Cardiovascular Disease Mortality Patterns in Georgia and North Carolina

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THE SOUTHERN Blue Ridge economic subregion in Georgia and North Carolina had some of the lowest U.S. death rates for middle-aged white persons during 1949–51 for all cardiovascular diseases, coronary heart disease alone, and all causes. Some of the plains areas of the Carolinas and Georgia, however, had the highest rates (*1*). Geographic differences in mortality rates thus provide a basis for epidemiologic or ecological studies of cardiovascular diseases.

The study reported here was undertaken to (*a*) test the hypothesis that the general pattern of death rates for cardiovascular diseases persists for a number of years, (*b*) describe more precisely the geographic areas with extremely high or extremely low rates, (*c*) develop methods for collecting and classifying vital data, and (*d*) identify factors associated with death rates, as a first step in the search for causal factors responsible for geographic differences in these rates.

Methods

Standard vital statistics procedures were used, with modifications as needed. The county of usual residence is the basic unit for which special tabulations were made by the State health departments of Georgia and North Carolina. A number of subtotals were checked and found to agree with regular State tabulations (*2,3*) and within 0.5 percent of National Center for Health Statistics tabulations (*4*). Age-sex-race-specific rates were computed for 10-year age groups, 25 years and over, using the average of the 1950 and 1960 censuses as the population at risk (*5,6*).

Attention was focused on death rates for white men because they have the highest death rates for coronary heart disease, by sex and race, and very high rates for all cardiovascular diseases combined; also, deaths during middle age, particularly ages 45–64, because (*a*) these may be considered premature deaths, thus important from a public health point of view, and (*b*) the underlying cause of death tends to be more specific and more easily defined than in old age.

Random error. Many rural counties, like census tracts in a city, have rather small populations and accordingly a small number of deaths. Chance fluctuation or random error is thus important. To cite an extreme example, based on coronary heart disease death rates in Georgia, we would expect for the white men aged 55–64 in Chattahoochee County an average of less than one-half death per year for coronary heart disease. Under such circumstances, chance fluctuation is likely to be so great that ordinary age-specific rates will have little meaning.

To reduce drastically the relative random error in rates we (*a*) tabulated all deaths for the 10-year period, 1950–59, (*b*) calculated age-adjusted age-specific rates for ages 35–74 as well

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as ages 45–64, adjusted by the direct method (*7*) to the entire U.S. population in those age groups in 1950, (*c*) used broad categories of causes of death, such as all cardiovascular diseases combined (International Statistical Classification, codes 330–334 and 400–468), and (*d*) used groups of counties, such as State economic areas and special groups of sparsely settled contiguous counties, which we call "demographic areas."

While counties of moderate size are useful as units for study of geographic differences in death rates, many counties in Georgia and a few in North Carolina have populations so small that their rates show substantial random fluctuations, even for the years 1950–59. The population of many such counties is similar to or even less than that of a typical city census tract. For this reason, before rates were calculated, counties with small populations were combined into demographic areas. A demographic area is an area within a State economic area, consisting of two to seven counties with small populations, usually contiguous to each other; the smallest practical number of counties that have sufficient population so that the relative standard error of estimate is less than 10 percent (deaths due to cardiovascular diseases for white men, aged 35–74). An individual county with such a population was not included as part of a demographic area.

These procedures also provide a degree of protection from potential differences in classification procedure, but at the same time they are less specific for time, age, cause, and area.

Adjustment for resident institutions. Deaths in State mental hospitals and other resident institutions are charged to the usual county of residence before admission. Therefore, the populations of such institutions generally are not at risk of being included in the deaths for the specified county, even though they are enumerated by the census as residents of that county. For this reason, these populations (*8*, *9*, and data from the Public Health Service's National Institute of Mental Health and Communicable Disease Center and the North Carolina Department of Mental Health) were excluded from the population base where they exceeded 3 percent of a county's population or 2 percent of a State economic area's population.

Table 1. Effect of adjustment for resident institution populations on death rates for cardiovascular diseases, white men aged 45–64 years, selected areas of North Carolina and Georgia, 1950–59

Area [1]	Unadjusted	Adjusted [2]
North Carolina	878. 0	--------
Burke County	632. 9	772. 8
Granville County	830. 3	1, 009. 1
Hoke County	759. 7	849. 0
Raleigh-Wake County	984. 4	1, 043. 8
State economic area 2	658. 7	693. 3
Georgia	876. 8	--------
Baldwin County	447. 2	1, 045. 3
Floyd County	885. 5	917. 2
Augusta-Richmond County	1, 094. 6	1, 199. 1
State economic area 4	823. 9	863. 2
State economic area 4b	803. 5	931. 3

[1] State economic areas are shown in figures 1 and 2.
[2] Method of adjustment appears below.

