A recent finding that death rates for coronary artery disease in the United States varied by states prompted the examination of a smaller geographic unit, a part of a metropolitan community. The results are provocative.

A COMPARISON OF CORONARY ARTERY DISEASE (ARTERIOSCLEROTIC HEART DISEASE) DEATHS IN HEALTH AREAS OF MANHATTAN, NEW YORK CITY

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A RECENT STATISTICAL study showed that for the United States "the death rates for arteriosclerotic heart disease are roughly twice as high in some states as in others.[1] Since the unit of study was an entire state, it is difficult to pin point possible causal relationships to explain the variations. The purpose of this paper is to report a survey of coronary artery disease (arteriosclerotic heart disease) among population groups, each comprising about 25,000 persons. Units of this size are suitable for detailed field studies in the event that significant differences in death rates could be shown to exist among them.

The units studied were the health areas in the borough of Manhattan, New York City. These consist of contiguous census tracts which, at the time their boundaries were drawn approximately thirty years ago, had an average population of 25,000. A little over twenty years ago the health areas were grouped into administrative units known as health center districts, each with an average population of 250,000. Manhattan has seven health districts totaling 89 health areas. There has been some exodus of population from this section of New York City since the health areas were first constituted, and there has also been considerable shifting of population within the borough. A good deal of variability between the census count of the different health areas has been brought about by these changes. The range in 1950, the year on which this study is based, ran from 10,000 to 40,000 as may be seen in Table 1.

Method

Since there is no single category in the International List of Diseases and Causes of Death, 1948 revision, which comprises all deaths from coronary artery disease (arteriosclerotic heart disease), this study includes all deaths tabulated under categories 420–422. These headings include all fatalities attributable to coronary artery disease (arteriosclerotic heart disease).

Annual mortality and morbidity statistics, which are published on a health area basis by the New York City Department of Health, are classified into

Table 1—Population of Health Areas in Manhattan, New York City, 1950

Size (000)	Number of Health Areas
10.0–14.9	8
15.0–19.9	16
20.0–24.9	26
25.0–29.9	20
30.0–34.9	11
35.0–39.9	2
Total	83 *

Source: 1950 Census.

* Four health areas with a population below 10,000 were not included. These are islands in the East River occupied by federal, state, and municipal institutions, including a military post, a state mental institution, and municipal hospitals for chronic illness. Two other newly constituted health areas were not included as such, but did enter into the calculations as part of the areas to which they formerly belonged.

"white and nonwhite." Details of age and sex of each death are not available for the health areas but have been tabulated for Manhattan as a whole.

For purposes of comparison, therefore, the death rates from coronary artery disease (arteriosclerotic heart disease) of each health area were adjusted for age, sex, and race to the 1950 rates for the borough of Manhattan, using the indirect method of standardization with three age groups: 0–44, 45–64, and 65 and over.[2] An adjusted death rate for coronary artery disease (arteriosclerotic heart disease) was calculated for each health area based upon the average number of deaths occurring in 1949, 1950, and 1951.

Comparisons between these average adjusted rates are less subject to chance fluctuation. The census enumeration (1950) was used without adjustment in the belief that the population changes within the three years would not invalidate the results.

Results of Analysis

Variation of Death Rates Among Health Areas

Table 2 gives the population for each health area, the health center district in which it lies, the deaths from coronary artery disease (arteriosclerotic heart disease) in the years 1949, 1950, and 1951, and the adjusted death rate based upon a three-year average of these deaths. These rates vary from a low of 249 deaths per 100,000 (health area 7.10), to a high of 689 (health area 25.20). The median is 359 deaths per

