Medical Care and Deaths due to Coronary Artery Disease in Brazil, 1980-1999

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Objective - *To estimate the frequency of medical care preceding deaths due to coronary artery diseases (CAD) in different Brazilian regions and capitals and to describe trends in medical care from 1980 to 1999.*

Methods - *Information on medical care preceding deaths due to coronary artery diseases/acute myocardial infarction in adults ≥ 20 years from 1980 to 1999 was collected in the DATASUS, the databank of the Brazilian Health Ministry. Sex, states, and capitals selected for 1999 were analyzed in the study. Medical care was stratified as follows: with, without, and ignored medical care. The descriptive analysis comprised frequencies, ratios of frequency, test for proportions, and increments or reductions in frequencies.*

Results - *Acute myocardial infarction (AMI) represented 75 to 85% of the CAD in the period; the frequency of deaths with medical care ranged from 48.9 to 63%, and that of ignored medical care ranged from 27.2 to 41.5%. The frequency of other CAD with medical care ranged from 56 to 76%. The frequency of deaths preceded by medical care decreased by 17.8%, and that with ignored medical care increased by 36.5% (RF=2). The values for the other CAD were –20.2% and +64.6% (RF=44.4). Deaths preceded by medical care were more frequent in females at all ages and in all Brazilian regions.*

Conclusion - *The results show a high frequency of sudden death and suggest errors in diagnosis or codification and overestimation of the statistics about mortality. Validation of the death certificate diagnosis and frequent surveillance are required.*

Key words: medical care, deaths, coronary artery disease

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Coronary artery disease, in particular acute myocardial infarction, is the major cause of sudden death [1-8]. However, studies on the validation of diagnoses are unanimous that an excessive number of unconfirmed acute myocardial infarctions occur, which results in overestimation of the statistics about mortality due to coronary artery disease [4,6,9-16]. Autopsy studies have shown a wide diversity in the diagnosis of sudden death varying with age and sex [3,17-20]. Other cardiac causes, including anomalies of the anatomic structure of the heart and coronary arteries with no atherosclerotic involvement, are common in sudden death under the age of 35 years [3,13,16,18,20]. On autopsy, the coronary arteries may show no involvement, sudden death being attributed to vasomotor phenomena or arrhythmias, or may show thrombosis but no evidence of erosion, plaque rupture, or acute lesions [19-23].

Currently, coronary artery disease is the second cardiovascular cause of death in Brazil, but the first in São Paulo, both in the state and in the capital, and in some other capitals. In the last few years, coronary artery disease has shown a relative increase in both sexes, or only in the male sex. This may be partly due to the artifactual decrease in cerebrovascular diseases observed in the most recent statistics of mortality, and, although cerebrovascular diseases are also a cause of sudden death, deaths due to cerebrovascular diseases without medical care are less frequent than those due to coronary artery disease [24].

The high incidence of uncertain diagnosis of coronary artery disease, mainly acute myocardial infarction, distorts the importance of the disease in the population, affecting health statistics and the evaluation of the requirements for prevention, treatment, and control of the disease. Considering the increasing importance of coronary artery disease as a cardiovascular cause of death in our country, it is paramount to know and disclose the bases that orient the statistics usually used to provide information about trends or other population approaches. In this study, the frequencies of medical care preceding death due to coronary artery diseases in the Brazilian regions and selected capitals were estimated, and the trends in those frequencies in Brazil in the 1980-1999 period are reported.

