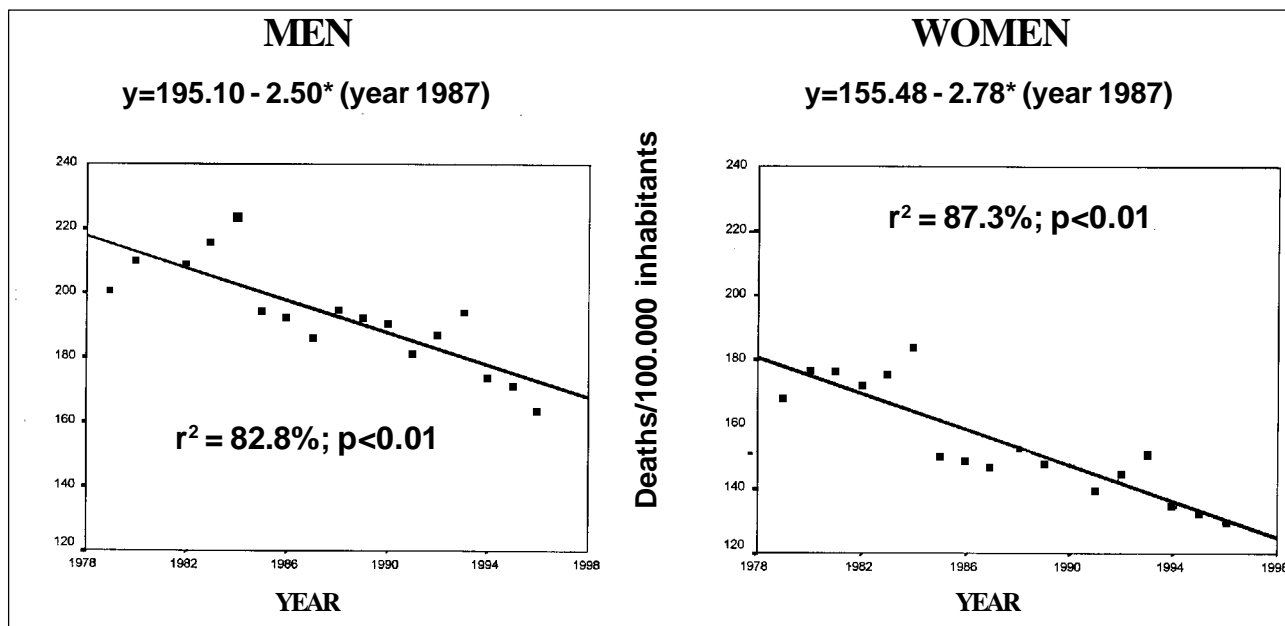Deaths/100.000 inhabitants

YEAR

YEAR

Fig. 4 - Cerebrovascular disease mortality coefficient trends (linear regression)

between 1969 and 1986. Over this period in Brazil, an increase in mortality from ischemic heart and cerebrovascular diseases of around 11% was observed. From 1985, Brazil started to show the same trend as that observed in the other Latin-American countries analyzed [37].

This study presents an important limitation in the mortality data, the most important variable of epidemiological studies. The data suffer from the negative influence of the diversity in the competence and quality of the collecting services or of the recording of the data, a worldwide problem. In Brazil, regional differences exist in the levels of competence of diverse structures. However, gradual improvement in the recording of data is being noted.

In conclusion, we verified that a reduction in mortality from circulatory, ischemic heart, and cerebrovascular diseases exists, attributed to factors involving the control of risk factors (prevention) and progress in the quality of medical assistance (improvement in survival). However, it remains a matter of discussion, which of the major groups have been responsible for the drop in mortality due to circulatory diseases [38-41]. Despite the absence of a strong correlation, there appears to exist a consensus among major government agencies, medical associations, and population projects [42-44] about the importance of the prevention and the control of risk factors. These agencies attribute the reduction in mortality from circulatory diseases to the control of smoking, of arterial hypertension, of blood cholesterol, of increased physical activity, and of better dietary habits [45]. In Brazil, an even greater reduction in mortality from circulatory diseases may be obtained if efforts in the field of their prevention and improved technical and scientific aspects are made.

