Secular Trends in Ischemic Heart Disease and Stroke Mortality from 1970 to 1976 in Spanish-surnamed and Other White Individuals in Bexar County, Texas

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SUMMARY Secular trends in age-adjusted cardiovascular mortality from 1970–1976 were examined for Spanish-surnamed and other white men and women in San Antonio and surrounding Bexar County, Texas. Declines in ischemic heart disease (IHD) mortality were observed in Spanish-surnamed men and women and in other white men; these trends were significant in Spanish-surnamed women and other white men.1–3 Acute myocardial infarction mortality declined in all four sex/ethnic groups, and these declines were significant in Spanish-surnamed women and in other white women and men. Mortality from chronic IHD declined significantly in Spanish-surnamed women, but not in the other three groups. No secular trends were seen in cerebrovascular mortality.

Declines in diabetes mortality in the Spanish-surnamed population were also observed, and were accompanied by an upward trend in the male-to-female ratio in IHD mortality in this group. Given the disproportionate effect of diabetes on fatal coronary heart disease in women compared to men, this latter finding suggests that the force of diabetes on IHD mortality may also have waned in this ethnic group during these years.

Changes in personal health habits have been considered as a possible explanation for the decline in IHD mortality nationally. Research in the social sciences, however, suggests that lower socioeconomic status individuals tend to adopt health innovations more slowly than upper socioeconomic status individuals. Thus, the fact that in our data the favorable trends in IHD mortality were shared equally by Spanish-surnamed and other white individuals suggests that factors other than changes in health habits may have played at least a contributory role. Additional possible explanations which we have considered include fluctuations in influenza and pneumonia mortality, improved control of hypertension, and improvements in emergency medical services and in-hospital coronary care.

RECENT REPORTS HAVE SUGGESTED that ischemic heart disease (IHD) mortality in the United States is declining. These reports have generated considerable speculation about the possible causes for such a trend.1–3 The study of mortality in specialized segments of the population whose economic and cultural patterns differ from those of the majority population may offer clues about what factors are operating to produce the overall trends in the general population. The original reports of declining IHD mortality emphasized that these trends appeared to be occurring over a broad age range, in both sexes, and in both blacks and whites.1 In this paper, we examine cardiovascular disease trends from 1970–1976 in the Mexican American population of San Antonio and surrounding Bexar County, Texas, and compare them with the trends observed in the other white residents of this county.

Methods

Bexar County, Texas has a total population, according to the 1970 US Census, of 866,405; of these, 308,437 are Spanish-surnamed. The county is primarily urban, with 79% of the population residing within the city limits of San Antonio.

Age-adjusted mortality rates by sex, ethnic group and cause of death were computed for the county for the years 1970–1976. Mortality data were obtained from the Vital Statistics Division of the San Antonio Metropolitan Health District. This division codes all death certificates as either “Spanish-surnamed white,” “other white,” or “non-white.” Estimates of the Spanish-surnamed population of Bexar County are available from the 1970 US Census. Both the Metropolitan Health District and the Bureau of the Census use the same procedures to classify surnames as Spanish or non-Spanish.4 Although the population estimates from the Bureau of the Census include whites and non-whites under “Spanish-surnamed,” the non-whites constitute only about 1% of the total Spanish-surnamed population of Bexar County. These estimates, therefore, were used to develop the denominators for the calculation of mortality rates for the “Spanish-surnamed white” population.

Population estimates from the census were adjusted for underenumeration before calculation of mortality rates. The 1970 Census provides separate age- and sex-specific underenumeration estimates for whites and blacks, but not for the Spanish-surnamed population. The crude underenumeration rates for whites and blacks are: white men, 2.5%; white women, 1.4%; black men, 9.9%; black women, 5.5%.9 Following the practice of Meck et al.,7 we have applied the black underenumeration rates to the Spanish-surnamed
population. It is likely that this approach underestimates the true extent of underenumeration of Spanish-surnamed individuals, since this group contains an unknown percentage of illegal aliens who presumably seek to avoid governmental enumeration. To that extent, the actual mortality rates for this ethnic group will be lower than those reported in this paper, since unenumerated individuals, if they die in Bexar County, are likely to be recorded in the county's vital statistics. This phenomenon would affect absolute mortality rates, but not secular trends.