Methods

A study of the temporal trends represented by quinquennial cut-points of mortality due to coronary artery diseases in Brazil in the 1980-1999 period was carried out. The latter year was used as the cross-sectional cut point for mortality due to the same cause in Brazilian macro-regions and in specific capitals of each region, as follows: the city of Belém (northern region); the cities of Recife and Salvador (northeastern region); the cities of Vitória, Belo Horizonte, and São Paulo (southeast); the city of Goiânia (west central region); and the cities of Florianópolis and Porto Alegre (southern region). DATASUS, the databank of the Health Ministry/FUNASA/CENEPI, and the databank of the information system on mortality (Sistema de Informações sobre Mortalidade - SIM) were used to collect data from the years 1980, 1985, 1990, and from 1995 to 1999 for Brazil, and 1999 for the regions and capitals. The following variables were analyzed: total number of deaths due to coronary artery disease (ICD 9th review = 410-414, and 10th review = I20-I25), CAD specified as acute myocardial infarction (ICD 9th review = 410, and 10th review = I21, I22), or "other" coronary artery diseases (other CAD, the remaining ICD 9th review = 411-414, and 10th review = I20, I23-I25), ages above 20 years, sex, and medical care preceding death. Those variables were categorized as follows: with medical care (w-MC), without medical care (n-MC), and ignored medical care or with no information (ig-MC). Because of the change from the 9th to the 10th International Classification of Diseases (ICD) of the World Health Organization from 1996 onwards, the codes of the 2 ICD were made compatible and, for demonstration, the intermediate years codified by the 10th review (from 1996 to 1998) were included, aiming at preventing interpretation bias if only the last year of the series was considered.

In the descriptive analyses, the predominant approach was that for acute myocardial infarction, because it was the major representative of coronary artery diseases in the death statistics. Differences and increases or decreases in the frequencies of death preceded by medical care as compared with those without medical care or ignored medical care were included, as were the *t* test for means, the test of difference between 2 proportions, and the ratios of frequencies (RF). For the dynamics of increase or decrease in deaths in each category of medical care, the calculations for each period or year were performed in relation to the immediately preceding one.

Results

Of the 76,310 deaths due to coronary artery disease in 1999, 57,654 (75.6%) were due to acute myocardial infarction, 59.5% occurring in males. Deaths in males and in females under the age of 60 years represented 13.5% and 11.0%, respectively ($P<0.01$). Of the total number of deaths, medical care preceded death in 50.7%, medical care did not occur in 8.2%, and information about medical care preceding death was ignored or no record about it existed in the remaining 41.1%.

The frequencies of death due to acute myocardial infarction preceded by medical care were greater among females in all age groups, with statistically significant differences ($P<0.01$ to $P<0.0001$), depending on the age group (tab. I). The ratios of frequency between deaths preceded by medical care and those with ignored medical care were <1 for males up to 50-59 years old, and did not exceed 1.2 in the remaining age groups; for females, on the other hand, they were greater than 1, and increased up to 1.8 in the age group above 80 years. The percentage differences in the diverse frequencies between the sexes ranged from +7.8% (70-79 years) to +18.9% (20-29 years). The mean age among females was greater than that among males, both for deaths preceded by medical care and those in the other categories ($P<0.0001$). In an intragroup comparison of ages, males and females receiving medical care had a greater mean age than those not receiving it ($P<0.0001$ for both cases) (tab. I).

The frequencies of death for the total number of coronary artery diseases, considering the medical care reported on death certificates (fig. 1), and for acute myocardial infarction (fig. 2) are similar, slightly more elevated for deaths preceded by medical care for total coronary artery diseases, greater in the southern region for coronary artery disease and acute myocardial infarction, and lower in the northeastern region. In all regions, in the capitals and in the states, the frequencies of death preceded by ignored medical care are very high (ranging from 32% in the southern region to 46% in the northeastern region for coronary artery diseases and acute myocardial infarction) (figs. 1 and 2).

Of the capitals selected, the cities of Goiânia and Porto Alegre stand out with the greatest percentages of deaths preceded by medical care for acute myocardial infarction (fig.3) and total of coronary artery diseases (fig. 4), followed by the cities of Belo Horizonte and Salvador. The high frequencies of deaths with ignored medical care in the city of São Paulo (47.2% for coronary artery diseases and 46.4% for acute myocardial infarction) have only been exceeded by those in the city of Belém (figs. 3 and 4).