Adjusted rates for all cardiovascular diseases and unadjusted rates, calculated by conventional procedures, for white men aged 45–64 years are shown in table 1. The adjustment had a similar effect on death rates for all causes and for coronary heart disease for age groups 35–74 years and for white women.

The method of adjustment developed for this study was also applied in two other studies (*10*, *11*) because it produces more accurate and meaningful rates for epidemiologic studies. While data on the age-sex-race distribution of the institutional population by county are in some instances incomplete, the resulting potential error should generally be less than 1 percent. Such adjusted rates should be directly comparable with rates for counties and other areas which do not have resident institutions. For comparison with the rate for the State as a whole, both the resident-institution-adjusted rates and the rates for counties and other areas without resident institutions are slightly high, an error near 1 percent.

Because of incomplete data, no correction was made for Asheville-Buncombe County. Available data indicates that such correction would probably increase its rate by not more than 4 percent.

A majority of the adult population of Baldwin County, Ga., is in Milledgeville State Mental Hospital; the unadjusted rates for this county were therefore not expected to be meaningful. The adjusted rate for this county (table 1) may also be viewed with some caution, because in some instances patients may be committed from Baldwin County (the county in which the State institution is located) without regard to actual residence. To determine the magnitude of this phenomenon, and to take a step in testing the soundness of this method of adjustment, a special study was undertaken of a 10 percent systematic sample of all deaths occurring in Baldwin and Augusta-Richmond Counties from 1950 through 1959. The deaths for at least 1 month were chosen for each of the 10 years, and all 12 months of the year were represented. Hospitalization data entered on this sample of death certificates indicates that adjusted rates for these two counties are essentially correct, that (*a*) Baldwin County's adjusted rate should possibly be reduced by 3 or 4 percent, and (*b*) any further correction for Augusta-Richmond County's adjusted rate is negligible.

State Economic Areas

The nonmetropolitan areas have lower death rates than the metropolitan areas, particularly for coronary heart disease. For Georgia and North Carolina, these differences are less than for the United States as a whole (*12*).

Average annual death rates for metropolitan areas are shown in table 2. Several of the metropolitan areas of Georgia of rather moderate size, including Macon and Savannah, have very high rates. Macon's rate is about 11 percent lower than Savannah's, but this modest difference is

Table 2. Death rates for selected causes, white men aged 45–64 years, metropolitan areas and economic subregions of Georgia and North Carolina, 1950–59 and 1949–51

Area	Cardiovascular diseases (330–334, 400–468)[1]		Coronary heart disease (420)[1]		All causes	
	1950–59	1949–51	1950–59	1949–51	1950–59	1949–51
United States	819. 0	845. 0	559. 3	534. 1	1, 497. 4	1, 563. 2
North Carolina	878. 0	915. 0	542. 2	490. 1	1, 455. 1	1, 518. 2
Metropolitan	917. 9	(2)	635. 7	(2)	1, 479. 0	(2)
Asheville	824. 4	845. 0	575. 8	486. 1	1, 379. 6	1, 431. 8
Charlotte	1, 019. 5	959. 9	778. 9	696. 6	1, 589. 4	1, 554. 5
Winston-Salem	896. 2	968. 5	625. 0	546. 9	1, 415. 6	1, 549. 1
Greensboro-High Point	859. 0	917. 6	569. 7	521. 6	1, 397. 4	1, 412. 9
Durham	923. 8	851. 2	648. 3	541. 3	1, 528. 7	1, 501. 8
Raleigh [3]	1, 043. 8	1, 124. 8	626. 2	661. 4	1, 650. 5	1, 758. 8
Nonmetropolitan	865. 2	(2)	511. 9	(2)	1, 447. 5	(2)
Georgia	876. 8	905. 1	543. 1	490. 1	1, 539. 7	1, 607. 3
Metroplitan	928. 8	(2)	627. 6	(2)	1, 642. 8	(2)
Albany	939. 5	(2)	633. 3	(2)	1, 691. 2	(2)
Atlanta [4]	893. 0	939. 9	599. 9	570. 1	1, 588. 7	1, 646. 7
Augusta [3 5]	1, 199. 1	1, 287. 6	825. 7	805. 8	2, 022. 3	2, 088. 0
Walker County [6]	683. 1	649. 6	428. 0	376. 5	1, 343. 0	1, 251. 5
Columbus [7]	1, 025. 5	1, 051. 4	638. 6	613. 2	1, 769. 7	1, 899. 4
Macon	1, 030. 4	1, 130. 6	675. 8	564. 4	1, 741. 7	1, 995. 5
Savannah	1, 156. 9	1, 239. 2	806. 2	826. 8	1, 915. 7	2, 080. 8
Nonmetropolitan	832. 8	(2)	483. 0	(2)	1, 467. 0	(2)
Economic subregion 33 (Southern Blue Ridge)	620. 6	578. 7	347. 2	227. 8	1, 153. 8	1, 144. 5
Economic subregion 24 (East Central North Carolina)	1, 053. 2	1, 070. 2	629. 8	564. 4	1, 730. 7	1, 742. 9
Economic subregion 22 (North Carolina Coast)	993. 5	1, 030. 4	567. 9	487. 9	1, 618. 6	1, 640. 1