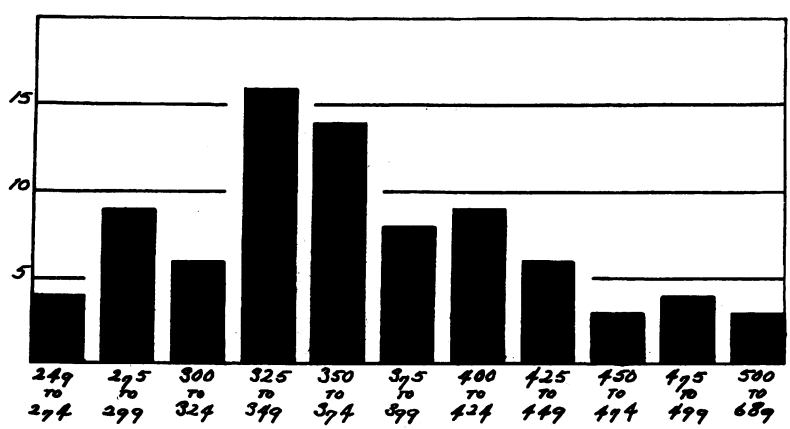

Figure 1—Variation in Coronary Artery Disease (Ateriosclerotic Heart Disease) Death Rates in Health Areas of Manhattan, 1949–1951 (Average)

100,000 and the quartiles are at 327 and 415. The distribution is shown in Figure 1.

From an examination of these figures it is apparent that the variation in mortality among health areas in Manhattan is as great as has been reported by Enterline and Stewart among all of the

Table 2—Deaths and Death Rates from Coronary Artery Disease (Arteriosclerotic Heart Disease) in Manhattan Health Areas, 1949–1951

Health Area	Population (000)	Health Center District *	Deaths †				Adjusted Death Rate per 100,000 ‡	
			1949	1950	1951	Avg.	Avg.	Range
1.10	23.2	W.H.	77	63	76	72	338	296–361
1.20	22.2	W.H.	70	79	68	72	343	324–377
2.10	28.0	W.H.	102	128	127	119	373	320–402
2.21	23.3	W.H.	73	74	72	73	298	294–302
2.22	19.1	W.H.	77	67	71	72	323	301–346
3.00	28.9	W.H.	139	120	106	122	358	311–405
4.00	32.2	W.H.	110	120	131	120	354	324–386
5.00	29.8	W.H.	113	143	116	124	362	330–418
6.10	17.6	W.H.	53	55	80	63	337	284–428
6.20	20.9	W.H.	50	74	60	61	362	297–439
7.10	15.8	W.H.	29	26	23	26	249	220–278
7.20	22.5	W.H.	40	45	52	46	340	296–384
8.00	31.2	C.H.	44	70	57	57	296	228–363
9.00	29.4	W.H.	84	91	88	88	311	297–322
10.00	28.5	C.H.	60	88	47	65	358	259–485
11.00	26.2	Riv.	58	59	61	59	381	375–394
12.00	22.7	C.H.	53	64	56	58	438	400–483
13.00	26.6	C.H.	65	92	73	77	455	384–543
14.00	20.7	Riv.	71	63	63	66	404	386–435
15.00	27.2	C.H.	56	58	51	55	382	354–402
16.00	32.9	C.H.	95	101	87	94	469	435–504
17.00	19.4	E.H.	72	59	72	68	415	360–439
18.00	32.0	Riv.	60	80	93	78	295	227–352
19.00	23.1	C.H.	56	56	39	50	416	325–466
20.00	28.8	E.H.	31	46	39	39	309	246–365
21.00	13.4	E.H.	25	38	31	31	344	277–421
22.00	21.9	E.H.	56	61	54	57	335	318–359
23.10	23.7	Riv.	98	150	117	122	355	285–436
23.20	16.8	Riv.	87	101	94	94	689	637–740
24.00	25.6	C.H.	42	66	54	54	386	300–472
25.00	27.9	E.H.	80	69	76	75	449	413–479
26.00	20.0	E.H.	38	39	48	42	253	228–288
27.10	12.5	Riv.	64	67	70	67	370	353–386
27.20	32.8	Riv.	114	134	126	125	448	400–470
28.00	25.4	E.H.	63	67	71	67	316	298–335
29.00	23.5	E.H.	60	60	77	66	337	306–393
30.00	13.6	E.H.	25	33	38	32	387	302–459
31.10	23.6	Riv.	133	113	120	122	377	349–411
31.20	25.2	Riv.	105	118	108	109	320	309–332
32.10	14.8	Riv.	52	45	55	51	320	283–345

Source: Vital Statistics by Health Areas, 1949, 1950, 1951. Department of Health, New York City.

* Health Center Districts are: C.H., Central Harlem; E.H., East Harlem; K.B., Kips Bay—Yorkville; L.E.S., Lower East Side; L.W.S., Lower West Side; Riv., Riverside; W.H., Washington Heights.