Acknowledgments

References

1. Thom TJ, Maurer J. Time trends for coronary heart disease mortality and mortality. In: Higgins MW, Luepker RV. eds. Trends in coronary heart disease mortality: the influence of medical care. New York: Oxford University Press, 1988: 7-15.

2. Hoyert DL, Kochanek KD, Murphy SL. Deaths: Final Data for 1997. National Center For Health Statistics. Vital Health Stat 1999; 47: 1-16.

3. Tunstall-Pedoe H, Kuulasmaa K, Mähönen M, Tolonen H, Ruokokoshi E, Amouyel P, for the WHO MONICA (monitoring trends and determinants in cardiovascular disease) Project. Contribution of trends in survival and coronary-event rates to changes in coronary heart disease mortality: 10-year results from WHO MONICA Project populations. Lancet 1999; 353: 1547-57.

4. Bonita R, Stewart A, Beaglehole R. International trends in stroke mortality: 1970-1985. Stroke 1990; 21: 989-92.

5. Lolio CA, Lotufo PA, Lira AC, Zanetta DM, Massad E. Tendência da mortalidade por doença isquêmica do coração nas capitais de regiões metropolitanas do Brasil, 1979-89. Arq Bras Cardiol 1995; 64: 195-9.

6. Lotufo PA, Bensenor IJ, Lolio CA. Tabagismo e mortalidade por doença isquêmica do coração. Estudo comparativo das capitais de regiões metropolitanas de Brasil, 1988. Arq Bras Cardiol 1995; 64: 7-9.

7. Lolio CA, Souza JM, Laurenti R. Decline in cardiovascular disease mortality in the city of São Paulo, Brazil, 1970 to 1983. Rev Saúde Pública 1986; 20: 454-64.

8. Lolio CA, Santo AH, Laurenti R. Importância da aterosclerose como causa de morte no Estado de São Paulo. Arq Bras Cardiol 1988; 51: 437-9.

9. Lotufo PA. Mortalidade precoce por doenças do coração no Brasil. Comparação com outros países. Arq Bras Cardiol 1998; 70: 321-5.

10. Puffer R, Griffith GW. Characteristics of urban mortality. Bol Oficina Sanit Panam 1968; 65: 446-70.

11. Cláudio DM, Marins JM. Cálculo numérico computacional. ed. São Paulo: Atlas; 1989.

12. FUNDAÇÃO IBGE. Censo demográfico Goiás: VIII Recenseamento Geral-1970. Rio de Janeiro; 1973. (Série Regional, I).

13. FUNDAÇÃO IBGE. Censo demográfico: dados gerais-migração-instrução-fecundidade-mortalidade. Rio de Janeiro; 1982. (Recenseamento geral do Brasil 1980, 9: v.1, t.4).

14. FUNDAÇÃO IBGE. Censo demográfico 1991: resultados do universo relativo às características da população e dos domicílios. Rio de Janeiro; 1994. n.27: Goiás.

15. IBGE. Contagem da população 1996. Rio de Janeiro; 1997. v.1. (Resultados relativos a sexo da população e situação da unidade domiciliar).

16. Ministério da Saúde. Fundação Nacional da Saúde. DATASUS. Sistema de informação sobre mortalidade 1979-1997: dados de declaração de óbito. [CD-ROM]. Brasília; 1998.

17. Ministério da Saúde. Estatística de mortalidade: Brasil-1978. Brasília: Centro de Documentação do Ministério da Saúde; 1984.

18. Organização Mundial da Saúde - Manual da Classificação Internacional de Doenças, Lesões e Causas de Óbitos. 9ª Revisão. 1975. São Paulo, Centro da OMS para Classificação das Doenças em Português, 1978.

19. Organização Mundial da Saúde. Classificação estatística internacional de doenças e problemas relacionados à saúde: Classificação Internacional de Doenças-10. São Paulo: EDUSP, 1995; 1.

20. Curtin LR, Klein RJ. Direct standardization (age-adjusted death rates). National Center for Health Statistics. Healthy People 2000: Statistical Notes, no 6-revised. 1995.

21. Waterhouse J, Muir C, Correa P, Powell J. Cancer incidence in five continents. Lyon (France): IARC, 1976: 453-9. (IARC Scientific Publications, 15).