[1] Numbers in parentheses are from the International Statistical Classification. [2] Not available. [3] Adjustments made for resident institutions. [4] Fulton, De Kalb, and Cobb Counties only. [5] Richmond County only. [6] Suburban Chattanooga. [7] Muscogee County only.

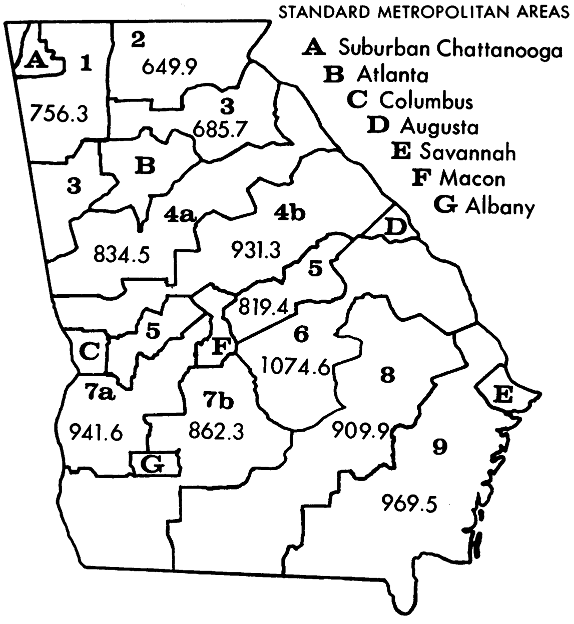
NOTE: Average annual death rate per 100,000 population, age-adjusted by 10-year age groups by the direct method to the total U.S. population aged 45–64 years in 1950. Economic subregions shown are for nonmetropolitan portions only, and are those which are entirely in Georgia and North Carolina.

statistically significant at the 0.01 level for white men 45–64 years and at the 0.001 level for white men 35–74 years, using a standard method of calculation (*13*). Rates for nonmetropolitan State economic areas, as defined by the Bureau of the Census (*14*), are presented in figures 1 and 2. Such areas generally consist of 6 to 20 contiguous counties, which are similar in the way people earn a living and in other socioeconomic aspects. Thus they provide a better basis for studies of geographic difference in death rates than do larger, less homogeneous units, such as States or economic subregions.

There are substantial differences in death rates, with the lowest rates for the Blue Ridge areas of both States and the Upper Piedmont area of Georgia. Areas with the highest rates are Savannah, Augusta, the area south of Augusta (Georgia), and the area southeast of Raleigh (North Carolina).

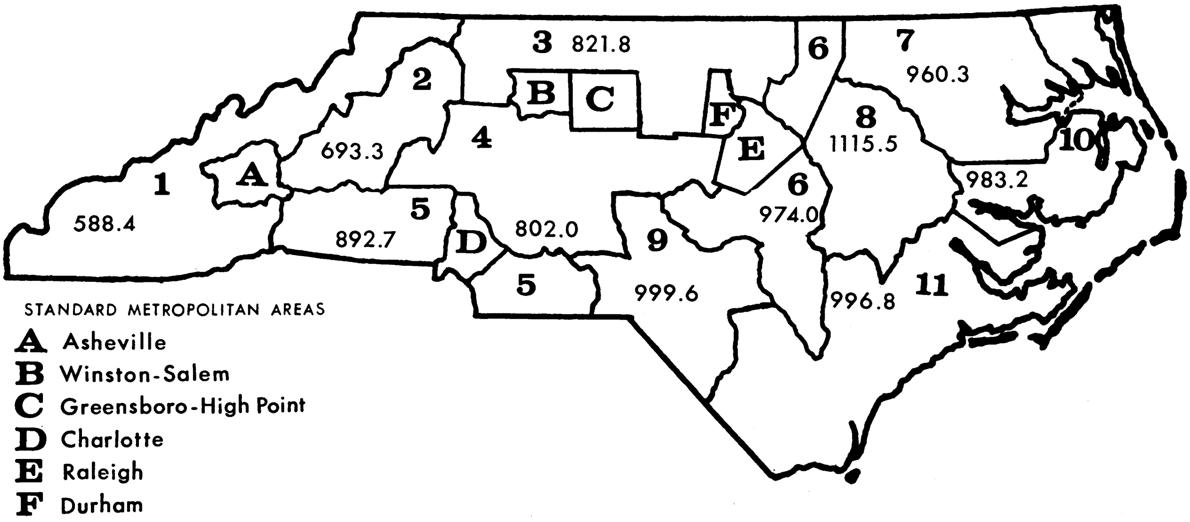
The high-rate areas thus tend to cluster, with areas contiguous to high-rate areas also tending to have high rates, and areas contiguous to low-rate areas tending to have low rates. This apparent tendency toward clustering is confirmed by the contiguity ratio, developed by Geary and reported by Duncan and associates (*15*), which in this instance equals 0.5 and differs significantly from unity ($P<0.05$). Thus, whatever the factors responsible for these differences in the risk of dying, they appear to extend over larger areas than State economic areas. This is in contrast to the pattern for California (*16*) in which any operative factors appear more circumscribed geographically.