Population Projections

The 1970 population estimates, adjusted for underenumeration, were projected to 1976 for each sex, ethnic group, and five-year age group as follows: population and total mortality figures for each year were separated into one-year age intervals; the number of deaths in each one-year age group was subtracted from the population figure for that age group; the age groups were then advanced one year and reaggregated into new five-year groups; interval births were added to the 0–5 year age group; finally, estimates of age, sex and ethnic group-specific net annual migration rates were added to each five-year age group. This process was repeated sequentially for each year subsequent to 1970 using the San Antonio Metropolitan Health District data on births and deaths for the appropriate year, and the San Antonio Comprehensive Planning Division estimates of the age, sex, and ethnic group-specific net annual migration which had occurred from 1960 to 1970. Thus, our model for projecting the population assumes that the average net annual migration rates which had prevailed from 1960 to 1970 continued through 1976. Since the number of births and deaths in Bexar County from 1970–1976 are known, the migration estimates constitute the main potential source of error in these projections. These estimates, however, amount to only about 0.5–1% of the corresponding base populations; errors in these rates, therefore, would probably have only a minimal effect on the overall extrapolated population figures.

Quality of Death Certificate Diagnoses

As an indicator of the overall quality of death certificate diagnoses, we determined the age-adjusted percentages of deaths assigned to "symptoms and ill-defined" conditions (ICDA codes 780–796) for each sex/ethnic group.

In each group, less than 1% of deaths was assigned to this category, and there were no significant differences between the two ethnic groups in the percentages of deaths so assigned. Age-adjusted autopsy rates, however, were slightly higher in other whites. The rate in other white men was 26.4% compared with 21.3% in Spanish-surnamed men, a difference which was statistically significant ($P < 0.01$). The rates in other white women were also higher than the rates in Spanish-surnamed women (17.4% vs 14.2%), although this difference was not statistically significant. These differences in autopsy rates might indicate greater accuracy of death certificate diagnoses in other whites. However, even if there were systematic differences in the accuracy of death certificate diagnoses between the two ethnic groups, these differences should primarily affect the absolute rates, and only to a lesser extent, the secular trends.

Statistical Methods

Cause-specific annual mortality rates for 1970–1976 by sex and ethnic group were age-adjusted to the 1970 US population using the direct method of age-adjustment.

We have used the following approach to evaluate the various secular trends which were observed: the variances of the age-adjusted mortality rates for each sex, ethnic group and cause of death were estimated by pooling the age-specific variances for the appropriate category as described by Armitage. These variances were used as the denominator in an $F$ test for linearity* for which the numerator was obtained from the mean square deviation from regression; if linearity was not rejected, the hypothesis of zero slope was tested using a $t$ test.

Results

Secular Trends in Cardiovascular Mortality

Secular trends from 1970–1976 in IHD mortality (IHD: ICDA codes 410–413) are shown in figure 1. The regression lines for other white men and Spanish-

*Because of the large numbers used to estimate the variances, infinite degrees of freedom were used in the denominator of the $F$ test.
surnamed men indicated that IHD mortality declined at a rate of approximately 3% per year in both groups. This trend was statistically significant for other white men ($P < 0.01$). For Spanish-surnamed men, however, linearity was rejected; therefore, no statistical inferences could be made concerning this trend. Other white women showed no secular trend in IHD mortality; Spanish-surnamed women, however, showed a statistically significant decline of 6% per year ($P < 0.01$). Significant declines were also observed for total cardiovascular disease mortality (ICDA codes 390–458) in other white men and in Spanish-surnamed individuals of both sexes. Thus, the observed declines in IHD mortality do not appear to have resulted from shifts in assignment of cause of death to other categories of cardiovascular disease.

Secular trends in acute myocardial infarction (AMI) mortality (AMI: ICDA code 410) are shown in figure 2. A steady decline in mortality from this cause is seen in other white men. Although linearity was rejected, this appeared to be due mainly to the steep decline from 1970–1971. When the trend from 1971–1976 was examined separately, linearity was not rejected, and the downward trend was found to be statistically significant ($P < 0.01$). AMI mortality in Spanish-surnamed men appeared to decline in roughly parallel fashion, averaging about 7% per year; no statistical inferences could be made concerning this trend, however, since linearity was again rejected. Declines in AMI mortality were observed in both other white and Spanish-surnamed women, averaging about 6% per year for the former and 8% per year for the latter; both trends were statistically significant ($P < 0.01$).

