Trends of the Risk of Death due to Circulatory, Cerebrovascular, and Ischemic Heart Diseases in 11 Brazilian Capitals from 1980 to 1998

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Objective - *To assess the trends of the risk of death due to circulatory (CD), cerebrovascular (CVD), and ischemic heart diseases (IHD) in 11 Brazilian capitals from 1980 to 1998.*

Methods - *Data on mortality due to CD, CVD and IHD were obtained from the Brazilian Health Ministry, and the population estimates were calculated by interpolation with the Lagrange method based on census data from 1980 and 1991 and the population count of 1996. The trends were analyzed with the multiple linear regression method.*

Results - *CD showed a trend towards a decrease in most capitals, except for Brasília, where a mild increase was observed. The cities of Porto Alegre, Curitiba, Rio de Janeiro, Cuiabá, Goiânia, Belém, and Manaus showed a decrease in the risk of death due to CVD and IHD, while the city of Brasília showed an increase in CVD and IHD. The city of São Paulo showed a mild increase in IHD for individuals of both sexes aged 30 to 39 years and for females aged 40 to 59 years. In the cities of Recife and Salvador, a reduction in CD was observed for all ages and both sexes. In the city of Recife, however, an increase in IHD was observed at younger ages (30 to 49 years), and this trend decreased until a mild reduction (-4%) was observed in males ≥ 70 years.*

Conclusion - *In general, a reduction in the risk of death due to CD and an increase in IHD were observed, mainly in the cities of Recife and Brasília.*

Key words: epidemiology, circulatory diseases, mortality

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The risk of death due to circulatory, cerebrovascular, and ischemic heart diseases in the Brazilian population showed a trend towards a decrease from 1985 onward. The drop in the risk of death due to ischemic heart diseases was more marked in males, while that due to cerebrovascular diseases was similar in males and females [1]. However, when analyzing the trends of the risk of death due to circulatory diseases in 5 Brazilian regions, an increase in that risk was observed in the population ≥ 30 years in the Northeastern and West Central regions of Brazil [2]. According to the authors, these data reflected the trend towards an increase in the incidence of cerebrovascular and ischemic heart diseases in those regions. This increase could be real or related to an improvement in the quality of the information on death certificates. An indirect indicator of the quality of that information is the proportion of death certificates with symptoms, signs, and ill-defined affections as the cause of death. The Northeastern region had the greatest proportion of mortality without a defined diagnosis, which, in 1995, represented 40% of the deaths. However, due to a better technical and scientific capacity of the medical conditions in the capitals as compared with that in the inner areas of the states, a better quality of the information provided by death certificates in those capitals is expected. Recent studies have shown an improvement in the quality of the death certificates. Siqueira et al [3] reported a high sensitivity (91.9%) in the original and corrected death certificates in the group of causes of death due to circulatory diseases in females in the Southern region of the municipality of São Paulo. Paes and Albuquerque [4] reported an improvement in the quality of the information on death certificates in most Brazilian states.

Therefore, our study analyzed the trends of the risk of death due to circulatory, cerebrovascular, and ischemic heart diseases in 11 capitals selected in 5 Brazilian regions. We aimed at validating the previous results of the trends of mortality due to circulatory diseases, ie, to improve the quality of the information on death certificates in some Brazilian capitals in regard to mortality trends.

Methods

The 11 most populated capitals of 5 Brazilian regions were chosen as follows: in the Northern region, Manaus and Belém; in the Northeastern region, Recife and Salvador; in the West Central region, Brasília and Cuiabá; in the Southeastern region, São Paulo and Rio de Janeiro; and in the Southern region, Curitiba and Porto Alegre.

Data on mortality due to circulatory, cerebrovascular, and ischemic heart diseases were obtained in the Brazilian Ministry of Health from 1980 to 1998 [5]. The estimates of the populations on the 1st of July from 1980 to 1998 in the 5 Brazilian regions were calculated by interpolation with the Lagrange method [6] based on census data from 1980 and 1991 and a population count from 1996 for each age group and sex [7-10].

The statistical model of multiple linear regression was used [11,12]. Information on mortality due to all circulatory diseases was modeled, and, then, data on mortality due to cerebrovascular and ischemic heart diseases were as well. The natural logarithm of the raw coefficient (number of deaths/population estimated on the 1st of July) was used as a dependent variable, and the cerebrovascular and ischemic heart diseases, the 11 Brazilian capitals, sex, years of the study calendar (from 1980 to 1996), age brackets (30-39, 40-49, 50-59, 60-69, and from 70 years onward), and their respective interactions were used as independent variables. The partial F test was used to remove the nonsignificant interactions for the models. The objective was to reach the end of the modeling process with the lowest number of possible interactions. The adjustment of the models was tested by analyzing residuals and the correlation coefficient. The analysis of residuals was performed with envelope-type graphs and graphs of the residuals of the model versus values adjusted to assess the adjustment of the models adopted.

Results

The trends of the risk of death due to circulatory, cerebrovascular, and ischemic heart diseases are shown in figures 1 to 10. The coefficients are presented as natural logarithms according to age and sex and in 2 tables with the raw coefficients for the years 1980, 1989, and 1998 of the series, and the percentage variation between the years 1980 and 1998. The analysis of residuals showed a good adjustment of the multiple linear regression model.