Figure 2. Cardiovascular disease death rates among white men aged 45–64 years, by State economic areas, Georgia, 1950–59



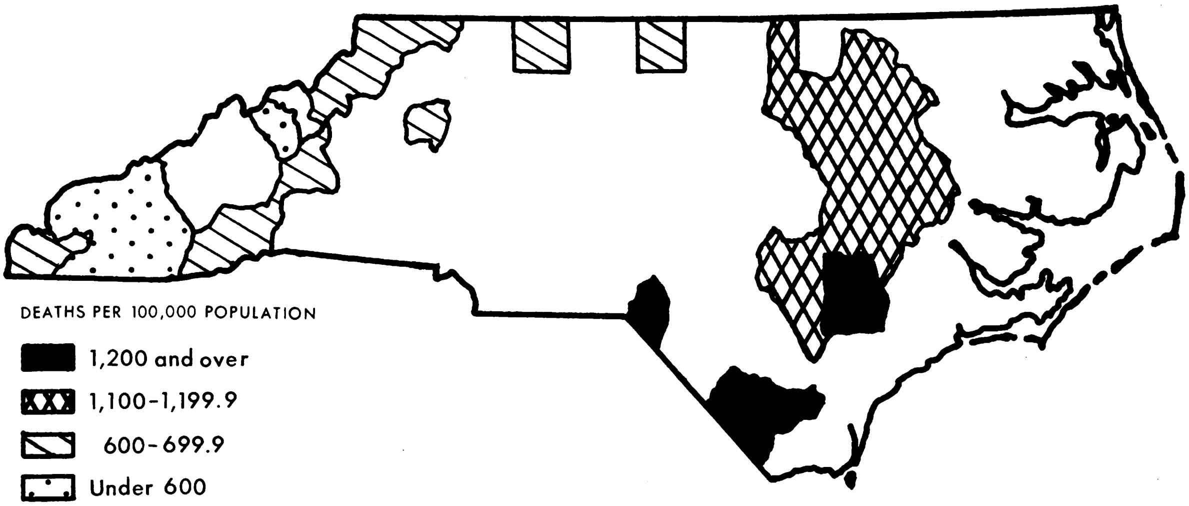
Bold figures designate State economic areas

Figure 1. Cardiovascular disease death rates among white men aged 45–64 years, by State economic areas, North Carolina, 1950–59



Bold figures designate State economic areas

Figure 3. North Carolina counties with highest and lowest cardiovascular disease death rates among white men aged 35–74 years, 1950–59



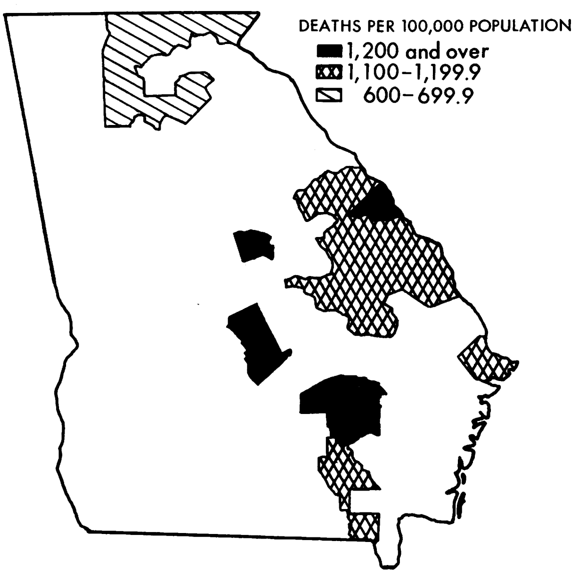
Counties and Demographic Areas

Since State economic areas often consist of a rather large number of counties, rates for individual counties and demographic areas are useful to show geographic patterns more clearly. Of the 17 counties in North Carolina with the lowest death rates for cardiovascular diseases, white men aged 35–74 years, all but two are in the Blue Ridge areas, and even these two are in the western half of the State (fig. 3). The 16 counties with the highest death rates are all in the east central portion of the State, in the vicinity of Raleigh and extending south to the South Carolina State line.