† Includes deaths listed under 420–422 International Disease Classification, 1948 Revision.

‡ Adjusted by indirect method to Manhattan borough population, 1950 census.

Table 2—(continued)

Health Area	Population (000)	Health Center District *	Deaths †				Adjusted Death Rate per 100,000 ‡	
			1949	1950	1951	Avg.	Avg.	Range
32.20	27.3	Riv.	104	116	93	104	347	310–387
33.00	20.0	E.H.	65	77	83	75	405	351–448
34.00	32.8	Riv.	147	141	153	147	349	335–364
35.00	35.7	Riv.	134	161	147	147	333	289–365
36.00	34.9	K.B.	108	132	118	119	262	238–291
37.00	23.8	K.B.	104	115	89	103	346	299–386
38.00	24.8	K.B.	73	86	83	81	327	295–347
39.00	24.6	L.W.S.	84	99	97	93	359	324–382
40.00	34.3	L.W.S.	152	176	151	160	359	339–395
41.00	24.2	K.B.	94	81	95	90	271	244–287
42.00	24.9	K.B.	128	158	160	149	490	422–520
43.00	18.5	K.B.	74	69	75	73	359	339–368
44.00	15.2	K.B.	72	53	51	59	330	285–402
45.00	21.0	L.W.S.	115	157	127	133	551	477–651
46.00	17.6	L.W.S.	61	62	82	68	340	305–410
47.00	37.3	L.W.S.	163	192	175	177	385	354–417
48.00	31.1	K.B.	137	155	153	148	299	271–314
49.00	21.9	K.B.	79	78	70	76	295	272–307
50.00	15.9	K.B.	50	69	66	62	320	258–341
52.00	32.0	L.W.S.	137	174	151	154	375	334–424
53.00	28.2	L.E.S.	101	126	112	113	417	372–465
54.00	16.4	K.B.	69	66	68	68	332	322–336
55.00	17.9	L.W.S.	74	72	74	73	425	419–431
56.00	29.7	L.W.S.	114	108	102	108	364	344–384
57.00	28.7	L.W.S.	101	119	108	109	288	267–315
58.00	21.7	L.E.S.	83	86	96	88	406	363–420
59.00	15.1	L.E.S.	66	74	61	67	395	359–436
60.00	32.9	L.E.S.	24	27	29	27	286	254–307
61.00	17.5	L.W.S.	58	57	45	53	297	252–325
62.00	24.2	L.E.S.	135	133	150	139	476	456–514
63.00	15.7	L.E.S.	33	38	48	50	403	333–484
64.00	20.8	L.W.S.	51	59	60	57	293	262–309
65.00	24.6	L.E.S.	144	172	155	157	485	445–532
66.00	25.3	L.E.S.	104	128	126	119	433	379–459
67.00	18.4	L.E.S.	100	111	67	93	449	323–536
68.00	26.5	L.W.S.	99	111	100	103	369	354–397
72.00	13.0	L.E.S.	59	61	77	66	460	412–537
73.00	12.9	L.E.S.	24	23	30	26	346	306–399
74.00	25.2	L.E.S.	127	120	127	125	402	386–408
76.00	12.2	L.E.S.	48	53	49	50	417	401–442
77.00	10.5	L.W.S.	68	61	56	62	483	437–530
78.00	28.2	L.E.S.	101	126	112	113	417	372–465
80.00	16.2	L.E.S.	85	101	73	86	508	431–597

Source: Vital Statistics by Health Areas, 1949, 1950, 1951. Department of Health, New York City.

* Health Center Districts are: C.H., Central Harlem; E.H., East Harlem; K.B., Kips Bay—Yorkville; L.E.S., Lower East Side; L.W.S., Lower West Side; Riv., Riverside; W.H., Washington Heights.

† Includes deaths listed under 420–422 International Disease Classification, 1948 Revision.

‡ Adjusted by indirect method to Manhattan borough population, 1950 census.