The coefficients and percentages of variations in mortality due to circulatory, cerebrovascular, and ischemic heart diseases are shown in tables I and II. The following trends were observed: 1) in the cities of Porto Alegre and Curitiba (Southern region) - a trend towards a decrease in circulatory, cerebrovascular, and ischemic heart diseases was observed for all age groups and both sexes from 1980 to 1998. The greatest reduction occurred in the cerebrovascular diseases in all age groups and both sexes; however, it was more marked in the males of the city of Porto Alegre; 2) in the cities of

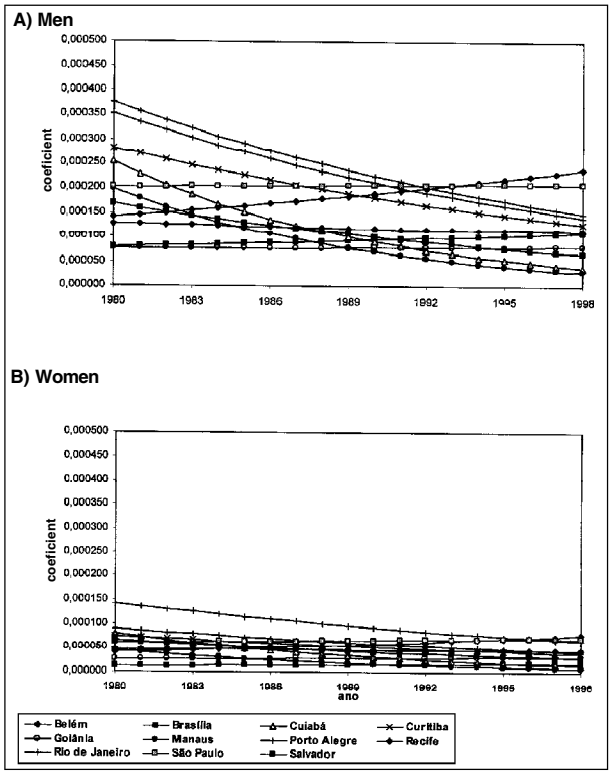

Fig. 1 - Trend of the risk of death due to ischemic heart diseases in 11 Brazilian capitals for ages 30 to 39 years. A) males; B) females.

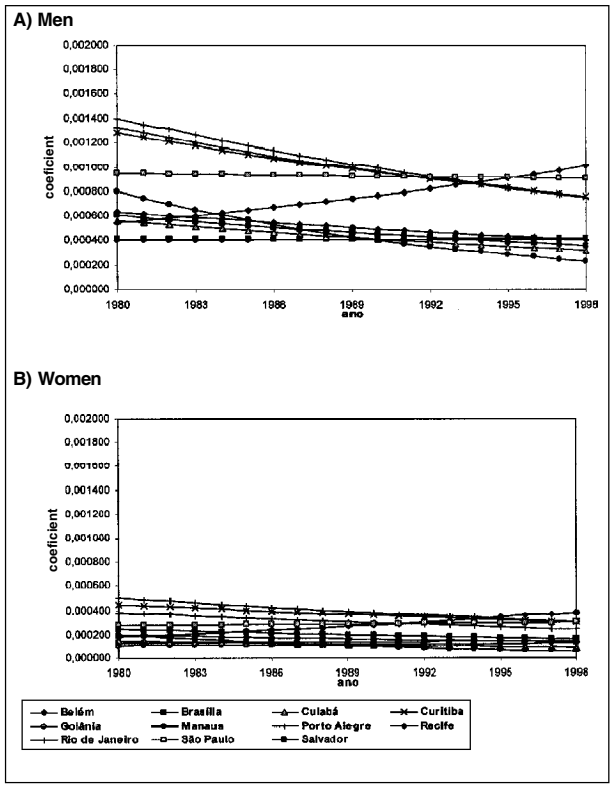

Fig. 2 - Trend of the risk of death due to ischemic heart diseases in 11 Brazilian capitals for ages 40 to 49 years. A) males; B) females.

Rio de Janeiro and São Paulo (Southeastern region) - a trend towards a decrease in circulatory diseases occurred and

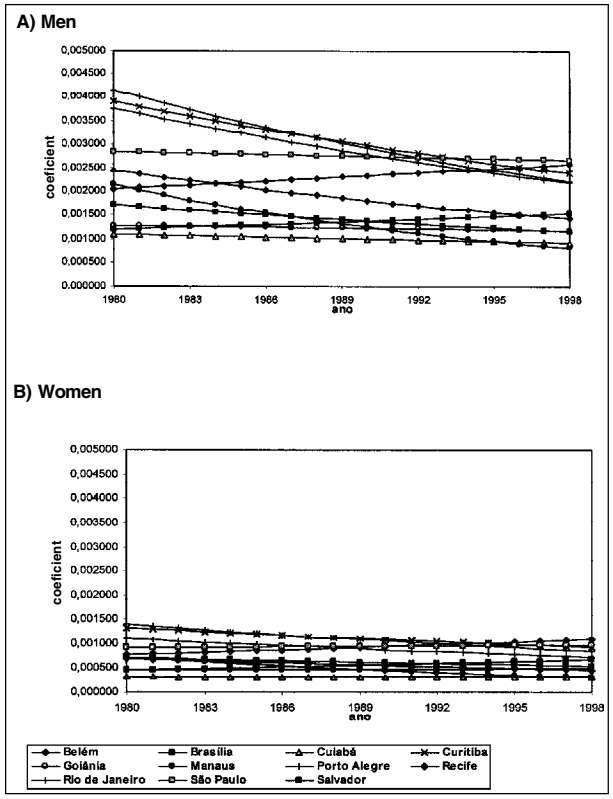

Fig. 3 - Trend of the risk of death due to ischemic heart diseases in 11 Brazilian capitals for ages 50 to 59 years. A) males; B) females.