Georgia presents a similar pattern, with all nine of the lowest rate areas in the northern part of the State, in the Blue Ridge and Upper Piedmont State economic areas (fig. 4). Areas with high rates, which are roughly double the low rates, are in the vicinity of Augusta and south.

The white areas in figures 3 and 4 are demographic areas and counties with rates between 700 and 1,099 per 100,000 population. Generally, however, the areas and counties adjacent to the lowest rate counties have below average rates, and among those adjacent to high-rate counties nearly all have above average rates.

Figure 4. Georgia counties with highest and lowest cardiovascular disease death rates among white men aged 35–74 years, 1950–59



Persistence

To what extent does the pattern of rates persist through time? For Georgia and North Carolina, trends are almost identical to those for the United States, 1949–51 and 1950–59, for all cardiovascular diseases, for coronary heart disease, and also for all causes (table 2). The areas within these two States for which data are available for both periods generally show a high degree of similarity. Augusta and Savannah had the highest rates and the southern Blue

Ridge region the lowest rates for both periods, differing little from the low rates in the U.S. western plains. Walker County, which is suburban Chattanooga, had the lowest rates among the metropolitan areas, while Atlanta and Asheville also ranked consistently low for metropolitan areas.

The persistence in rates in table 2 may be shown more clearly through ordinary product-moment correlations, *r*, as follows:

Causes	*r*
All cardiovascular causes	0.96
Coronary heart disease	.95
All causes	.94

The range in the rates, however, is not quite so great for the 10-year period, 1950–59, as for the 3-year period, 1949–51; this may be a result of a reduction in random error or perhaps an increasing environmental homogeneity. If factors in the physical, biological, and cultural environment are producing these differences in death rates, and if many of these factors, such as food and social customs, are becoming less heterogeneous, then it is not surprising that differences in death rates may be decreasing somewhat.

For these same areas, the correlations of cardiovascular disease death rates for 1950–59 and 1959–61 were calculated just for the following age-sex groups with the least random error.

Groups	*r*
White men, 55–64 years	0.70
White men, 65–74 years	.85
White women, 65–74 years	.84

(Actually, for 1959–61 cardiovascular-renal disease death rates were used, which are consistently about 1 percent higher than cardiovascular disease rates.)

Similar high correlations of age-adjusted rates for 1950 (*17*) with age-adjusted rates for 1960 (*18*) exist for the 48 States and the District of Columbia for coronary heart disease for white males and females of all ages.

The correlation of death rates for all causes for 1960 (*19*) with rates for earlier periods (*12*) is also substantial, but not as high as those shown in the preceding text table.

Perfect correlation cannot be expected for several reasons: (*a*) random error or chance fluctuation, (*b*) systematic errors, and (*c*) etiological factors present in only one time period. An obvious example is an influenza epidemic which strikes one area more severely than others. A major illustration has been published (*20*) of a trend for a large State (California) which is markedly different from that for the United States.

In 1940, the Carolinas and Georgia were three of the six States with cities having the highest rates for cardiovascular-renal diseases (*21*). This is in harmony with the high rates for metropolitan areas in these States for different periods between 1949 and 1961, even though definitions used for geographic areas and methods of age adjustment were different.

Cause of Death Associations

Although the hypothesis is not generally supported by concrete evidence, the geographic differences observed for a specific cause or group of causes may result from either differences in classification of cause among areas or to environmental factors which increase the rate for one cause, such as coronary heart disease, but lower the rate for another cause, such as stroke. The correlations beween causes in the various geographic areas are consistently positive despite little association between some causes, such as coronary heart disease and stroke (table 3).

The correlation of the cardiovascular disease death rate with the all-causes death rate (table 3) indicates how closely the two rates tend to parallel each other, even more than would be expected from cardiovascular disease deaths representing 54 percent of all deaths.

For the noncardiovascular causes as a group, the range in rates tends to be less than for cardiovascular causes; for example, the highest noncardiovascular rate is only 43 percent higher than the lowest, while the highest cardiovascular rate is almost double the lowest.