Frequencies of death preceded by medical care for acute myocardial infarction in the regions (tab. II) were greater for females ($P<0.05$ to $P<0.001$), the greatest being detected in the southeastern and southern regions and the lowest in the northeastern region. The frequencies of death with ignored medical care ranged from 36% (south) to 48.8% (southeast) for males, and from 27.3% (south) to 43.8% (northeast) for females. The ratio of frequency between deaths with medical care and those with ignored medical care was 1.5 for females in the country, the lowest being observed in the northeastern region, where no difference was found (RF=1). For males, the greatest ratio was observed in the southern region (1.4), the remaining regions showing low ratios.

For acute myocardial infarction and other coronary artery diseases, the frequencies of death with medical care showed an initial increase, then a decrease, and they returned to plateaus lower than those of 1980 at the end of the series, with a positive balance of 29% for acute myocardial infarction and a negative balance of 4.1% for other coronary artery diseases (tab. III-a, columns a). The increase was

Arq Bras Cardiol
2003; 81: 336-42.

Tabela I - Medical care preceding death due to acute myocardial infarction (AMI), ratios of frequencies (RF) between sexes (F/M)*, and absolute differences of the frequencies, adults ≥ 20 years, Brazil, 1999**

Age	w-MC M	%	F	%	M/F RF	n-MC M	%	F	%	M/F RF	ig-MC M	%	F	%	M/F RF	w-AM/n AM RF M	F
20-29	49	21.5	46	40.4a	1.9	40	17.5	14	12.3	1	139	61	54	47.4	0.8	0.3	0.9
difference F-M				+18.9					-5.2					-13.6			
30-39	376	29.1	189	39.7a	1.4	225	17.4	77	16.2	0.9	689	53.4	210	44.1	0.8	0.5	0.9
difference F-M				+10.6					-1.2					-9.3			
40-49	1.415	35.1	759	46.5b	1.2	546	13.6	183	11.2	2	2.064	51.3	691	42.3	0.8	0.7	1.1
difference F-M				+11.4					-2.4					-9			
50-59	2.791	40	1.572	50.8c	1.2	816	11.7	320	10.3	0.9	3.377	48.3	1.202	38.8	0.8	0.7	1.3
difference F-M				+10.8					-1.4					-9.5			
60-69	4.073	45.5	3.014	55,9 c	1.2	850	9.5	406	7.5	0.8	4.023	45	1.967	36.5	0.8	1	1.5
difference F-M				+10.4				-2						-8.5			
70-79	4.126	50	3.834	57.8 c	1.2	691	8.4	462	6.9	0.8	3.429	41.6	2.342	35.3	0.8	1.2	1.6
difference F-M				+7,8				-1.5						-6.3			
80+	2.337	51	3.622	60.2 c	1.2	347	7.6	373	6.2	0.8	1.894	41.4	2.020	33.6	0.8	1.2	1.8
difference F-M				+9.2				-1.4						-7.8			
Overall	15.167	44.2	13.036	55.8	1.3	3.515	10.2	1.835	7.9	0.8	15.615	45.5	8.486	36.3	0.8	1	1.5
difference F-M				+11.6				-2.3						-9.2			

*F- female; M- male; in bold: difference of the female-male frequencies; a- P<0.01; b- P<0.001; c- P<0.0001;
mean age of males: w-MC- 65.7±13.1 years; n-MC + ig-MC–62.3±14.2 years, P<0.0001;
mean age of females: w-MC – 70.1 ± 12.8 years; n-MC + ig-MC – 67.6± 13.9 years, P<0.0001;
mean age of males x females: w-MC, P<0.0001; n-MC + ig-MC - P<0.0001.

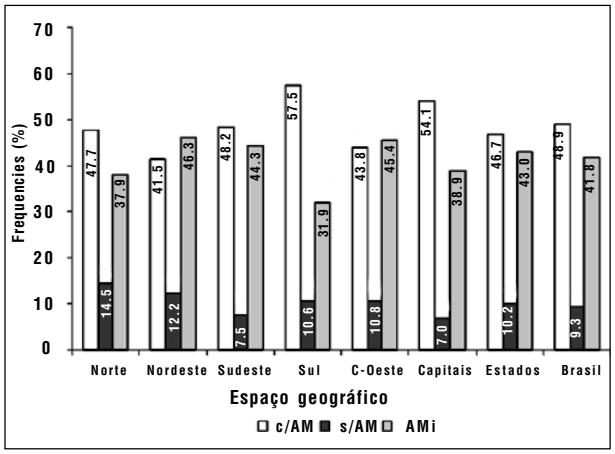

Fig. 1 – Medical care preceding death due to coronary artery diseases, Brazilian regions, states, and capitals, 1999.