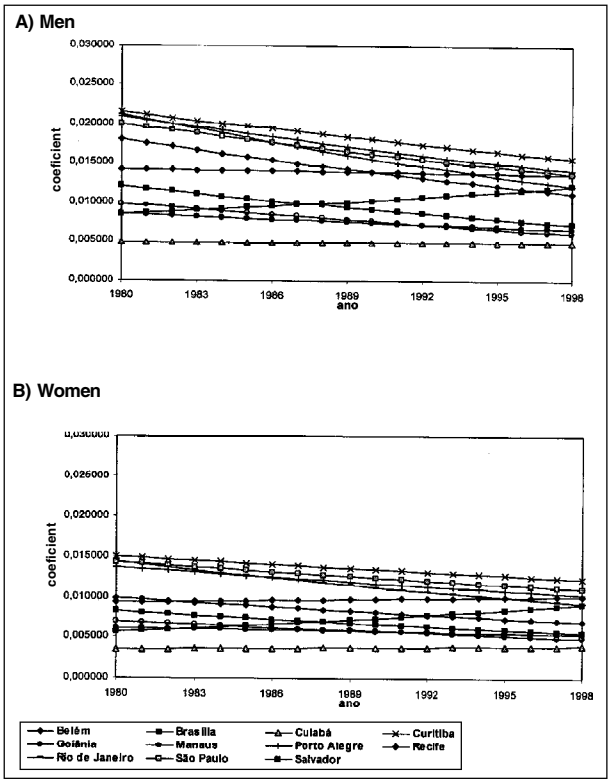

Fig. 5 - Trend of the risk of death due to ischemic heart diseases in 11 Brazilian capitals for ages 70 years or above. A) males; B) females.

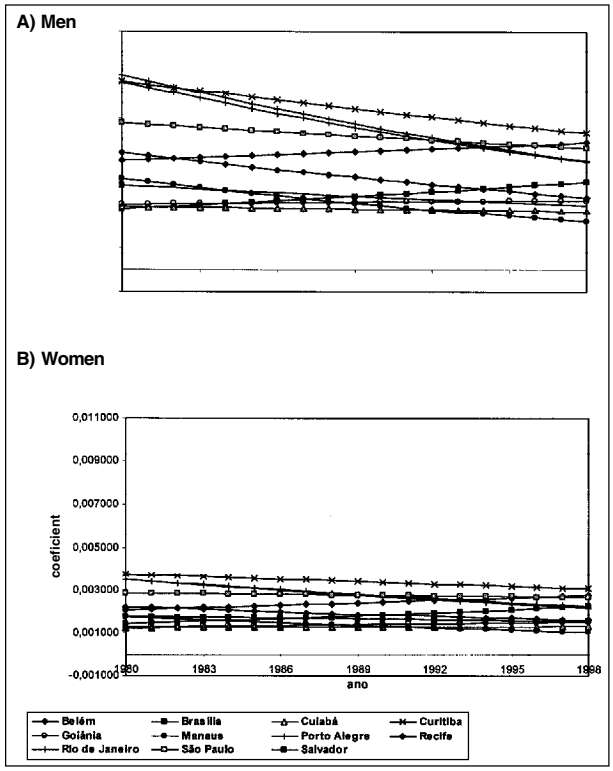

Fig. 4 - Trend of the risk of death due to ischemic heart diseases in 11 Brazilian capitals for ages 60 to 69 years. A) males; B) females.

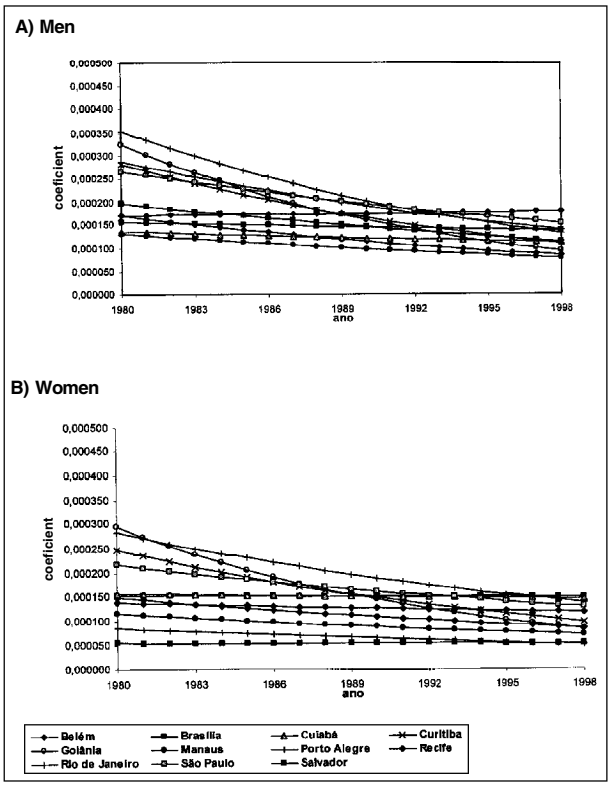

Fig. 6 - Trend of the risk of death due to cerebrovascular diseases in 11 Brazilian capitals for ages 30 to 39 years. A) males; B) females.

was more marked in the city of Rio de Janeiro. In the city of São Paulo, a mild increase in ischemic heart diseases was observed in individuals of both sexes aged 30 to 39 years and in females aged 40 to 59 years. In the remaining age groups,

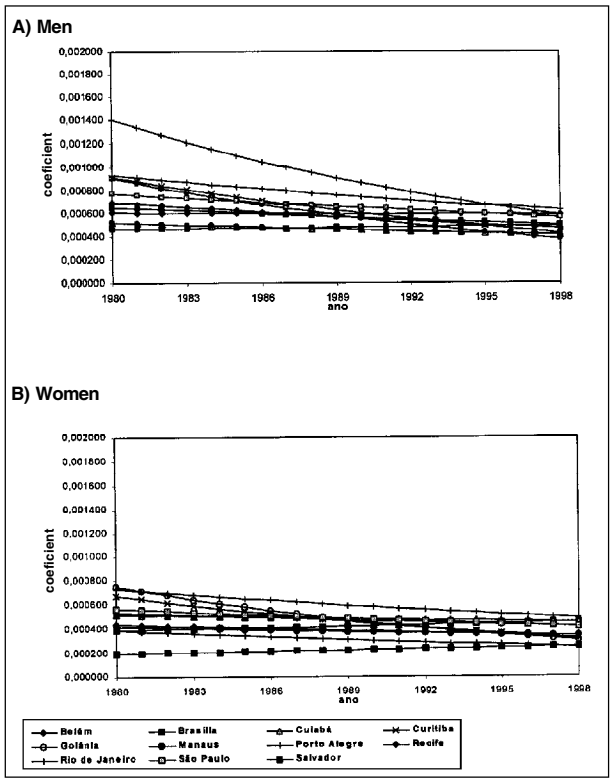

Fig. 7 - Trend of the risk of death due to cerebrovascular diseases in 11 Brazilian capitals for ages 40 to 49 years. A) males; B) females.