Secular trends in chronic IHD (ICDA code 412) are shown in figure 3. In other white men and women there may have been upward trends for this cause of mortality. In both cases, however, linearity was rejected, so that the statistical significance of these trends could not be evaluated. Linearity was also rejected in the case of Spanish-surnamed men. A statistically significant decline ($P < 0.01$) averaging about 4% per year was observed in Spanish-surnamed women.

As shown in figure 4, no significant secular trends are apparent for cerebrovascular disease mortality (ICDA codes 430–438) in any of the four sex/ethnic groups.

**Relation Between Trends in Cardiovascular Mortality and Influenza/Pneumonia Mortality**

It has been suggested that the secular decline in national IHD mortality may be related to epidemic fluctuations in influenza and pneumonia (ICDA codes 470–474 and 480–486). In order to explore this possibility, we compared the patterns of secular trends in these two mortality categories by sex and ethnic group. The results for other whites are presented in figures 5 and 6, and for Spanish-surnamed individuals in figures 7 and 8. Mortality from influenza and pneumonia was higher in the Spanish-surnamed population than in other whites. A rough parallel, at least from 1970–1974, is seen in the patterns of secular
change for these two mortality categories in other white men (fig. 5), though there was little apparent relationship between the patterns of change in these two mortality categories for other white women (fig. 6). This latter group, however, is probably a relatively insensitive one in which to test this hypothesis, since its fluctuations in IHD mortality were minor. Although a striking parallel existed from 1972-1976 for Spanish-surnamed men (fig. 7), for reasons which are unclear, major divergences occurred between 1970-1972. Finally, among Spanish-surnamed women there was a very striking parallel in the changes in these two mortality categories throughout the entire period (fig. 8).

Relation Between Trends in Diabetes and IHD

Secular trends in mortality due to diabetes mellitus (ICDA code 250) are shown in figure 9. Mortality from this cause was considerably higher among Spanish-surnamed individuals of both sexes than...
among other whites. A steep and significant decline ($P < 0.01$) of about 9% per year was observed in Spanish-surnamed women. Spanish-surnamed men also showed a decline, which averaged about 5% per year; this trend, however, was not statistically significant. No significant trends were seen in other whites of either sex.

It has been proposed that diabetes cancels the usual favored status of women with respect to coronary heart disease (CHD) death. If this is so, a population with a high prevalence of diabetes should have an attenuated male-to-female ratio in IHD mortality (assuming there is equal prevalence of diabetes in the two sexes or a higher prevalence in women). Figure 10 shows that the male-to-female ratio in age-adjusted IHD rates for the Spanish-surnamed population was initially lower than that in the other white population, but it gradually rose to approximate the latter. Although this trend was not statistically significant, it was in the direction which would have been predicted if the impact of diabetes in the Spanish-surnamed population had waned from 1970–1976, as suggested by the data shown in figure 9. Furthermore, the concordance between these two observations suggests that neither is an artifact.

Discussion

In attempting to explain the recent national decline in IHD, the following possibilities have been considered: changes in personal health habits; changes in other diseases which influence IHD mortality; and changes in the quality and availability of medical care.

Changes in Personal Health Habits

In this category, proposed explanations have included a decline in cigarette smoking (particularly in

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**Figure 8.** Relation between trends in age-adjusted ischemic heart disease mortality (ICDA codes 410–3) and age-adjusted influenza/pneumonia mortality (ICDA codes 470–4 and 480–6) in Spanish-surnamed women.

**Figure 9.** Secular trends in age-adjusted diabetes mortality (ICDA code 250) in Bexar County, Texas from 1970–1976 by sex and ethnic group.