greater for deaths with ignored medical care, being +85% for acute myocardial infarction and +96.4% for the remaining coronary artery diseases. Ignored medical care/with medical care final ratios of frequency of 2.9 and 92.3 were respectively observed for acute myocardial infarction and the remaining coronary artery diseases (figs. 5a, data by quinquennia, and 5b for consecutive years from 1996 to 1999, where a marked change may be detected in 1999). In the b columns of the same table, both acute myocardial infarction and the remaining coronary artery diseases show a negative balance for the frequencies of death with medical care and a positive balance for the 2 other categories, more expressive for the remaining coronary artery diseases. Figure 6a shows a summary of data behavior in the period, and table III-b and figure 6b synthesize the stratification of deaths by categories of medical care during 20 years (tabs. III-a, III-b) (figs. 5a, 5b, and 6a, 6b).

Discussion

Coronary artery disease is one of the most important adult diseases in Brazil and one of those that, in the last decades, has benefited most from the technological advances for diagnosis and treatment and from the implementation of specialized intensive care units with monitoring currently spread throughout the country. These advances, availability, and comprehensiveness have not reached all social levels in the different regions. The absolute increase in the number of deaths due to acute myocardial infarction and other coronary artery diseases has been accompanied by an unequal increase in the medical care categories; 2.9 times more deaths occurred with ignored medical care compared with those with medical care for acute myocardial infarction; however, the other coronary artery diseases experienced a

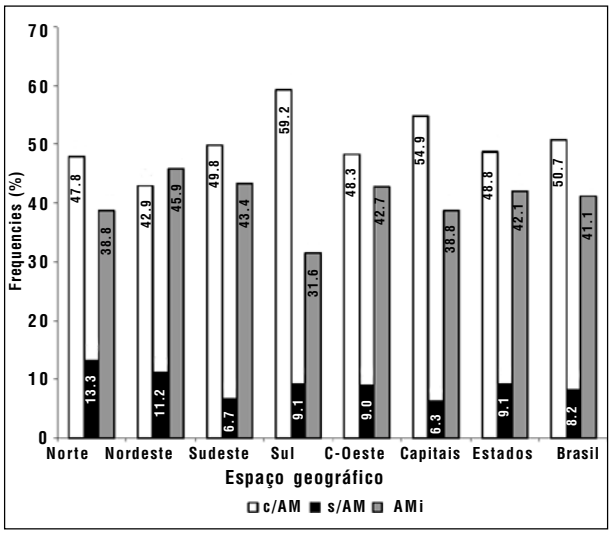

Fig. 2 - Medical care preceding death due to acute myocardial infarction, Brazilian regions, states, and capitals, 1999.

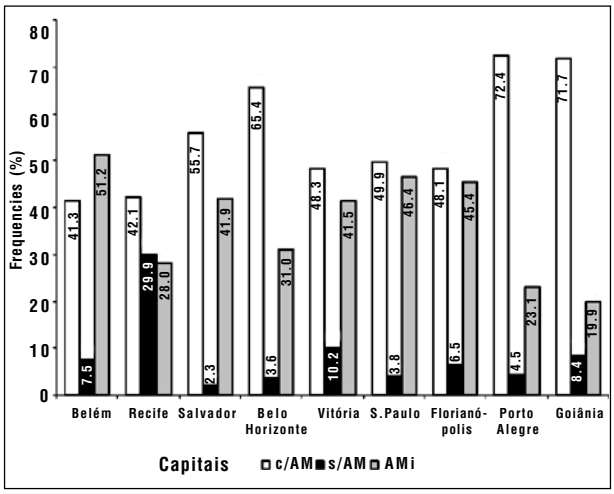

Fig. 4 - Medical care preceding death due to acute myocardial infarction, selected capitals, Brazil, 1999.

