

# E PIDEMIOLOGY OF ACUTE MYOCARDIAL INFARCTION IN SALVADOR, BRAZIL: I. INCIDENCE, LETHALITY, AND MORTALITY<sup>1</sup>

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## I NTRODUCTION

Among cardiovascular diseases, acute myocardial infarction stands out as the leading threat to human life, especially for men in the developed countries, where the morbidity and mortality attributable to this and other cardiovascular diseases is known reasonably well (1-3). This knowledge has enabled researchers to study other epidemiologic aspects of ischemic heart disease—including those relating to risk factors (2, 4-7), sudden death (7, 8), acute myocardial infarction (AMI) in young men and women (9-14), geographic differences (15, 16), family traits of individuals developing early AMI (17, 18), silent AMI (19), and survival of AMI victims (20-25).

These subjects all have an important bearing on the prevention of AMI. It is also worth noting that an analysis of AMI mortality trends in industrial countries indicates that such mortality has declined in some of them in recent times (3).

In contrast, information about cardiovascular disease epidemiology in developing countries is very scarce. In 10 Latin American cities where mortality patterns were studied 20 years ago, nearly a third of all the deaths recorded were caused by cardiovascular diseases (26). We also know that between a fifth and a third of the recorded deaths in Brazil's state capitals are caused by cardiovascular diseases, and that ischemic heart disease is the leading cause of death in three southern capitals and the second leading cause of death (following cerebrovascular accidents) in most of the other capitals (27). Also, a study of deaths from ischemic heart disease in São

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Paulo municipality during the 1940–1973 period showed the death rate from this cause to have doubled over the 34-year period, and to have risen 3.5 times as a proportion of total deaths during the same period (28).

The growing importance of cardiovascular diseases in Brazil, as indicated by these and other data, is creating an increasingly urgent need for epidemiologic studies—both to define local situations and to provide information for health planning. The purpose of the work being partially reported here was to define the role of acute myocardial infarction as a health problem in the city of Salvador, Bahia, Brazil, by determining certain basic features of its epidemiology—particularly AMI incidence, mortality, lethality, and the risk factors involved. Only the first three matters will be discussed in this article.

## CASES STUDIED AND METHODS

When not fulminating, symptomatic acute myocardial infarction generally causes the sufferer to seek medical assistance; and in Salvador such assistance is almost invariably sought at one of a few emergency clinics and hospitals. With this in mind, a review was made of all medical histories of Salvador residents in whom AMI (Code No. 410 in the *International Classification of Diseases*, 9th Revision) was diagnosed during calendar year 1982. At that time the Salvador population over 25 years old totaled approximately 628,226 inhabitants.

After eliminating medical facilities that did not hospitalize AMI patients, a survey was conducted at three emergency clinics, six general hospitals, and one specialized hospital. One of the three clinics received patients referred from other clinics in the city, including social security health care posts, when these patients were diagnosed as having AMI or if AMI was suspected.

All three of the clinics surveyed were privately run. However, under agreements with the social security institution, the national government, and state and private agencies, they saw patients from all parts of the city and at every socioeconomic level.

Two of the seven hospitals surveyed were state-run, these two being an emergency hospital that was in much demand and a general hospital with an emergency ward. Three of the other hospitals, including the university hospital, had no emergency wards. AMI emergencies were admitted there by referral from the emergency clinics. The other two hospitals had emergency wards, one specializing in cardiopulmonary disease and the other being a prepayment clinic with its own clientele at various social levels. Apart from the hospital with this prepayment clinic, all the hospitals and clinics surveyed were parties to agreements under which treatment was made available to individuals at all social levels residing anywhere in the city. All seven hospitals had intensive care units.

The clinical and epidemiologic data sought (see the form in Annex 1) were taken from the patients' personal medical histories; no complementary information was sought from the patients' physicians or families. The diagnoses recorded had been made by physicians or medical teams attending the patients. These diagnoses were based on the patients' clinical histories, physical examinations, electrocardiograms, and serum

enzyme and isoenzyme tests. Some patients were diagnosed by autopsy. Since the survey covered all AMI cases in the city, no standard survey criteria for AMI diagnosis were employed.

While this survey was being conducted, all death certificates at the Bahia Health Secretariat's Health Information Center that cited ICD Code No. 410 were screened so as to include all AMI cases seen at other Salvador facilities where death occurred without prior hospitalization. Besides helping to round out morbidity data, this death certificate information was used to calculate mortality and lethality. The following data were taken from each death certificate: the subject's age, sex, marital status, occupation, date and place of death, place of residence, diagnosis, immediate and associated causes of death, complementary tests performed, autopsy results, and duration of illness.