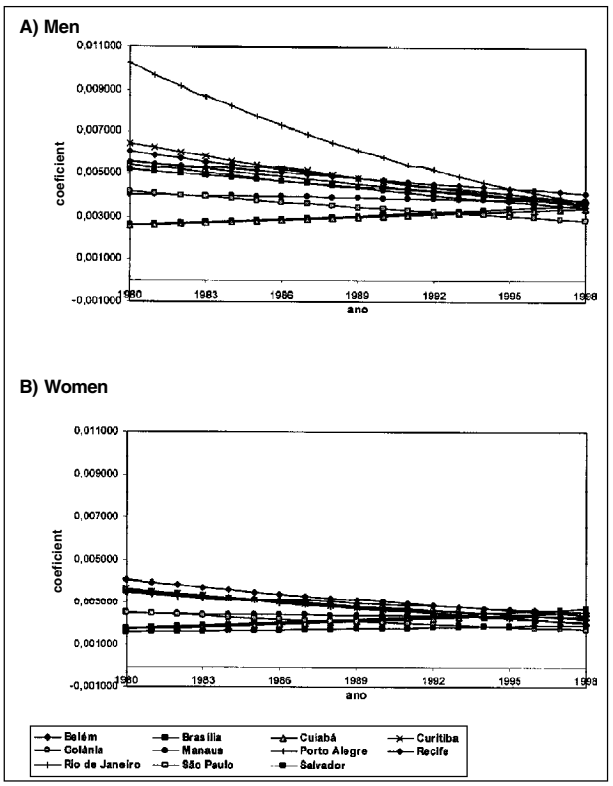

Fig. 9 - Trend of the risk of death due to cerebrovascular diseases in 11 Brazilian capitals for ages 60 to 69 years. A) males; B) females.

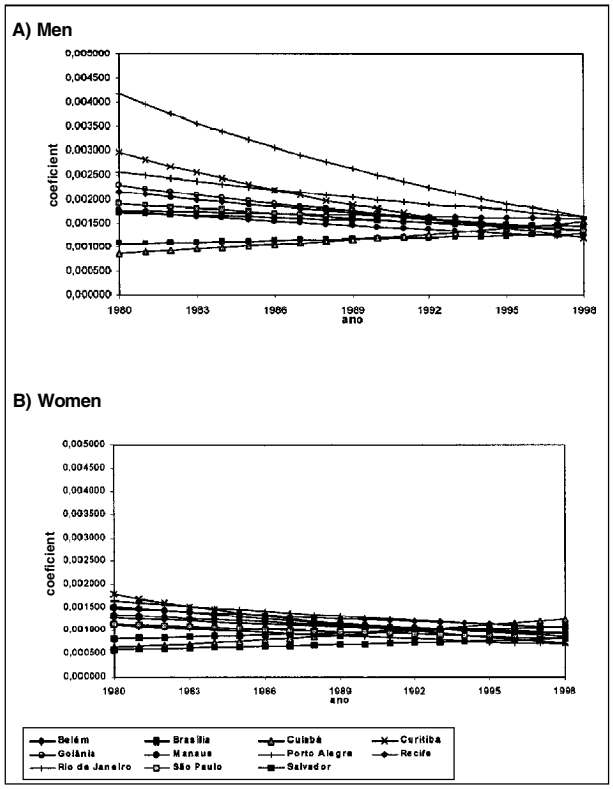

Fig. 8 - Trend of the risk of death due to cerebrovascular diseases in 11 Brazilian capitals for ages 50 to 59 years. A) males; B) females.

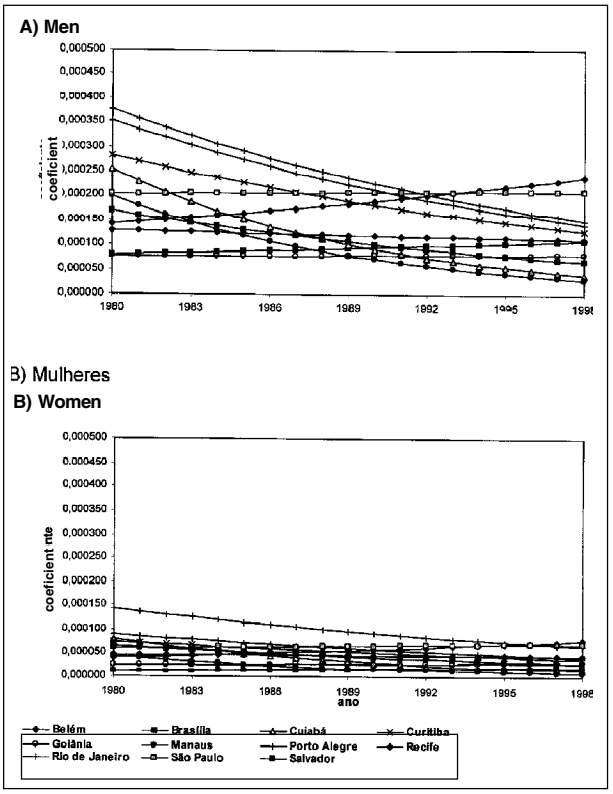

Fig. 10 - Trend of the risk of death due to cerebrovascular diseases in 11 Brazilian capitals for ages 70 years or above. A) males; B) females.