Two demographic areas with substantial differences in death rates for cardiovascular diseases among white men aged 45–64 years are shown below:

Demographic area (counties)	*All causes*	*Cardio-vascular diseases*
373 (Bleckley and Dodge, Ga.)	1,825.0	1,186.6
319 (Clay, Graham, and Swain, N.C.)	1,101.7	535.0

Obviously these differences cannot be due entirely to differences in vocabulary in certifying causes of death; specifically, the cardiovascular disease death rate alone in demographic area 373 is greater than the death rate for all causes in demographic area 319.

In the two States, 24 counties had high cardiovascular disease death rates, and all these counties are in eastern North Carolina and the southeastern half of Georgia. ("High" is defined as a rate of more than 1,100 deaths per 100,000 white men aged 45–64 years.) Twenty-two counties had lower death rates for all causes than did high-rate counties for cardiovascular diseases, and all these low-rate counties but two are in or near the southern Blue Ridge Mountain areas of the two States. The two exceptions are among the least populous counties, in which random error is to be expected.

While random error may also play a role in some of the other counties, the fact remains that vocabulary used in classification of cause alone cannot be responsible for these differences, even if we assume that every death in the 22 low-rate counties was due to what in the high-rate counties would be called cardiovascular disease.

Table 3. Correlation of death rates for selected causes, white men and women aged 45–64 years, 33 State economic areas of Georgia and North Carolina, 1950–59

Cause correlation	White men	White women
Coronary heart disease with:		
Stroke	0.25	0.37
All cardiovascular disease [1]	.89	.79
Residual causes [2]	.27	.44
All causes [1]	.82	.77
Stroke with:		
All cardiovascular causes [1]	.60	.78
Residual causes [2]	.58	.65
All causes [1]	.68	.73
All cardiovascular causes with:		
Residual causes [2]	.45	.75
Noncardiovascular causes	.66	.53
All causes [1]	.95	.95

[1] Correlation of a part with a whole.

[2] All causes other than cardiovascular, except malignant neoplasms, accidents and violence, tuberculosis, and "other infective and parasitic causes" (ISC 030–138). Residual causes, as used here, include among other causes renal disease, diabetes, influenza and pneumonia, cirrhosis of the liver, and chronic diseases of the respiratory system.

Other studies (*17, 22, 23*) have presented evidence consistent with the hypothesis that death rates are generally accurate for broad categories of cause, such as all cardiovascular diseases, and for coronary heart disease. Occasionally, however, a possible exception deserves further study.

One would not expect specific causes of death such as malignant neoplasms, accidents and violence, tuberculosis, and "other infective and parasitic causes" (ISC 030–138) to be confused often with one of the cardiovascular causes. This was borne out by an autopsy study (*24*). On the other hand, the remaining noncardiovascular causes, including renal diseases, diabetes, pneumonia, chronic respiratory diseases, and all other noncardiovascular causes except those specified, are likely to present diagnostic problems at times. When one of these entities coexists with a cardiovascular disease, it may be difficult to determine which of the diseases is the underlying cause of death. Even so, the correlations in table 3 clearly show a tendency for death rates for these "residual causes" to rise and fall in a pattern somewhat similar to that for the cardiovascular diseases.

Thus, despite possible diagnostic difficulties, there is no evidence of any general contribution of this factor of alternate diagnoses to the geographic differences in death rates. Rather, the opposite hypothesis is supported: whatever is producing the geographic differences in death rates may affect more than one entity among the cardiovascular-renal and associated diseases.

Coronary heart disease and lung cancer have produced some parallel correlations (*25*). Lung cancer (ISC 162, 163) rates were computed for Georgia as part of our study. For white men aged 25–74 years in all 16 State economic areas of Georgia, lung cancer correlations were: with coronary heart disease, 0.94; and with all cardiovascular diseases, 0.77.

Although rates for lung cancer are quite low compared with rates for coronary heart disease, the range is much greater. For white men aged 35–74 years, the lung cancer rate for Savannah (99.2) is five times as high as for the Blue Ridge counties (19.5), while the coronary heart disease rate for Savannah (753.7) is less than 2½ times as high as for the Blue Ridge counties (337.4).

The correlation between coronary heart disease and lung cancer is considerably greater than might be expected from current clinical impressions and epidemiologic studies. The degree of this association is therefore being explored in other States. Also, plans are being developed to test specific methodological and etiological hypotheses.

Age-Sex Pattern

Various age-specific death rates and age-specific age-adjusted death rates have been used in the study of geographic differences in mortality. Extensive use has been made of the group, white men aged 45–64 years (*10–12, 17, 23, 26*), as well as of age-specific rates by 10-year age groups (*4, 18, 19, 27*) and all ages, age adjusted (*17, 18, 21, 22, 27, 28*). Age group 35–64 has also been used (*16, 20*), as has age group 35–74 (*11*) and both sexes in age group 45–74 (*1*). Emphasis has been placed on middle age, used broadly, but with varying definitions. Even in the studies in which death rates for all ages are presented, several different methods of age adjustment have been used. For this reason in particular, care should be taken in comparing rates from one study with another.

