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ROSE QUESTIONNAIRE ANGINA AMONG UNITED STATES BLACK, WHITE, AND MEXICAN-AMERICAN WOMEN AND MEN

PREVALENCE AND CORRELATES FROM THE SECOND NATIONAL AND HISPANIC HEALTH AND NUTRITION EXAMINATION SURVEYS

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The prevalence of Rose Questionnaire angina and its association with coronary heart disease risk factors and manifestations were investigated in representative samples of the US population. The study populations included 1,135 black and 8,323 white subjects aged 25–74 years examined in the Second National Health and Nutrition Examination Survey, 1976–1980, and 2,775 Mexican-American subjects aged 25–74 years examined in the Hispanic Health and Nutrition Examination Survey, Mexican-American portion, 1982–1983. Age-adjusted prevalence rates of Rose angina were similar among black, white, and Mexican-American women (6.8%, 6.3%, and 5.4%, respectively). An excess in the prevalence of Rose angina was observed in women compared with men for white and Mexican-American persons under age 55 years, but not for those over age 55. Electrocardiographic evidence of myocardial infarction and self-reported heart attack were strongly associated with prevalent Rose angina among white men and women aged 55 years and over, but not among those below age 55. Serum cholesterol, body mass index (weight (kg)/height (m)^2), current cigarette smoking, and dyspnea were independently associated with an increased risk of prevalent angina in multivariate logistic models for white women, excluding those with a prior heart attack. Because many younger women with chest pain who may consult physicians are likely to have elevations in cardiovascular risk factors, their self-reported chest pain can be used as an opportunity to intervene and reduce their future risk of cardiovascular disease.

angina pectoris; body weight; cholesterol; coronary disease; dyspnea; smoking

Little is known about the frequency of angina symptoms in nationally representative populations and the relation of chest pain to coronary heart disease risk factors and manifestations. First described by Heberden in 1768 (1), angina has recently

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Abbreviations: HHANES, Hispanic Health and Nutrition Examination Survey; HHANES (MA), Mexican-American portion of HHANES; NHANES II, Second National Health and Nutrition Examination Survey.

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been defined as transient chest pain symptomatology thought to be associated with myocardial ischemia but occurring without permanent damage to the myocardium (2). Chest pain is subjective, and currently there is no definitive clinical evaluation to distinguish chest pain with an ischemic cardiovascular origin from other types of chest pain (3). Therefore, the interpretation of self-reported chest pain presents special challenges for both clinicians and epidemiologists.

While physicians can incorporate self-reported symptomatology with other evidence of disease and substantial clinical judgment in determining the presence of angina, epidemiologists must rely, to a great extent, on explicit and standardized criteria applied equally to each study subject. More than 20 years ago, Rose developed a questionnaire for the standardized assessment of cardiovascular chest pain in epidemiologic studies (4). Since then, the questionnaire has received extensive use among men, for whom it appears to be associated with the presence of coronary heart disease and to predict the future risk of fatal and nonfatal coronary events (5–7).

Much less is known about the utility of the Rose Questionnaire among women. At the same time, sex differences in the clinical significance of chest pain symptomatology have been noted for nearly a century (8) and have been reaffirmed in more recent epidemiologic studies (9, 10). These studies have suggested that women reporting angina in the absence of other manifestations of coronary heart disease, such as previous myocardial infarction, have a lower prevalence of coronary occlusion as indicated by arteriography and have a more favorable prognosis in terms of future coronary events than do men. Nevertheless, the presence of Rose Questionnaire angina among women has been associated with an increased risk of nonfatal myocardial infarction, as well as coronary heart disease mortality and total mortality (11–13). There is a well documented lower incidence of myocardial infarction among women as compared with men of similar ages, and the occurrence of myocardial infarction in younger and premenopausal women is fairly rare (14). Paradoxically, it is precisely in the younger age groups that the greatest sex differences in prevalence rates of Rose Questionnaire angina have been observed, with rates among women about twice as high as those among men (11, 15–17). In the light of lower coronary heart disease rates in younger women, the interpretation of chest pain symptomatology in younger women is further complicated by the existence of several other etiologies for angina-like chest pain that occur in people of all ages, including gastrointestinal, musculoskeletal, and hyperventilatory conditions (18).