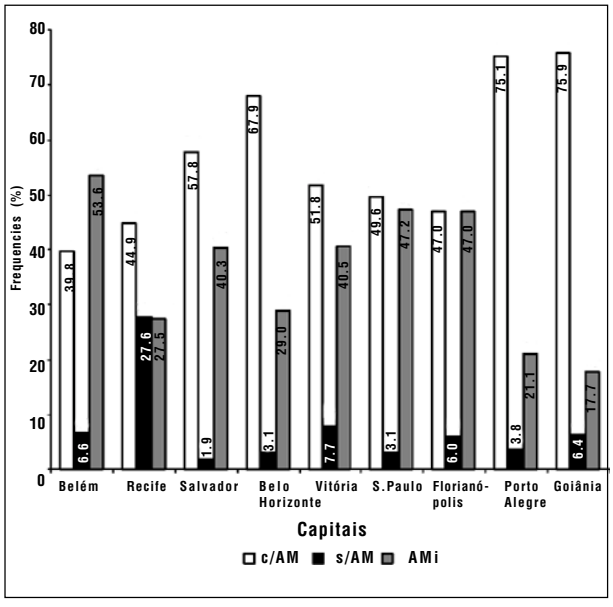

Fig. 3 - Medical care preceding death due to total coronary artery diseases, selected capitals, Brazil, 1999.

decrease in deaths with medical care in specific temporal cut points. The trend points to difficulties in access to diagnosis and treatment for coronary artery diseases by 70% of the Brazilian population covered by the Brazilian public health system (Sistema Único de Saúde - SUS), unlike that provided by other health-care sources. Manifestations of the acute form of the disease, mainly acute myocardial infarction (approximately 75 to 85% of the cases), contribute to that because they do not always allow access to health care, diagnosis, and immediate therapeutic decisions required for each case. Consequently, many deaths actually occur with no medical care and hospitalization, making it impossible to discriminate, based on solid statistics, whether the deaths were sudden, instantaneous, or occurred with no time for medical care, or whether other reasons for the lack of medical care existed. Acute myocardial infarction is a frequent event and the major cause of sudden death, independently of the temporal criterion for this type of outcome. Therefore, acute myocardial infarction is the diagnosis of choice for filling out the death certificate for sudden death in general, as it is in other countries [6,8]. Diagnosis without confirmation is common in the elderly [11], for whom validation studies have shown an excess of acute myocardial infarction of up to 20% [2], but global overestimates of diagnosis may reach up to 25% [6,8,13,14].

The field on the death certificate reserved for indicating the type of medical care may have been left blank due to doubt, fear, or uncertainty in regard to the accuracy of the cause of death reported. The results of this study showed high ratios of frequency when comparing deaths with ignored medical care due to acute myocardial infarction with those due to other coronary artery diseases in the 1980-1999 period (tab. III-a).

Sudden deaths due to coronary artery disease in young people were more often in the male sex [19,23]; deaths with ignored medical care predominated in males < 40 years, but the percentage referring to sudden deaths could not be determined.

The predominance of deaths with medical care in females may reflect less aggressive initial symptoms, with better chances of access to medical services, but with later in-hospital worsening. Among males, sudden deaths are early, frequent, and more than 70% occur out of the hospital [5,12,23,25], where, selectively, those assisted would have a better prognosis and the females the worst prognosis. Official data on hospitalizations via SUS in Brazil in the year 1999 show an in-hospital lethality due to acute myocardial infarction for males of 14.2% and for females of 19.9%, with shorter hospitalization for the latter. For the other coronary artery diseases, the values were the same, 2.9% for each sex, with shorter hospitalization also for females. For females with acute myocardial infarction, the

Tabela II - Sex and medical care preceding death due to acute myocardial infarction (AMI) in adults ≥ 20 years in all Brazilian macro-regions 1999