a mild reduction in the risk of death was observed, except for individuals aged 70 years or more, in whom the reduction was greater, being 32% and 23% for males and females, respectively. In a different way, a marked reduction in the

Table I - Risk of death due to circulatory diseases per 100,000 inhabitants estimated in 11 Brazilian capitals according to sex and age group in the years of 1980, 1989, and 1998

Age groups	Capitals	Circulatory diseases							
		Males				Females			
		1980	1989	1998	%V	1980	1989	1998	%V
30-39 years	Belém	55.39	43.59	34.31	-38	41.1	30.85	23.15	-44
	Brasilia	58.33	56.11	53.98	-7	40.69	35.13	30.32	-25
	Cuiabá	99.54	57.31	33	-67	74.22	39.01	20.5	-72
	Curitiba	77.98	56.09	40.35	-48	52.54	33.37	21.2	-60
	Goiânia	76.01	53.83	38.12	-50	60.1	33.17	18.31	-70
	Manaus	55.77	30.83	17.04	-69	38.76	19.36	9.67	-75
	Porto Alegre	90.66	63.05	43.85	-52	47.5	30.66	19.79	-58
	Recife	64.31	63.34	62.38	-3	43.44	35.35	28.77	-34
	Rio de Janeiro	88.46	66.14	49.45	-44	65.55	44.36	30.03	-54
	São Paulo	71.14	64.43	58.36	-18	46.04	36.9	29.58	-36
	Salvador	77.89	60.42	46.87	-40	69.94	46.35	30.71	-56
40-49 years	Belém	220.33	156.09	110.58	-50	114.09	89.04	69.5	-39
	Brasília	182.5	173.64	165.21	-9	109.76	108.25	106.77	-3
	Cuiabá	261.21	189.41	137.35	-47	165.7	126.72	96.91	-42
	Curitiba	292.44	220.42	166.15	-43	156.73	120.51	92.66	-41
	Goiânia	206.99	165.58	132.46	-36	151.07	108.83	78.4	-48
	Manaus	191.6	127.95	85.45	-55	105.84	73.77	51.41	-51
	Porto Alegre	307.78	225.93	165.85	-46	127.82	100.62	79.2	-38
	Recife	227.64	216.55	206	-10	143.99	130.76	118.75	-18
	Rio de Janeiro	309.92	246.08	195.39	-37	170.15	141.29	117.33	-31
	São Paulo	247.28	222.4	200.03	-19	126.16	116.01	106.68	-15
	Salvador	232.83	194.2	161.98	-30	170.21	140.1	115.31	-32
50-59 years	Belém	726.58	526.73	381.85	-47	324.84	253.96	198.55	-39
	Brasília	470.9	452.45	434.73	-8	291.56	284.28	277.18	-5
	Cuiabá	499.25	473.18	448.47	-10	286.06	279.9	273.87	-4
	Curitiba	883.38	670.42	508.8	-42	437.1	331.25	251.03	-43
	Goiânia	584.29	511.66	448.05	-23	394.43	304.48	235.04	-40
	Manaus	573.04	394.97	272.23	-52	346.09	243.7	171.61	-50
	Porto Alegre	778.1	608.87	476.45	-39	312.23	256.47	210.66	-33
	Recife	623.33	617.58	611.88	-2	386.22	357.58	331.07	-14
	Rio de Janeiro	860.74	687.63	549.33	-36	416.15	340.35	278.36	-33
	São Paulo	651.64	601.31	554.88	-15	315.88	291.72	269.41	-15
	Salvador	564.68	529.4	496.31	-12	405.22	366.99	332.37	-18
60-69 years	Belém	1780.9	1341.4	1010.35	-43	888.99	720.49	583.93	-34
	Brasília	1121.78	1129.38	1137.03	1	704.01	717.63	731.52	4
	Cuiabá	1409.41	1178.83	985.97	-30	826.4	711.97	613.39	-26
	Curitiba	2001.17	1642.29	1347.77	-33	1110.13	907.69	742.17	-33
	Goiânia	1340.94	1217.61	1105.62	-18	992.52	792.68	633.09	-36
	Manaus	1451.43	1100.94	835.08	-42	786.51	608.13	470.2	-40
	Porto Alegre	1730.97	1384.45	1107.3	-36	798.6	668.97	560.39	-30
	Recife	1678.43	1535.21	1404.22	-16	1005.35	857.38	731.19	-27
	Rio de Janeiro	1874.43	1529.8	1248.47	-33	978.77	815.92	680.17	-31
	São Paulo	1535.83	1372.54	1226.6	-20	833.98	744.23	664.15	-20
	Salvador	1503.48	1336.51	1188.08	-21	965.21	827.01	708.6	-27
>70years	Belém	7245.28	5658.79	4419.69	-39	4499.61	3731.76	3094.95	-31
	Brasília	3624.04	3619.48	3614.92	0	2788.13	2782.36	2776.61	0
	Cuiabá	3745.78	3324.4	2950.43	-21	3070.19	2769.81	2498.82	-19
	Curitiba	5745.52	4899	4177.2	-27	4594.59	3851.91	3229.28	-30
	Goiânia	3745.41	3485.84	3244.27	-13	3825.39	3090.31	2496.48	-35
	Manaus	5452.26	3652.93	2447.41	-55	4502.13	3034.33	2045.07	-55
	Porto Alegre	4605.91	4011.96	3494.6	-24	3539.69	3186.78	2869.05	-19
	Recife	5193.62	4610.61	4093.05	-21	4542.15	3710.18	3030.6	-33
	Rio de Janeiro	5454.06	4353.59	3475.16	-36	4526.41	3642.17	2930.67	-35
	São Paulo	4681.84	4116.82	3619.99	-23	3994.35	3461.15	2999.12	-25
	Salvador	4728.94	4008.67	3398.11	-28	4386.14	3536.62	2851.63	-35

risk of death due to cerebrovascular diseases was observed. In the city of Rio de Janeiro, the reduction in the risk of death due to cerebrovascular and ischemic heart diseases was significant in all age groups and both sexes; 3) in the cities of Brasília, Cuiabá, and Goiânia (Central West region) - a trend towards a decrease in circulatory diseases in the cities of Cuiabá and Goiânia was observed in all age groups and both sexes. In the city of Brasília, a mild reduction and stabilization in circulatory diseases was observed in males and females in the age groups of 30 to 59 years and ≥ 70 years,