## RESULTS

The survey found that 619 recorded cases of AMI had occurred among the Salvador population in 1982. Another four people, all of whom survived, were diagnosed as having AMI cases.

However, their medical records could not be found, and they were so few in number that they were excluded from the survey analysis.

Of the 619 subjects included in the analysis, 385 (62.2%) were hospitalized, 219 (35.4%) died in their homes or on their way to the hospital, nine (1.5%) died on public thoroughfares, and six (1.0%) died "at other locations," mostly their places of work. In all, 62% of the subjects were males and 38% females; as was to have been expected, the frequency of AMI rose with age among both sexes (Table 1).

As Table 2 shows, the incidence of AMI was found to be higher among males than among females up to 64 years of age, with the ratio of male incidence:female incidence ranging from 1.4 (in the 25-34 age group) to 3.6 (in the 45-54 age group). No marked difference was found between the male incidence and female incidence in the population over 64 years old.

TABLE 1. The ages of the 619 study subjects with AMI in the 1982 Salvador survey, by sex.

Age group (in years)	Males		Females		Total	
	No.	%	No.	(%)	No.	(%)
< 25	1	(0.3)	1	(0.4)	2	(0.3)
25-34	10	(2.6)	8	(3.4)	18	(2.9)
35-44	37	(9.6)	20	(8.5)	57	(9.2)
45-54	87	(22.7)	27	(11.5)	114	(18.4)
55-64	103	(26.8)	41	(17.4)	144	(23.3)
≥ 65	137	(35.7)	135	(57.4)	272	(43.9)
Unknown	9	(2.3)	3	(1.3)	12	(1.9)
Total	384	(100)	235	(100)	619	(100)

TABLE 2. The incidence of AMI cases per 100,000 inhabitants over 25 years old in Salvador, Brazil, during calendar year 1982, by age group and sex.

Age group (in years)	Men			Women			Overall incidence per 100,000	Ratio of male incidence to female incidence
	Salvador population	No. of AMI cases	Incidence per 100,000 population	Salvador population	No. of AMI cases	Incidence per 100,000 population		
25-34	121,466	10	8.23	134,411	8	5.95	7.03	1.4
35-44	74,478	37	49.67	82,629	20	24.20	36.28	2.1
45-54	49,865	87	174.47	55,139	27	48.96	108.56	3.6
55-64	28,928	103	365.05	31,965	41	128.26	236.48	2.8
≥ 65	23,494	137	583.12	23,891	135	521.41	550.77	1.1
Unknown	—	9	—	—	3	—	—	—
Total	298,231	383	128.42	330,035	234	70.90	98.20	1.8

As indicated in Table 1, only two cases of AMI were found in people under 25 years of age (one of either sex). Both of these cases were excluded from the overall incidence and mortality figures presented in Table 2. It should also be noted that the rates for age in Table 2 are slightly underestimated because the ages of 12 individuals with AMI were unknown.

Data on AMI mortality (deaths per 100,000 inhabitants) and lethality (the ratio of deaths to cases) are shown in Table 3. In all, the survey registered 445 deaths from AMI among the 619 patients, and 211 of these deaths occurred among the 385 hospitalized patients. Thus, general lethality was 71.9% while hospital lethality was 54.8%. (As noted earlier, 234 of the 445 deaths, or 52.6%, occurred among people who had not been hospitalized.) In general, lethality was high among both sexes and all age groups, but was significantly higher among women than among men.

The survey found AMI mortality to be 70.5 deaths per 100,000 inhabitants (85.2 per 100,000 among males and 57.3 per 100,000 among females). Except in the oldest and two youngest age groups, mortality was found to be markedly higher among men than among women.

With respect to diagnosis, AMI was confirmed by ECG in 75.1% of the 385 patients hospitalized with a clinical diagnosis of AMI (Table 4). Many of these patients with positive ECGs were also tested several times for serum enzymes and isoenzymes (creatinine phosphokinase, lactate dehydrogenase, and

TABLE 3. AMI mortality per 100,000 Salvador inhabitants over 24 years old and AMI lethality per 100 cases in Salvador during calendar year 1982, by sex and age group.