**Figure 10.** Secular trends in male-to-female ratio in age-adjusted ischemic heart disease mortality (ICDA codes 410–3) in Bexar County, Texas from 1970–1976 by ethnic group.
adult males)\textsuperscript{13} and secular trends toward decreased consumption of cholesterol and saturated fat, and increased consumption of polyunsaturated fat.\textsuperscript{2, 3} There is also data to indicate that serum cholesterol levels have been declining in the US.\textsuperscript{14}

Research in the social sciences, however, has indicated that low socioeconomic status (SES) individuals are slower than high SES individuals to adopt innovative health practices.\textsuperscript{15} Recent declines in cigarette smoking, for example, have been more marked among upper than among lower SES men.\textsuperscript{13} Similarly, jogging, usually undertaken at least partly for health reasons, is more commonly adopted by upper than by lower SES individuals.\textsuperscript{16} Since a large proportion of Spanish-surnamed individuals in Bexar County are of lower SES than other whites, one might postulate that they have been less likely than the latter to have modified their health habits. Nevertheless, these two ethnic groups appear to have shared equally in the favorable secular trends in IHD mortality. When taken together, these observations suggest that changes in personal health habits are probably not the sole cause of the observed declines in IHD mortality, particularly for the Spanish-surnamed population.

Changes in Other Diseases which Influence IHD Mortality

Epidemic fluctuations in influenza and pneumonia have been linked to the national decline in IHD mortality.\textsuperscript{1} Our data, presented in figures 5–8, offer some support for this hypothesis. It also appears that this relationship may have been somewhat stronger in the Spanish-surnamed population, further suggesting that factors other than health habit changes were particularly important in this group.

A lessening of the impact of diabetes on IHD mortality could also have contributed to the decline in mortality from this cause, at least in the Spanish-surnamed population. Of course, the decline in diabetes mortality itself could have merely reflected an improvement in medical care with a resultant decrease in the diabetes fatality rate. Alternatively, the observed decline could have been due to a shift in assignment of cause of death. We believe, however, that the rise in the male-to-female ratio in IHD mortality which we observed in the Spanish-surnamed population suggests that a more fundamental change may have taken place. Since diabetes disproportionately increases the risk of CHD death in women,\textsuperscript{19} a waning of the force of diabetes on IHD mortality should benefit women more than men, with a resultant increase in the male-to-female ratio in mortality from this cause. Taken together, the decline in diabetes mortality and the changing sex ratio in IHD mortality suggest that there may have been a decline in the actual incidence and/or prevalence of diabetes in the Spanish-surnamed population.

Changes in Medical Care

Improved case findings and treatment of hypertension have also been proposed as explanations for the favorable national trends in IHD mortality.\textsuperscript{3} Nationally, there has been a long-term decline in mortality from hypertension and hypertensive heart disease.\textsuperscript{4} Moreover, the national decline in IHD mortality has been steeper for IHD with hypertension than for IHD without hypertension.\textsuperscript{1} We also observed declines in mortality due to hypertension (ICDA codes 400–404) in other white men and women and Spanish-surnamed men in Bexar County. With respect to control of hypertension itself, however, the data is mixed, with two studies showing recent improvement,\textsuperscript{17, 18} and one study showing little change from the 1960s to the 1970s.\textsuperscript{19} Furthermore, although hypertension is a stronger risk factor for cerebrovascular than for coronary disease, there was no secular decline in cerebrovascular disease in our data.

Although currently the subject of considerable controversy,\textsuperscript{20–22} improvements in emergency medical services and in coronary care are clearly among the possible explanations for the favorable secular trends in IHD mortality. Such improvements would presumably affect the IHD fatality rate without directly affecting IHD incidence. Improved medical care might also produce a shift in mortality from acute to chronic IHD, a trend which appears in our data, at least for other whites.

In 1968, a modern county hospital for medically indigent patients was built in Bexar County, and in 1974 an Emergency Medical Service was developed which provided a capability for out-of-hospital cardiac resuscitation. This service was available to all San Antonio residents, regardless of income. It is possible, therefore, that access to modern coronary care may have been more nearly equal across the two ethnic groups than were fundamental health habits. During 1974, the year the Emergency Medical Service was inaugurated, IHD mortality declined in all four sex/ethnic groups. In both other white men and Spanish-surnamed women, the two groups in which the overall declines in IHD mortality were statistically significant, 1974 marked a drop to a lower range of IHD mortality, approximately 40 per 100 thousand population, below the pre-1974 rates. On the basis of these observations we may speculate that emergency medical services backed up by modern in-hospital coronary care may have played an important role in the observed declines in IHD mortality in Bexar County. However, this interpretation is confounded by the fact that influenza and pneumonia mortality also declined in 1974.

Obviously, an analysis such as presented in this paper cannot definitively answer the important questions raised by the national decline in IHD mortality. However, it can help to focus our thinking and point the direction for future research.

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