Questions have been raised frequently as to whether cause-specific death rates past 65 years of age are accurate enough for such ecologic study. Special tabulations by the authors of one of the major autopsy studies (*24*) show that for age group 65 and over, the number of deaths due to the cardiovascular diseases as determined by autopsy is approximately the same as the number of such deaths as clinically certified. Thus, some direct evidence is presented that death rates for older persons may be reasonably accurate, even though an autopsied group is not necessarily representative of total deaths. Indirect evidence obtained from correlation of death rates of various sex-age groups with each other showed that white men aged 65–74 consistently have a high correlation with various middle-aged groups, a few of which are presented in table 4. The absolute difference in rates from one geographic area to another is substantially greater for men aged 65–74 than for any younger age group, although the percentage difference tends to be slightly less.

Table 4. Correlation of age-sex-specific death rates for white men and women for selected causes, 33 State economic areas of North Carolina and Georgia, 1950–59

Sex and age groups (in years) correlated	Cardiovascular diseases (330–334, 400–468) [1]	Coronary heart disease (420) [1]	All causes
Men in different age groups:			
25–34 with 35–44	0.39	0.32	0.65
35–44 with 45–54	.58	.63	.42
45–54 with 55–64	.85	.90	.88
55–64 with 65–74	.83	.90	.90
65–74 with 75–84	.88	.88	.86
75–84 with 85 and over	.04	.60	−.07
Men with women in same age groups:			
25–34	.37	.14	.52
35–44	.44	.42	.44
45–54	.39	.54	.72
55–64	.71	.80	.67
65–74	.78	.89	.71
35–74 (age adujsted)	.78	.90	.79
75–84	.78	.82	.70
85 and over	−.06	.57	−.09

[1] Numbers in parentheses are from the International Statistical Classification.

A previous study (*17*) showed that the geographic pattern of death rates for persons over 75 years of age tends to be somewhat different from that for middle-aged persons. Our study indicates that this is particularly true for those 85 years and over.

The correlation of death rates by geographic areas for younger men aged 25–34 years with those aged 35–44 years is rather low, possibly because of random error. For men aged 25–34 in particular, the number of deaths for all cardiovascular diseases combined is so small, even for a State economic area of 10 to 15 counties for the entire decade 1950–59, that a variation of 30 percent may be anticipated because of random error (at the 0.05 level of statistical significance). Thus, even for moderately large areas, differences in death rates for young adults must be marked in order to have reasonable assurance that they exist.

Geographic differences do not always show the same pattern for each sex (*1, 17, 18*), yet for the areas of these two States, the correlation by sex is high, particularly for coronary heart disease. The hypothesis has been suggested that rates for white men in specified age groups would show a marked correlation by geographic areas with rates for white women 10 or 20 years older, since the rates for these two groups are similar. While such correlations are rather substantial, they are no higher than the correlation by sex with the same age group.

For State economic areas with a large enough number of deaths so that random error is reduced to negligible levels, the correlation of age group 45–64 with 35–74 is so high that it makes little difference which of these age groups is used to describe the geographic pattern (table 5). When smaller areas are used, age group 35–74 would have less random error and therefore would be preferable to age group 45–64. For the 100 counties of North Carolina the correlations of these age groupings for white men are also high, but for white women the correlations are low enough to indicate a need for some caution in using rates based on small numbers.

Completeness of Filing

It is generally assumed by the National Center for Health Statistics (*4*) that the filing of death certificates is essentially complete. Established procedures, such as the requirement of a death certificate prior to the issuance of a burial permit to the undertaker, encourage compliance in filing.

Table 5. Correlation of death rates for selected causes for white men and women aged 45–64 years with those aged 35–74 years,[1] areas of North Carolina and Georgia, 1950–59

Areas correlated and cause	Men	Women
33 State economic areas of North Carolina and Georgia:		
Cardiovascular diseases	0.98	0.94
Coronary heart disease	.99	.94
Stroke (ISC 330–334)	.96	.91
All causes	.98	.95
100 counties of North Carolina:		
Cardiovascular diseases	.95	.80
Coronary heart disease	.96	.79
All causes	.96	.85

[1] Rates age adjusted by 10-year age groups, direct method, to the total U.S. population in those age groups in 1950; correlation of a part with a whole.