Age group (in years)	Males						Females					
	No. of AMI cases	No. of deaths	Mortality		No. of AMI cases	No. of deaths	Mortality (deaths per 100,000 inhabitants)	Lethality		Mortality (deaths per 100,000 inhabitants)	Lethality (deaths per 100 cases)	Ratio of male mortality to female mortality
			(deaths per 100,000 inhabitants)	(deaths per 100 cases)				(deaths per 100,000 inhabitants)	(deaths per 100 cases)			
<25	1	1	—	100.0	1	1	—	100.0	—	—	100.0	—
25-34	10	7	5.70	70.0	8	8	5.95	100.0	5.95	100.0	100.0	1.0
35-44	37	23	30.88	62.2	20	14	16.94	70.0	16.94	70.0	70.0	1.8
45-54	87	47	94.25	54.0	27	18	32.64	66.7	32.64	66.7	66.7	2.9
55-64	103	66	228.15	64.1	41	31	96.98	75.6	96.98	75.6	75.6	2.4
≥65	137	109	463.94	79.6	135	117	451.89	86.7	451.89	86.7	86.7	1.1
Unknown	9	2	—	22.2	3	1	—	33.3	—	—	33.3	—
Total	384	255	85.20 <sup>a</sup>	66.4 <sup>b</sup>	235	190	57.26 <sup>a</sup>	80.9 <sup>b</sup>	57.26 <sup>a</sup>	80.9 <sup>b</sup>	80.9 <sup>b</sup>	1.1 <sup>a</sup>

<sup>a</sup> Excluding the under 25 age group.<sup>b</sup> Z = 3.89, p < 0.01.

glutaminoxalacetic transaminase), the levels of which were invariably high. Complementary tests for cholesterol, triglycerides, and uric acid were little used. A clinical diagnosis alone was made for 20.8% of the hospitalized cases, all of which ended in early death. Diagnosis was based on autopsy in 4.1% of the hospitalized cases. Of the 234 patients who died without hospitalization, autopsies were done on 23 (9.8%); in 77 of the remaining 211 cases, the death certificate indicated that complementary tests had been performed.

Regarding the occupations of the study subjects, 11.5% were professionals; 6.1% had predominately middle class jobs (as teachers, bank employees, secretaries, etc.); 11.2% had lower middle class jobs (as shoemakers, carpenters, painters, etc.); 7.2% had lower class jobs (as servants, peddlers, masonry workers, etc.). In 50.4% of the cases the subject's occupation could not be classified (this occurred most notably in the case of retirees and civil servants), in 8.9% the subject's occupation was unknown, and in the remaining 4.7% the subject's occupation did not fit easily into any of the above categories.

Regarding distribution by type of neighborhood, 9.7% of the AMI victims lived in suburban communities categorized by the municipal government as lower to middle class, 21.8% lived in urban areas categorized as lower and lower middle class, 14.7% lived in urban areas considered predominately middle class, and the remainder lived in middle to upper class areas.

**TABLE 4. Diagnostic examinations and complementary tests performed on the 385 Salvador AMI patients hospitalized in calendar year 1982.**

Type of examination	Test performed on the 385 hospitalized AMI patients	
	No.	%
Electrocardiogram	289	75.1
Glutamic-oxalacetic transaminase	141	36.6
Creatinine phosphokinase	109	28.3
Lactate dehydrogenase	105	27.3
Cholesterol	41	10.6
Triglycerides	22	5.7
Uric acid	18	4.7
Necropsy	16	4.1
Clinical examination	80	20.8

Some correlation was observed between AMI frequencies among workers in low-income occupations and AMI frequencies in low-income neighborhoods (21.8% of the subjects resided in low-income neighborhoods).

Analysis of the cases' monthly distribution did not reveal any significant seasonal trends, the percentage of cases per month ranging from 7.0% to 9.8% of the total, without clustering.

## DISCUSSION

In 1982 the incidence of AMI in the city of Salvador (considered as ICD No. 410 alone, and not under the general heading of Ischemic Heart Disease, Nos. 410 through 414) was 98.20 per 100,000 inhabitants and the mortality

was 70.50 per 100,000. By comparison, the recorded incidence of cerebrovascular accidents in Salvador in 1980 was 168.4 per 100,000 inhabitants, while mortality from that cause was 103.7 per 100,000 (29).

The AMI incidence found by our survey should be considered less than completely accurate, partly because it does not include silent AMI cases (which normally pass undetected) and partly because it may include cases where death intervened before the diagnosis could be confirmed. In the Framingham cohort (19), 23% of the infarctions diagnosed were of the silent kind and were only identified by routine ECGs.

Moreover, many sudden deaths attributed to AMI are diagnosed merely on the basis of clinical evidence, even though other pathologies can also produce sudden death (7). In addition, the fact that between 50% and 70% of all AMI deaths occur before the patient can be hospitalized (7) hinders verification of the diagnosis. In this regard it is significant that half the patients who die suddenly of AMI and undergo autopsy reveal signs not of the recent infarction but of advanced heart disease, sometimes with old infarctions (7).