Region		w-MC	%	F/M RF*	n-MC	%	F/M RF*	igMC	%	F/M RF*	w-MC/ ig-MC RF
N											
	M	467	44.4		157	14.9		427	40.6		1.1
	F	334	52.2a	1.2	89	13.9	0.9	217	33.9	0.8	1.6
NE											
	M	1.985	38.7		670	13.1		2.472	48.2		0.8
	F	1.766	45.2a	1.2	429	11	0.8	1.713	43.8	0.9	1
SE											
	M	8.228	43		1.579	8.2		9.330	48.8		0.9
	F	7.125	56a	1.3	817	6.4	0.8	4.784	37.6	0.8	1.5
S											
	M	3.797	51.7		905	12.3		2.644	36		1.4
	F	3.326	64.6a	1.2	415	8	0.6	1.405	27.3	2.2	2.4
CO											
	M	690	39.7		204	11.8		842	48.5		0.8
	F	475	51.3a	1.3	84	9	0.8	367	39.6	0.8	1.3
BR											
	M	15.167	44.2		3.515	10.2		15.615	45.5		1
	F	13.036	55.8a	1.3	1.835	7.9	0.8	8.486	36.3	0.8	1.5

M/F RF = Female/male ratio of frequency*; a - P<0.0001

Table III.a - Percentages of increase (I) or reduction (R) in the frequencies of medical care preceding deaths due to acute myocardial infarction (AMI) and other coronary artery disease disease, Brazil 1980-1999

Year	Acute myocardial infarction									Other coronary artery diseases								
	w-MC	% of I or R		n-MC	% of I or R		ig-MC	% of I or R		n-MC	% of I or R		w-MC	% of I or R		ig-MC	% of I or R	
		a	b		a	b		a	b		a	b		a	b		a	b
1980	22.067			3.256			11.653			11.199			596			3.985		
	59.7			8.8			31.5			71			3.8			25.3		
1985	27.847	26.2		4.292	10.2		12.084	3.7		13.212	17.8		350	-37.5		3.748	-6	
	63		5.5	9.7		10.2	27.3		-13.3	76.3		7.5	2		-46.8	21.7		-14.4
1990	31.098	11.7		5.110	19		13.533	12		12.022	-9		808	130.9		3.548	-5.3	
	62.5		-0.7	10.27		5.9	27.2		-0.4	73.4		-3.8	4.9		144	21.7		0.1
1995	32.092	3.2		5.839	14.3		15.809	16.8		11.200	-6.8		1.172	45		3.430	-3.3	
	59.7		-4.5	10.9		5.8	29.4		8.1	70.9		-3.4	7.4		50.3	21.7		0.2
1999	28.203	-12.1		5.350	-8.4		24.101	52.5		10.520	-6.1		897	-23.5		7.239	111	
	48.9		-18.1	9.3		-14.4	41.8		42.1	56.4		-20.4	4.8		-35.3	38.8		78.8
1999-1980		29	-17.8		35.1	7.4		85	36.5		-4.1	-20.2		114.9	112.3		96.4	64.6

a) percentage of increase or reduction in the number of deaths for each temporal cut point in regard to the preceding one; b) percentage of increase or reduction in the frequencies of death previously calculated in regard to the total number of deaths for each component of the CAD (AMI or other CAD) for each year; RF for the totals in column a: AMI: ig-MC/w-MC = 2.9; n-MC/w-MC = 1.2. For CAD: ig-MC/w-MC = 92.3; n-MC/w-MC = 110.8; RF for totals in column b: AMI: ig-MC/w-MC = 18.7; n-MC/w-MC = 10.4. For CAD: ig-MC/w-MC = 44.4; n-MC/w-MC=92.11; AMI: ig-MC/w-MC = 2.9; n-MC/w-MC = 1.2. For CAD: ig-MC/w-MC = 92.3; n-MC/w-MC = 110.8.

temporal reference for medical care obtainment is 6% to 7% in the first 5 minutes of symptoms as compared with 2% to 6% for males [26], which partially supports the chance that the possibilities discussed are true. In addition, similar information may be found in the literature [27-29], as may be the reference about loss of records of nonfatal events for females [30], perhaps indicating an unreal increase in lethality.