Table II - Coefficient of mortality due to cerebrovascular and ischemic heart diseases per 100,000 inhabitants estimated in 11 Brazilian capitals according to sex and age group in the years 1980, 1989, and 1998.

Age groups and capitals	Ischemic heart diseases								Cerebrovascular diseases							
	Males				Females				Males				Females			
30-39 years	1980	1989	1998	%V	1980	1989	1998	%V	1980	1989	1998	%V	1980	1989	1998	%V
Belém	12.82	11.91	11.06	-14	4.62	4.55	4.48	-3	17.02	11.89	8.3	-51	14.71	11.07	8.32	-43
Brasília	7.89	9.25	10.85	38	1.22	1.51	1.88	55	15.68	14.66	13.72	-13	15.18	14.98	14.77	-3
Cuiabá	25.33	10.04	3.98	-84	7.97	3.35	1.41	-82	13.55	12.33	11.21	-17	15.6	14.94	14.31	-8
Curitiba	28.16	18.97	12.78	-55	7.38	5.27	3.77	-49	28.25	17.53	10.88	-61	24.75	15.44	9.63	-61
Goiânia	7.59	7.8	8.01	6	2.57	2.8	3.06	19	32.43	17.3	9.23	-72	29.38	15.4	8.07	-73
Manaus	19.83	7.77	3.05	-85	4.39	1.82	0.76	-83	13.14	10.08	7.74	-41	11.56	8.94	6.91	-40
Porto Alegre	35.2	22.33	14.16	-60	8.9	5.98	4.02	-55	35.29	21.46	13.05	-63	8.5	6.48	4.94	-42
Recife	14.2	18.36	23.74	67	4.05	5.55	7.62	88	17.11	17.58	18.06	6	13.7	12.59	11.57	-16
Rio de Janeiro	37.53	23.72	14.99	-60	14.25	9.55	6.4	-55	28.72	19.97	13.89	-52	28.19	19.57	13.58	-52
São Paulo	20.27	20.61	20.94	3	6.01	6.47	6.98	16	26.56	20.21	15.38	-42	21.62	16.54	12.65	-41
Salvador	16.85	10.57	6.64	-61	6.48	4.31	2.87	-56	19.9	15.05	11.37	-43	5.49	5.36	5.24	-5
40-49 years																
Belém	63.49	50.53	40.22	-37	19.91	16.8	14.18	-29	69.27	56.75	46.49	-33	43.86	38.7	34.15	-22
Brasília	41.19	41.41	41.63	1	13.45	14.34	15.28	14	46.06	47.46	48.91	6	38.94	42.32	45.99	18
Cuiabá	56.17	42.33	31.9	-43	15.36	12.28	9.81	-36	51.4	45.88	40.95	-20	51.71	48.59	45.66	-12
Curitiba	128.17	98.64	75.91	-41	44.83	36.58	29.85	-33	91.23	62.26	42.5	-53	67.38	46.22	31.7	-53
Goiânia	40.39	40.88	41.38	2	11.49	12.33	13.24	15	89.98	58.08	37.49	-58	74.85	47.47	30.11	-60
Manaus	79.61	43.01	23.23	-71	19.91	11.4	6.53	-67	51.54	46.14	41.3	-20	41.91	37.78	34.05	-19
Porto Alegre	132.12	99.67	75.19	-43	38	30.39	24.31	-36	140.61	90.25	57.92	-59	38.86	31.26	25.15	-35
Recife	54.49	74.13	100.84	85	18.47	26.64	38.42	108	60.21	59.31	58.43	-3	53.77	47.39	41.76	-22
Rio de Janeiro	140.21	102.76	75.32	-46	50.11	38.94	30.27	-40	92.66	75.95	62.25	-33	72.71	59.5	48.68	-33
São Paulo	94.76	92.68	90.64	-4	27.7	28.72	29.79	8	77.21	65.7	55.91	-28	56.8	48.59	41.57	-27
Salvador	60.54	46.59	35.85	-41	24.54	20.02	16.34	-33	64.85	56.76	49.68	-23	20.06	22.69	25.66	28
50-59 years																
Belém	243.12	185.96	142.24	-41	68.95	55.92	45.36	-34	215.9	170.77	135.06	-37	127.67	108.75	92.63	-27
Brasília	119.61	135.44	153.36	28	45.98	55.21	66.29	44	107.24	116.81	127.23	19	81.95	94.14	108.15	32
Cuiabá	110.02	100.45	91.71	-17	31.59	30.58	29.6	-6	86.08	114.8	153.11	78	63.14	88.65	124.47	97
Curitiba	390.12	304.91	238.32	-39	132.22	109.58	90.81	-31	296.03	188.49	120.01	-59	177.46	113.55	72.66	-59
Goiânia	127.82	122.53	117.45	-8	46.33	47.1	47.87	3	228.41	174.99	134.07	-41	153	115.17	86.69	-43
Manaus	213.53	131.23	80.65	-62	71.44	46.56	30.34	-58	174.57	145.14	120.68	-31	134.21	112.36	94.07	-30
Porto Alegre	375.97	285.93	217.45	-42	109.29	88.11	71.05	-35	417.7	261.99	164.32	-61	111.95	88	69.18	-38
Recife	204.85	229.64	257.42	26	76.57	71.01	108.18	41	176.21	167.13	158.51	-10	148.6	126.09	106.99	-28
Rio de Janeiro	414.81	301.75	219.5	-47	139.16	107.34	82.79	-41	254.47	204.22	163.9	-36	164.24	131.58	105.42	-36
São Paulo	284.33	275.09	266.15	-6	90.62	92.96	95.37	5	190.95	160.16	134.33	-30	114.96	96.93	81.74	-29
Salvador	171.78	140.09	114.24	-33	71.01	61.4	53.09	-25	171.02	156.58	143.36	-16	58.52	69.24	81.92	40
60-69 years																
Belém	538.13	424.36	334.65	-38	223.76	187.1	156.45	-30	606.77	475.87	373.21	-38	349.57	295.26	249.39	-29
Brasília	281.37	337.4	404.6	44	140.16	178.21	226.6	62	262.15	305.07	355.03	35	176.82	217.02	266.35	51
Cuiabá	291.02	280.46	270.27	-7	123.8	126.5	129.26	4	260.43	297.88	340.73	31	172.32	207.52	249.9	45
Curitiba	867.34	739.55	630.58	-27	374.31	338.42	305.97	-18	644.38	478.68	355.58	-45	366.16	273.35	204.06	-44
Goiânia	302.48	311.71	321.23	6	125.12	136.72	149.39	19	543.65	431.15	341.94	-37	360.96	281.26	219.16	-39
Manaus	419.67	305.8	222.83	-47	172.33	133.15	102.87	-40	401.68	387.19	373.23	-7	244.4	237.23	230.26	-6
Porto Alegre	896.92	669.88	500.31	-44	348.14	275.7	218.34	-37	1026.2	612.61	365.72	-64	358.95	268.57	200.95	-44
Recife	501.21	541.59	585.22	17	210.13	240.76	275.86	31	558.09	476.76	407.29	-27	405.49	309.9	236.85	-42
Rio de Janeiro	864.13	654.69	496.02	-43	348.37	279.86	224.82	-35	563.22	450.76	360.75	-36	347.74	277.82	221.97	-36
São Paulo	676.09	615.79	560.87	-17	286.21	276.41	266.95	-7	415.64	344.34	285.27	-31	248.27	206.78	172.22	-31
Salvador	386.74	338.08	295.55	-24	176.51	163.62	151.66	-14	518.02	439.04	372.1	-28	160.61	175.91	192.67	20
>70 years																
Belém	1797.72	1422.65	1125.83	-37	985.83	827.22	694.13	-30	2912.76	2275.77	1778.09	-39	1817.01	1528.93	1286.53	-29
Brasília	833.28	1004.73	1211.47	-100	560.71	716.87	916.53	63	1002.39	1100.95	1209.19	21	764.5	885.53	1025.73	34
Cuiabá	484.54	484.67	484.8	0	347.39	368.45	390.79	12	763.79	925.27	1120.89	47	597.61	762.2	972.12	63
Curitiba	2153.45	1834.68	1563.1	-27	1501.57	1356.49	1225.43	-18	2119.25	1618.23	1235.65	-42	1591.16	1221.01	936.97	-41
Goiânia	979.73	773.93	611.35	-38	695.1	582.22	487.67	-30	1448.11	1229.76	1044.34	-28	1271.91	1061.24	885.47	-30
Manaus	843.16	745.82	659.72	-22	611.75	573.78	538.17	-12	1210.15	1180.99	1152.53	-5	1067.17	1048.7	1030.55	-3
Porto Alegre	2092.86	1714.45	1404.46	-33	1368.18	1188.43	1032.29	-25	2372.99	1631.76	1122.06	-53	1343.34	1157.75	997.8	-26
Recife	1412.32	1385.75	1359.68	-4	932.41	970.08	1009.26	8	1899.42	1638.63	1413.64	-26	1811.09	1397.82	1078.84	-40
Rio de Janeiro	2125.59	1604.77	1211.56	-43	1434.92	1148.7	919.57	-36	1708.85	1294.91	981.24	-43	1530.66	1157.9	875.92	-43
São Paulo	1997.65	1652.73	1367.37	-32	1431.7	1255.97	1101.82	-23	1237.11	1064.57	916.09	-26	1053.75	911.6	788.64	-25
Salvador	1207.85	932.48	719.89	-40	824.86	675.23	552.74	-33	1705.55	1401.96	1152.4	-32	705.77	749.71	796.38	13