No special methodologic criterion for AMI diagnosis was established in advance for this study. However, 75.1% of the hospitalized cases were diagnosed both by their clinical histories and by ECG, and some of these patients were also tested for serum enzymes. Of the remaining 24.9% of the hospitalized patients, 4.1% were diagnosed by autopsy and only 20.8% were diagnosed by clinical evidence alone.

In contrast, only 9.8% of the unhospitalized persons who died were autopsied, and only 35% of these subjects' death certificates made reference to complementary tests being performed. Since in most of these fatal cases the in-

farction was of brief duration, it is most probable that these tests were done before the heart attack, and that the individuals already had heart disease that had been diagnosed earlier.

Both the incidence and the mortality found by this survey are regarded as low relative to the rates observed in developed countries. Nevertheless, these rates are still disquieting, especially those found among men over 44 years old. (It is worth noting that 48.5% to 55.4% of the Brazilian population over 49 years of age dies of cardiovascular disease—30.) The proportion of deaths among previously unhospitalized subjects (52.6%) is in line with that described in the literature (1, 2, 7, 31), but the lethality among hospitalized patients (54.8%) was rather higher than that seen in other countries among either male or female patients (1, 11, 16, 21). It would be desirable for analysis of this matter to be performed by the individual medical services involved, but that is made difficult in practice by the transfer of patients from emergency units to hospitals.

Regarding differences between men and women, it is noteworthy that neither the incidence of AMI nor AMI mortality differed much between the two sexes in the group over 65 years old, so that the male:female ratios for incidence and mortality in this group were close to unity.

The observed frequencies of AMI in different occupations did not reflect the risks in those occupations, because population data for specific calculations of this variable were not available. However, the frequency of AMI in pa-

tients with lower and lower middle class occupations was strikingly high, such patients accounting for over half of those classified by type of occupation. It should be noted that less than half of the patients were classified this way because of the difficulty of classifying retirees and civil servants. However, it is unlikely that the socioeconomic status of individuals employed in occupations here regarded as lower and lower middle class would rise to a higher socioeconomic level if they were classified on the basis of other parameters

All in all, these results, in conjunction with those of other epidemiologic studies of cardiovascular diseases in Brazil, point up the growing importance of these diseases in Brazil's major urban centers and provide a preliminary basis for health planning.

## SUMMARY

A survey of acute myocardial infarction (AMI) cases was conducted in the city of Salvador, Brazil, in order to determine rates of AMI incidence, mortality, and lethality. The survey, designed to include all AMI cases occurring in the city during calendar year 1982, was limited to cases and deaths covered by code number 410 of the *International Classification of Diseases* (9th Revision).

Recorded AMI cases involving clinic or hospital admissions were found by reviewing the medical histories of all patients hospitalized with a diagnosis of AMI between 1 January and 31 December 1982. In addition, all death certificates citing AMI as the cause of death in that year were examined.

The combined results indicated that 617 AMI cases occurred among 628,226 Salvador residents over 25 years old, and 443 of these were fatal.

The apparent AMI incidence was 128 cases per 100,000 among men over 24, 71 cases per 100,000 among women over 24, and 98 cases per 100,000 among the whole population in this age range. Likewise, apparent mortality was 85 deaths per 100,000 among men over 24, 57 deaths per 100,000 among women over 24, and 71 deaths per 100,000 among all people in this age range. Lethality (the percentage of cases proving fatal) was 54.8% among hospitalized subjects with AMI and 71.9% overall.

The rates found cannot be regarded as completely accurate, partly because they do not include silent AMI cases and partly because in many cases of sudden death the diagnosis could not be confirmed. Nevertheless, the incidence and mortality rates found are disquieting (despite the fact that they are lower than those prevailing in the developed countries). Also, the lethality figures are notable because they suggest that the death rate among hospitalized AMI patients tended to be higher than that seen in other countries. In addition, the AMI incidence was found to be considerably higher among men than among women in most age groups, but no significant difference was observed in the incidence among men and among women who were over 64 years old.