United States. Similar results were reported by Lilienfeld for Baltimore.[4]

Consistency Within Individual Health Areas

Variation in death rates among health areas could be due entirely to chance if deaths for only one year were studied. However, taking into account probable under-reporting in 1949, the year the revised classification of the International List was introduced, the figures for the three years, 1949 through 1951, revealed a remarkable consistency. This may be seen by an inspection of the fourth, fifth, and sixth columns of Table 2, where the number of deaths for these three years are listed. When the adjusted rates are distributed in quartiles for each of the three years, the health areas are found to fall, for the most part, in the same quartile in successive years.

Geographic Distribution

The distribution of the adjusted death rates within the borough of Manhattan is presented in Figure 2. There is a wide range of death rates within each health center district with five of the seven districts having health areas in each quartile, and the others (Washington Heights and Kips Bay-Yorkville) each including areas in three quartiles.

Thus there is no distinctive pattern

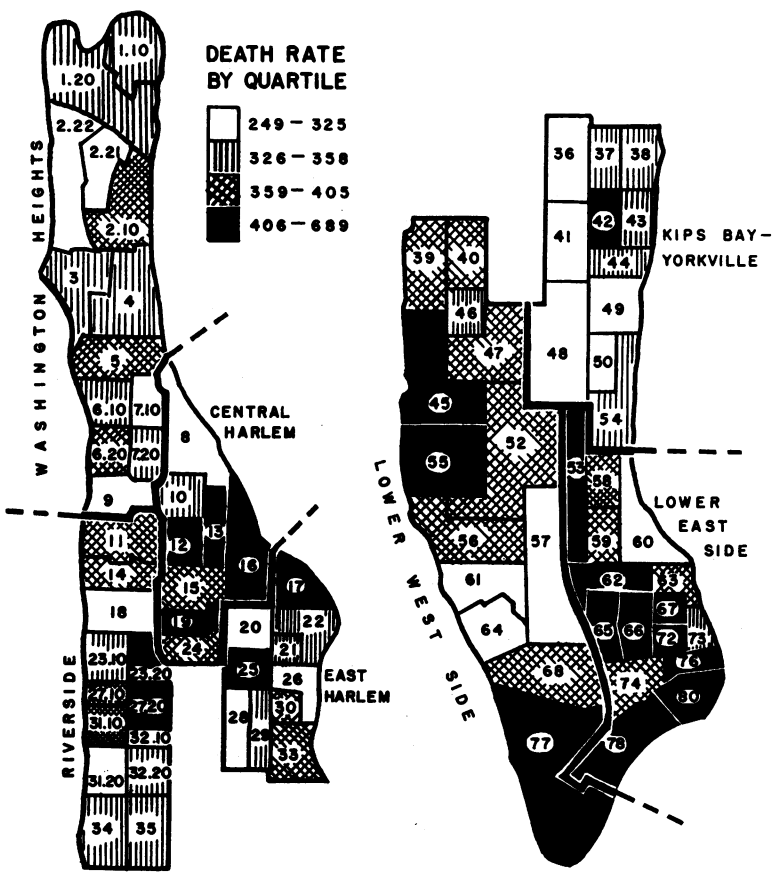

Figure 2—Adjusted Death Rates for Coronary Artery Disease (Arteriosclerotic Heart Disease) in Manhattan, 1949–1951 (Average)

Table 3—Mortality in Health Center Districts of Manhattan from Coronary Artery Disease (Arteriosclerotic Heart Disease), 1949–1951 (Average)

Health Center District	Number of Health Areas	Mortality Above Median		Mortality Below Median	
		Number	Per cent	Number	Per cent
Lower East Side	15	13	87	2	13
Central Harlem	8	6	75	2	25
Lower West Side	13	9	69	4	31
Riverside	13	6	46	7	54
East Harlem	10	4	40	6	60
Washington Heights	13	3	23	10	77
Kips Bay-Yorkville	11	1	9	10	91
Total	83	42	50	41	50

observable, although there is some tendency for clustering of health areas falling within the same quartile.

The effects of this tendency in terms of the health center district administrative units are shown in Table 3. Mortality in the Lower East Side, as reflected in adjusted death rates per 100,000, is above the median in 13 of 15 health areas and is almost equally high in Central Harlem. In Kips Bay-Yorkville and Washington Heights only a few health areas are above median mortality.

Relationship to Income

Several demographic characteristics of the population under study were available for investigation of possible association with the adjusted health area death rates. Only one of these, median family income, will be included in this paper.