In the temporal cut points of the historical series, the frequencies of death with medical care due to other coronary artery diseases were always greater than those due to acute myocardial infarction (P<0.01 to P<0.0001). The sudden increase in deaths with ignored medical care due to other coronary artery diseases in 1999 may be an artifact of the databank, because a drop in the absolute number of deaths in that year was observed, as were marked changes in the distribution of deaths by the category of acute myocardial infarction occurring in 1999.

Considering the lack of information about previous medical care for half of the deaths attributed to acute myocardial infarction and for 38.8% of those attributed to other coronary artery diseases in Brazil, another possibility could be the misuse of the ICD rules by the teams codifying the deaths, mainly when the physician or the individual responsible for the diagnosis did not properly clarify the basic cause of death. Only the cities of Porto Alegre and Goiânia had high percentages of deaths with medical care without

Tabela III.b - Increase or reduction in the number of deaths and respective percentages, acute myocardial infarction (AMI) and other coronary artery diseases by category of medical care in successive quinquennia, Brazil 1980 - 1999

Medical care	AMI	%	Other DAC	%	Total	%
w-MC	6.136	29.7	-679	-23.6	5.457	23.2
n-MC	2.094	10.1	301	10.5	2.395	10.2
ig-MC	12.448	60.2	3.254	113.1	15.702	66.6
Total	20.678	100	2.876	100	23.554	100

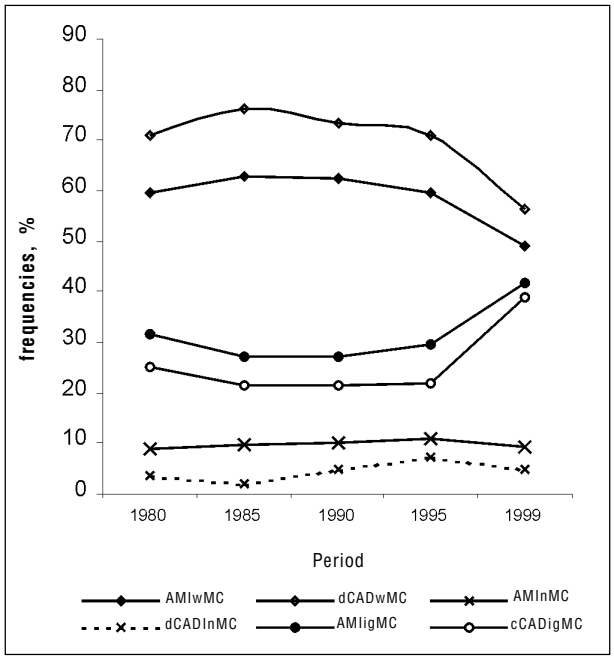

Fig. 5a - Trends in medical care preceding death due to acute myocardial infarction and other coronary artery diseases, Brazil, 1980-1999.

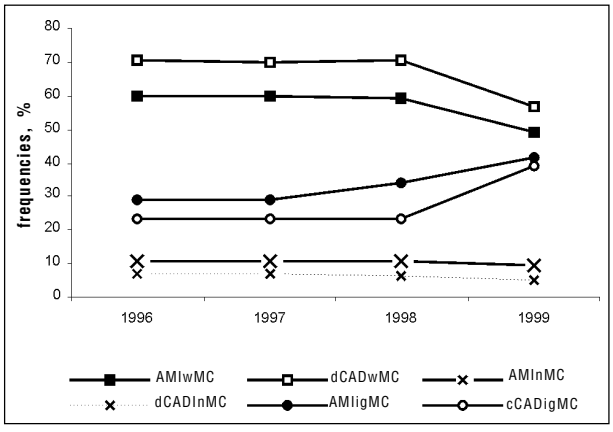

Fig. 5b - Trends in medical care preceding death due to acute myocardial infarction and other coronary artery diseases, Brazil, 1996-1999.

significant differences between acute myocardial infarction and other coronary artery diseases.