In a low-death-rate area, such as the southern Blue Ridge, it is easy to suggest the hypothesis that the low rate is a result of incomplete filing. A general exploratory survey in this area revealed that family burial plots have not been used for decades and that conventional funerals, including the services of an undertaker, are well established as "social necessities." Health officers, other physicians, and other community leaders, in both the low-rate areas and high-rate areas were informally questioned as to possible incomplete filing. All these persons believed that filing was complete.

A study of deaths of premature infants (*29*) revealed relatively complete filing of death certificates, despite the ease with which misunderstandings might arise as to whether the premature infant was a live birth or a stillbirth. The deaths for which there were no death certificates were well distributed over North Carolina, and thus for high-death-rate areas as well as low. This study supports the alternate hypothesis that the filing of death certificates is probably fairly complete and that the analysis of geographic differences in death rates is not appreciably affected thereby.

A method of testing completeness of filing by establishing and following a population register for a period of years or decades has been suggested (*30*). No such study has yet been undertaken, primarily because of the cost and the hazard that enough persons would be lost to followup as to give equivocal results. Such a study based on a population register of those aged 85 and over, in an area with a low death rate for this age group, would seem to be a practical way of endeavoring to discover a population group with incomplete filing. The southern Blue Ridge area is not particularly suited to such a study because the death rates for age 85 and over are roughly average rather than low, and thus there is no basis to suspect incomplete filing for this age group.

Discussion

The objective in studying geographic differences in death rates is to discover factors responsible for these differences. While the study of the adequacy of methods of data collecting and classifying is by no means complete, progress has been made in the development of adjustment techniques, so that current data appear to be basically sound.

Cardiovascular disease death rates show a high degree of association with types of soil shown in a U.S. Department of Agriculture map (*31*). Most of the counties and demographic areas with lowest death rates (figs. 3, 4) have predominantly Porters-Ashe soil, a gray-brown podzolic soil, and the remainder are in the Cecil Appling soil areas of the Upper Piedmont. Nearly all of the high-rate nonmetropolitan counties are in the Norfolk-Ruston soil areas. For both States, special groupings of counties were made according to predominant soil type to obtain rates from the computer for these "soil areas"; these areas also showed a marked association between death rates and soil type.

The association of soil type and death rates appears to be too close to assume that it is a result of chance alone. The nature of the association is unknown. Even if there is a causal relationship, at present no evidence exists as to the direction of the causation. There may be trace elements in some of the soils which are either protective or harmful, or the soil may be merely a factor in determining the type of socioeconomic structure and activities in an area, which in turn may influence death rates.

The nonmetropolitan counties of Georgia were grouped according to predominance of like kinds of geological formations into 12 geological areas (personal communication from W. H. Bradley, senior research geologist, U.S. Geological Survey, March 30, 1961) with the hypothesis that there might be a relationship between the underlying geological formations and death rates. The differences in rates for these areas are slight compared with the contrasts in rates already shown for State economic areas and for soil areas. It therefore does not seem of value to study further this particular grouping of geological areas.

Metropolitan areas as a group have higher rates than do nonmetropolitan areas (table 2). In Georgia and North Carolina, however, there are a number of rural counties for which the cardiovascular disease death rates are as high or higher than those for any of the metropolitan counties. It seems reasonable, therefore, to exercise some restraint in assuming that there is a causal relationship between urbanization per se and high cardiovascular disease death rates.

The areas with the lowest rates in these two States are below average in economic status. In Missouri the counties with the lowest rates do not show any association with economic status (*11*). In cities for which data are available, the areas of lowest economic status tend to have high death rates (*32,33*). Present data thus indicate that economic status alone is unlikely to be important.

Summary

For white men aged 45–64 and 35–74, the southern Blue Ridge area and adjacent counties of Georgia and North Carolina have the lowest death rates in these two States—for all cardiovascular diseases, coronary heart disease, and all causes, for the 10-year period 1950–59. These rates differed little from the low rates in the U.S. western plains.

In the two States, the highest rates (Savannah and Augusta, Ga., and Raleigh, N.C., and the areas south of Augusta and Raleigh) were generally twice as high as those in the low-rate areas for coronary heart disease and all cardiovascular diseases.

Specified methods were used to reduce random error and to test and increase the adequacy of death rates for epidemiologic study of cardiovascular diseases.

The geographic pattern of rates was generally quite similar for 1950–59, 1949–51, and 1959–61. Also, the pattern of death rates for white men aged 65–74 years was similar to that for those aged 55–64 years.

A marked degree of association was noted between death rates and soil types in Georgia, sufficient to encourage further epidemiologic study. A high correlation was also noted between death rates for coronary heart disease and lung cancer. The degree of this correlation is being explored in other States.

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