Median family income in the 83 health areas in this study was $3,024 in 1949 and the range of health area median income $1,778 to $10,000.

Quartile distribution of family income was compared to the quartile listing of adjusted death rates. It was noted that 29 (35 per cent) of the health areas showed incomes above the median and death rates below this point. Exactly the same number revealed the reverse situation. The remaining 25

Table 4—Comparative Median Family Income in Health Center Districts of Manhattan

Health Center District	Number of Health Areas	Income Above Median		Income Below Median	
		Number	Per cent	Number	Per cent
Lower East Side	15	3	20	12	80
Central Harlem	8	0	0	8	100
Lower West Side	13	9	69	4	31
Riverside	13	9	69	4	31
East Harlem	10	1	10	9	90
Washington Heights	13	10	77	3	23
Kips Bay-Yorkville	11	10	91	1	9
Total	83	42	50	41	50

health areas were evenly divided between a group of 12 (14 per cent) with incomes and death rates in the lower half of the scale and 13 (16 per cent) with the opposite finding. This distribution shows an inverse relationship between the median health area income and death rate from coronary artery disease (arteriosclerotic heart disease).

Table 4, showing comparative incomes in health center districts, lists these districts in the same order as they appear in Table 3.

Lower East Side and Central Harlem, most of whose health areas have incomes below the median (Table 4) have mortality above the median (Table 3). Washington Heights and Kips Bay, whose health areas have income principally above the median (Table 4) have mortality below the median. This presentation also suggests a tendency toward inverse association between income and coronary artery disease (arteriosclerotic heart disease) deaths.

Discussion

There are apparently real geographic differences in the death rates from coronary artery disease (arteriosclerotic heart disease) in Manhattan which cannot be attributed to variations in the age, sex, or race composition of the population units investigated. No obvious reasons come to mind to explain the kind of pattern resulting from these differences. There does seem, however, to be some tendency for health areas with high death rates to be located in sections of the city known to be economically underprivileged. A reverse distribution was also observed.

When this impression was tested, area by area and for the health districts as a whole, about two-thirds of the health areas were found to show a negative association between median family income and death rate. Health areas for which this did not hold true were conspicuously congregated in East Harlem District (7 out of 10 health areas) and to a lesser extent in Lower West Side (5 out of 13 health areas), but were also to be found scattered throughout other sections of the island. One can speculate as to cultural or genetic factors which may be operating to bring about this deviation from the over-all trend of income-death relationships. There are a number of possibilities which seem to justify exploration, such as occupation, education, marital status, and ethnic background.

Before these studies are made, however, it is important to investigate a series of deaths in order to determine: (1) the extent to which the cause of death reported on the death certificate can be medically verified,[3] and (2) the relationship between an individual dying with coronary artery disease (arteriosclerotic heart disease) and the population from which he is drawn. In this way a picture can be put together of an ideal type who, in this community of Manhattan, appears to be in particular danger of succumbing to coronary artery disease (arteriosclerotic heart disease).

Studies such as the present one can go no further than to develop a frame of reference within which to evaluate experience in terms of individuals. Information of a more detailed sort could be provided by field studies of reported deaths. Such studies would be statistical studies of population groups.

Summary

A statistical study is reported of variation in death rates from coronary artery disease (arteriosclerotic heart disease) in the various health areas of Manhattan, New York City, for the years 1949–1951.

Adjusted death rates ranged from a

low of 249 per 100,000 to a high of 689. It was found that there was little variation from year to year in the number of deaths in a given health area.

There was a tendency toward inverse association between median family income of the health areas and their death rates from coronary artery disease (arteriosclerotic heart disease).

It is suggested that these health areas, with an average population of 25,000, are convenient units for further epidemiologic investigation.

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Worth Repeating

"The most effectual means of securing sanitary reforms [in New Orleans] is the formation of a voluntary health association which would concentrate and unite the labor of those individuals whose philanthropy would induce them to engage in the undertaking. The purpose of this association would be: first, to undertake the truth with regard to our sanitary condition; next, to inform the community upon the subject; and finally to urge those measures that might be deemed advisable."

—H. J. SIMONDS, M.D., New Orleans, 1851