respectively, and a mild increase in the age group of 60 to 69 years. However, a significant increase in the risk of death due to cerebrovascular and ischemic heart diseases was observed in both sexes and in almost all age groups, except for ischemic heart diseases in males ≥ 70 years and cerebrovascular diseases in males and females aged 30 to 39 years. The greatest increase in the risk of death due to cerebrovascular diseases was observed in the city of Brasília (78% and 97% for males and females, respectively, aged 50 to 59 years), where the greatest decrease in the risk of death due to ischemic heart diseases occurred in males aged 70 years or more. In the city of Cuiabá, a significant reduction in the risk of death due to circulatory, cerebrovascular, and ischemic heart diseases was observed in males and females, except for a mild increase in ischemic heart diseases in females older than 60 years and a marked increase in cerebrovascular diseases in males and females older than 50 years. The greatest reduction in the risk of death due to ischemic heart diseases was observed in females aged 30 to 39 years in the city of Cuiabá (-82%). A significant reduction in the risk of death due to circulatory and cerebrovascular diseases was observed in all age groups and both sexes in the city of Goiânia. However, a discrete increase in ischemic heart diseases was observed in males aged 30 to 49 years and females aged 50 to 69 years. A greater increase was observed in females aged 30 to 49 years and ≥ 70 years. The greatest reduction in the risk of death due to cerebrovascular diseases was observed in the city of Goiânia, -72% and -73%, respectively, in males and females aged 30 to 39 years; 4) in the cities of Recife and Salvador (Northeastern region) - a trend towards a decrease in circulatory diseases was observed in the cities of Recife and Salvador in all age groups and both sexes. In Recife, however, a significant increase in the risk of death due to ischemic heart diseases was observed, mainly in the younger groups (30 to 49 years), and this risk progressively decreased until a discrete reduction (-4%) was observed in males ≥ 70 years. A significant reduction in the risk of death due to cerebrovascular diseases was observed in all age groups and both sexes. The greatest increase in the risk of death due to ischemic heart diseases occurred in the city of Recife, 85% and 108% for males and females, respectively, aged 40 to 49 years. In the city of Salvador, a significant reduction in the risk of death due to ischemic heart diseases was observed, except for males and females aged 60 to 69 years. An increase in cerebrovascular diseases in females aged 50 years or more was observed, as was a significant reduction in those diseases in males of all ages; 5) in the cities of Belém and Manaus (Northern region) - a trend towards a decrease in circulatory, cerebrovascular, and ischemic heart diseases was observed in the cities of Belém and Manaus in all age groups and both sexes.