22. Laurenti R, Mello Jorge MH, Lebrão ML, Gotlieb SLD. Estatísticas de saúde. 2ª ed. São Paulo: EPU Editora Pedagógica e Universitária Ltda, 1987.

23. Kleinbaum DG, Kupper LL, Muller KE. Applied regression analysis and other multivariable methods. 2nd ed. Belmont, California: Duxbury Press, 1988: 41-80.

24. CDC. Achievements in public health, 1990-1999: Decline in deaths from heart disease and stroke. MMWR 1999; 48: 649-56.

25. Uemura K, Piza Z. Trends in cardiovascular disease mortality in industrialized contries since 1950. Wld Hlth Statist Quart 1988; 41: 155-78.

26. Tunstall-Pedoe H, Kuulasmaa K, Mähönen M, Tolonen H, Ruokokoski E, Amouyel P, for the WHO MONICA (monitoring trends and determinants in cardiovascular disease) Project. 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. Lancet 1999; 353: 1547-57.

27. Stegmayr B, Vinogradova T, Malyutina S, Peltonen M, Nikitin Y, Asplund K. Widening gap of stroke between east and west. Eight-year trends in occurrence and risk factors in Russia and Sweden. Stroke 2000; 31: 2-8.

28. Thorvaldsen P, Kuulasmaa K, Rajakangas A-M, Rastenyte D, Sarti C, Wilhelmsen L. WHO MONICA Project. Stroke Trends in the WHO MONICA Project. Stroke 1997; 28: 500-6.

29. CDC. Trends in ischemic heart disease mortality. United States, 1980-1988. MMWR 1992; 41: 548-9.

30. CDC. Trends in ischemic heart disease mortality. United States, 1980-1988. MMWR 1992; 41: 555-6.

31. CDC. Trends in ischemic heart disease deaths. United States, 1990-1994. MMWR 1997; 46: 146-50.

32. Wing S, Dargent-Molina P, Casper M, Riggan W, Hayes C, Tyroler HA. Changing association between community occupational structure and ischaemic heart disease mortality in the United States. Lancet 1987; 2: 1067-70.

33. Ingram DD, Gillum RF. Regional and urbanization differentials in coronary heart disease mortality in the United States, 1968-85. J Clin Epidemiol 1989; 42: 857-68.

34. Cordeiro R, Olivencia ER, Cardoso CF, et al. Desigualdade de indicadores de mortalidade no Sudeste do Brasil. Rev Saúde Pública 1999; 33: 593-601.

35. Lackland DT, Egan BM, Jones PJ. Impact of nativity and race on "Stroke Belt" mortality. Hypertension 1999; 34: 57-62.

36. Casper M, Wing S, Strogatz D. Variation in the magnitude of black-white differences in stroke mortality by community occupational structure. J Epidemiol Community Health 1991; 45: 302-6.

37. Nicholls ES, Peruga A, Restrepo HE. Cardiovascular disease in the Americas. Wld Hlth Statist Quart 1993; 46: 134-150.

38. Enriquez-Sarano M, Klodas E, Garratt KN, Bailey KR, Tajik AJ, Holmes DR Jr. Secular trends in coronary atherosclerosis-analysis in patients with valvular regurgitation. N Engl J Med 1996; 335: 316-22.

39. Rosamond WD, Chambless LE, Folsom AR, et al. Trends in the incidence of myocardial infarction and in mortality due to coronary heart disease, 1987 to 1994. N Engl J Med 1998; 339: 861-7.

40. Hunink MG, Goldman L, Tosteson AN, et al. The recent decline in mortality from coronary heart disease, 1980-1990. The effect of secular trends in risk factors and treatment. JAMA 1997; 277: 535-42.

41. Wilson PW, D'agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. Circulation 1998; 97: 1837-47.

42. National Cholesterol Education Program. Second Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel II). Circulation 1994; 89: 1333-445.

43. The sixth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Arch Intern Med 1997; 157: 2413-46. [Erratum Arch Intern Med 1998; 158: 573.]

44. Pasternak RC, Grundy SM, Levy D, Thompson PD. Spectrum of risk factors for coronary heart disease. J Am Coll Cardiol 1996; 27: 978-90.

45. National Center for Health Statistics. Health United States 1996-1997: injury chartbook. Hyattsville, Md.: National Center for Health Statistics 1997; 183: 190-1.