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**ANNEX 1. Form used in obtaining data from the study subjects' personal medical histories.**

**FEDERAL UNIVERSITY OF BAHIA, SCHOOL OF MEDICINE, DEPARTMENT OF PREVENTIVE MEDICINE  
CLINICAL-EPIDEMIOLOGIC STUDY OF CHRONIC DISEASES: ACUTE MYOCARDIAL INFARCTION**

Medical Service \_\_\_\_\_ Date of Admission \_\_\_\_/\_\_\_\_/\_\_\_\_

**A. Identification**

Full name \_\_\_\_\_  
 Age \_\_\_\_\_ Sex \_\_\_\_\_ Race \_\_\_\_\_ Marital status \_\_\_\_\_  
 Education \_\_\_\_\_ Profession/Occupation \_\_\_\_\_  
 Address \_\_\_\_\_ City \_\_\_\_\_  
 Birthplace \_\_\_\_\_

- B. Clinical epidemiologic data**
- |                                                   | YES | NO  | UNKNOWN |
|---------------------------------------------------|-----|-----|---------|
| 1. Known arterial hypertension being treated      | ( ) | ( ) | ( )     |
| 2. Known coronary insufficiency being treated     | ( ) | ( ) | ( )     |
| 3. Diabetes being treated                         | ( ) | ( ) | ( )     |
| 4. Past infarction                                | ( ) | ( ) | ( )     |
| No. of infarcts _____                             |     |     |         |
| 5. Past cerebrovascular accident                  | ( ) | ( ) | ( )     |
| 6. Peripheral arterial disease                    | ( ) | ( ) | ( )     |
| 7. Valvular cardiac disease                       | ( ) | ( ) | ( )     |
| 8. Chronic pulmonary disease                      | ( ) | ( ) | ( )     |
| 9. Kidney disease                                 | ( ) | ( ) | ( )     |
| 10. Gout                                          | ( ) | ( ) | ( )     |
| 11. Peptic ulcer                                  | ( ) | ( ) | ( )     |
| 12. Past/present congestive cardiac insufficiency | ( ) | ( ) | ( )     |
| 13. Other, specify _____                          | ( ) | ( ) | ( )     |

**C. Other health data**

1. Cigarette smoker YES ( ) NO ( )  
 If yes, specify No. of cigarettes smoked per day \_\_\_\_\_  
 How long have you been smoking? \_\_\_\_\_
2. Previous heart surgery YES ( ) NO ( )
3. Use of oral contraceptives YES ( ) NO ( )
4. Stress test YES ( ) NO ( )  
     normal ( ) abnormal ( )
5. Cineangiography normal ( ) abnormal ( )
6. Sports/exercise YES ( ) NO ( )  
 7. If yes, type \_\_\_\_\_ No. of times per week \_\_\_\_\_

- D. Family history of infarction** YES ( ) NO ( )  
 If yes, No. of persons who have had infarctions \_\_\_\_\_  
 Relationship to yourself \_\_\_\_\_

- E. Diagnosis of infarction**
- |              |                         |             |
|--------------|-------------------------|-------------|
| Clinical ( ) | Clinical-laboratory ( ) | Autopsy ( ) |
|--------------|-------------------------|-------------|

**F. Blood pressure while hospitalized** \_\_\_\_\_ × \_\_\_\_\_

**G. Complementary tests**

1. ECG, date \_\_\_\_/\_\_\_\_/\_\_\_\_
- |                                     |            |              |
|-------------------------------------|------------|--------------|
| Transmural infarction               | YES ( )    | NO ( )       |
| Subendocardial infarction           | YES ( )    | NO ( )       |
| 2. Cholesterol                      | Normal ( ) | Elevated ( ) |
| 3. Triglycerides                    | " ( )      | " ( )        |
| 4. Creatinine phosphokinase         | " ( )      | " ( )        |
| 5. Glutamic-oxalacetic transaminase | " ( )      | " ( )        |
| 6. Lactate dehydrogenase            | " ( )      | " ( )        |
| 7. Uric acid                        | " ( )      | " ( )        |
| 8. Glycemia                         | " ( )      | " ( )        |
| 9. Leukogram                        | " ( )      | " ( )        |
| 10. Hemoglobin                      | " ( )      | " ( )        |
| 11. Hematocrit                      | " ( )      | " ( )        |
| 12. Sedimentation rate              | " ( )      | " ( )        |

**H. Complications**

- |                             |     |            |
|-----------------------------|-----|------------|
| 1. None                     | ( ) | Date _____ |
| 2. Shock                    | ( ) | " _____    |
| 3. Cardiac insufficiency    | ( ) | " _____    |
| 4. Ventricular fibrillation | ( ) | " _____    |
| 5. Other arrhythmia         | ( ) | " _____    |
| 6. Pulmonary embolism       | ( ) | " _____    |
| 7. Cerebral embolism        | ( ) | " _____    |
| 8. Sudden death             | ( ) | " _____    |
| 9. Other, specify _____     | ( ) | " _____    |

**I. Cause of death** \_\_\_\_\_

**J. Outcome:**

Discharged ( ) Date \_\_\_\_\_  
 Transferred to \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_  
 Deceased at \_\_\_\_\_ o'clock on \_\_\_\_\_ (date)