Discussion

This study showed the same trend towards a decrease in circulatory diseases in the Brazilian population [1]. Only the city of Brasília showed a discrete increase in the trend of the risk of death. A previous study [2] of the Brazilian regions also showed a trend towards a decrease in circulatory diseases in the Southeastern, Southern, and Northern regions in all age groups and both sexes from 1979 to 1996, but, in the Northeastern and West Central regions, a trend towards an increase in the risk of death was observed in almost all age groups analyzed. The increase was significantly greater in males aged 40 to 69 years in the Northeastern region. It is worth noting that the risk of death due to ischemic heart diseases was twice that due to cerebrovascular diseases [2]. Previous studies [13,14], mainly of the younger Brazilian population, showed a greater participation of ischemic heart diseases in the risk of death due to circulatory diseases in males and cerebrovascular diseases in females, despite the reports [15,16] on greater mortality due to acute myocardial infarction in females.

In regard to the capitals, the city of Recife showed a greater increase in the risk of death due to ischemic heart diseases than due to cerebrovascular diseases; the city of Brasília showed a similar increase in the cerebrovascular and ischemic heart diseases; and the city of Cuiabá showed an increase in cerebrovascular diseases in the population older than 50 years. The increase in the risk of death in those capitals may have been influenced by the following: 1) an improvement in the diagnosis of the cause of death; 2) an increase in urbanization; 3) worsening of the socioeconomic conditions in the region; 4) low educational level; and 5) other still controversial reasons, such as weight at birth and cultural aspects. The improvement in the quality of death certificates is an interesting hypothesis, because the circulatory diseases may comprise the greatest part of the ill-defined deaths. Therefore, the reduction observed in ill-defined deaths in the period studied may explain the increase in the risk of death due to circulatory diseases in these capitals and confirm the trend toward a decrease in most capitals, ie, an artificial increase and a smaller reduction in the trends of the risk of death due to circulatory, cerebrovascular, and ischemic heart diseases, respectively. These results may cause distortions in opinion or myths about circulatory diseases in the area of epidemiology [17,18].

Worsening of socioeconomic conditions, urbanization, and low educational level are also attractive hypotheses, because worsening of the quality of life is associated with a reduction in the risk of death due to circulatory diseases [19-21]. The reason for the greater participation of cerebrovascular or ischemic heart diseases in the risk of death due to circulatory diseases in the above-cited capitals is unknown. Regional cultural aspects and risk factors may play a role. However, an analysis of the temporal behavior of the major risk factors for circulatory diseases, such as smoking, arterial hypertension, dyslipidemia, and diabetes, should be initially performed to detect the most significant factor for specific regions and cities. This information will facilitate the institution of adequate control programs aiming at reversing the trends towards an increase observed for circulatory diseases.

Our study showed the importance of the analysis of

the trends of the risk of death in specific small regions and cities, because they may not reflect the national trends or the trends in large regions. These trends also serve to rank the priorities in local primary and secondary prevention, as, for example, in the city of São Paulo, where a mild increase in ischemic heart diseases was observed in specific age groups, males and females aged 30 to 39 years and females aged 40 to 59 years. Individuals in these age groups are under the influence of important mechanisms responsible for the etiopathogeny of the atherosclerotic process, and therefore, constitute a group at early risk for circulatory diseases, and will influence morbidity and mortality of subsequent age groups.

Our study also showed important aspects of the risk of death due to circulatory diseases in Brazil. Despite the trend towards a decrease in the risk of death due to circulatory, cerebrovascular, and ischemic heart diseases in Brazil [1], the regional analysis showed distinct realities [2] intensified by the analysis of the capitals. The magnitude of the differences was even greater when the risks of death due to cerebrovascular and ischemic heart diseases in the capitals were analyzed separately. Males and females also showed some peculiarities in regard to the risk of death due to circulatory diseases. Therefore, this study showed the need for and the importance of sector analyses of mortality due to circulatory diseases in the Brazilian population, facilitating the implantation of health care policies in the cardiovascular area.

Data on mortality of the Ministry of Health are prone to problems, such as diagnosis errors, deficiencies in filling out death certificates, the proportion of deaths with unknown causes, and typing errors. Studies validating the information on mortality do not exist for most states and cities in the country. However, an indirect indicator of the quality of the information provided by death certificates is the proportion of death certificates with symptoms, signs, and ill-defined affections as the diagnosis of the cause of death, which is still significant in most Brazilian cities of the Northeastern, Northern, and West Central regions.

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