The discrepancies between the statistics in the regions and capitals, better in the southern region and worse in the northeastern region, are surprising because of the similarity between the northern and southeastern regions for acute myocardial infarction. In the latter, the greatest disadvantage occurred for death with ignored medical care. The Brazilian regions comprise heterogeneous states with repercussions ranging from the access to emergency services to the quality of health statistics. However, data from the capitals showed that, despite the greater development and region of insertion, in the city of São Paulo, coronary artery diseases have been the major cause of death for many years, but the statistics there were poor, the same occurring in the city of Florianópolis, where coronary artery diseases have been the major cause of death for a short time.

With 50% of the diagnoses reported as "suspect" in regard to accuracy, it is somehow necessary to clarify the magnitude of the overestimate of coronary artery diseases on death certificates, but, as in other countries, minor chances of underestimation represented by deaths codified in the group of the ill-defined causes also exist [7,8]. Validation of the diagnoses of coronary artery disease on death certificates is one of the activities performed by epidemiological

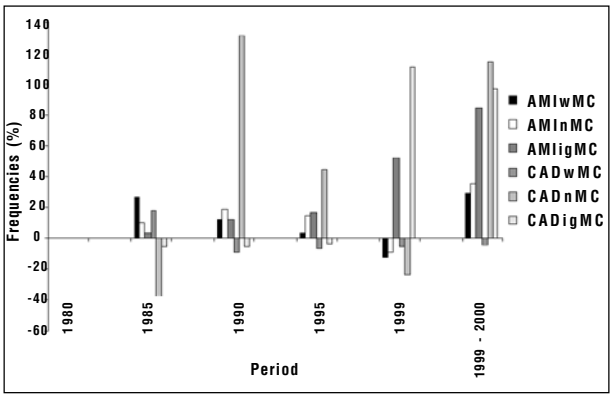

Fig. 6a - Dynamics of medical care preceding death due to acute myocardial infarction and other coronary artery diseases, Brazil, 1980-1999.

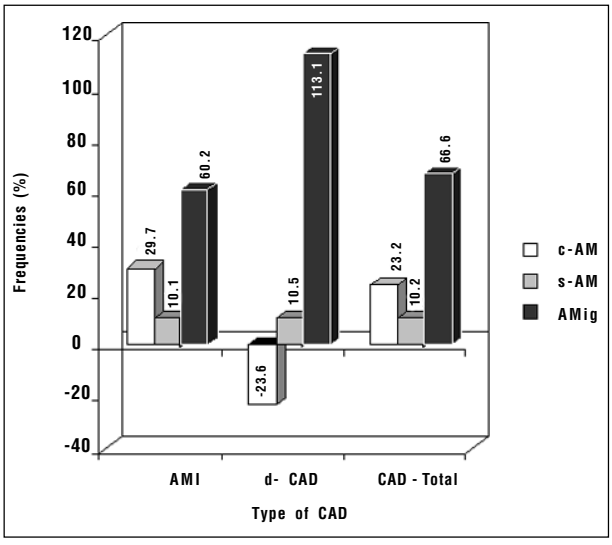

Fig. 6b – Increase or decrease in the total number of deaths due to acute myocardial infarction or other coronary artery diseases, successive quinquennia, 1980-1999.

surveillance programs in industrialized countries. This type of procedure is essential to national data, so the position of coronary artery diseases in the death statistics in Brazil can be more reliably obtained. Usually, surveillance routinely uses methodology with descriptive analysis [31], which may facilitate its diffusion throughout the country. However, independently of the initial validation, monitoring information about medical care in deaths due to cardiovascular diseases that can result in sudden death is required. Criteria for the diagnosis of acute myocardial infarction and other coronary artery diseases should be elaborated and spread out, when medical care is not possible or is not available, or when no autopsy service is available; however, international criteria that can be adapted and tested in Brazil already exist.

Considering that the quality of the statistics about mortality is paramount for epidemiological research, because they portray population features, it is recommended that, in studies performed in Brazil with statistics available for coronary artery diseases, the quality of the databank information and the possible resulting mistakes be assessed.

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