Prevalence estimates of Rose Questionnaire angina among women vary widely, from less than 1 per cent to 24 per cent, in studies conducted in the United States and around the world (table 1). In general, prevalence estimates have been higher outside of the United States (11, 12, 16, 19, 20) than within the United States (11, 17). Although these differences may arise from several sources including real differences in the prevalence of coronary heart disease, international variation in angina prevalence rates suggests the possibility that ethnic or cultural factors may affect the perception and/or reporting of chest pain. Recent studies in the United States have been limited by their restriction to white persons sampled from groups that are not necessarily representative of the entire US population (11, 17).

The present investigation had the following objectives: 1) to estimate the prevalence of Rose Questionnaire angina among representative samples of US black, white, and Mexican-American women and men; 2) to determine whether sex differentials in the prevalence of Rose angina observed previously in selected populations of younger women and men could be generalized to representative samples of US black, white, and Mexican-American subjects; and 3) to

TABLE 1

Prevalence of Rose Questionnaire angina among women: studies to date

Investigator(s) and year of report	Location	Year(s) and type of questionnaire	Study population	% with angina*
Bengtsson, 1973 (15)†	Gothenburg, Sweden	1968–1969, interview	1,462 women aged 38, 46, 50, 54, and 60 years	0.3–3.9
Tibbling, 1981 (19)	Linköping, Sweden	Year unknown, mailed questionnaire	1,442 women aged 25 and 55 years	5.7 (25-year-olds) 13.4 (55-year-olds)
Feinleib et al., 1982 (11)	Britain, Norway, and the United States	Early 1960s, mailed questionnaire	9,979 British and 4,762 Norwegian women who had migrated to the United States; 9,607 British and 14,066 Norwegian women (nonmigrants) aged 35–69 years	British migrants: 4–5 Norwegian migrants: 3–5 British nonmigrants: 8–14 Norwegian nonmigrants: 7–12
Reunanen et al., 1983 (16)	Finland	1966–1972, interview	5,224 women aged 30–59 years	1.5–12.0
Campbell et al., 1984 (12)	Rhondda Fach, South Wales	1967, interview	1,428 women aged 45–74 years	12.9–23.9
Jensen, 1984 (43)	Copenhagen, Denmark	1976–1978, interview	7,699 women aged 20–80+ years	2.0–10.0
Rossouw et al., 1984 (20)	Swellendam, Riversdale, and Robertson, South Africa	1979, interview	3,831 women aged 15–64 years	2.1–~10.0
Wilcosky et al., 1987 (17)	10 North American sites	1972–1976, interview	2,191 women in the Lipid Research Clinics Program Prevalence Study aged 30–79 years	3–6

* Per cents are rounded to the nearest whole number if they were presented graphically in the original article.

† Reference number.

investigate the association of Rose angina with several cardiovascular risk factors and with electrocardiographic and historical evidence of myocardial infarction among women and men. Greater emphasis is placed on the findings for women, for whom the clinical significance of Rose Questionnaire angina is less well understood. To our knowledge, this is the first presentation of Rose Questionnaire angina prevalence rates from representative samples of the US population.

Materials and methods

Survey design

Data for this report were collected during two surveys conducted by the National Center for Health Statistics. Findings presented for non-Hispanic black and white persons are based on data collected in the Second National Health and Nutrition Examination Survey (NHANES II). Data for Mexican Americans are based on data collected in the Mexican-American portion of the Hispanic Health and Nutrition Examination Survey (HHANES (MA)). Analyses were restricted to persons aged 25–74 years in both surveys.

NHANES II was a national probability sample of the civilian noninstitutionalized population of the United States, aged six months through 74 years, residing in 64 randomly selected geographic locations. The sample design of NHANES II was a stratified multistage probability sample with oversampling of preschool children, persons living in low-income areas (defined by the US Bureau of the Census in 1970), and adults aged 60–74 years. Of the 15,496 people aged 25–74 years selected in the sample, 10,450 (67.4 per cent) agreed to participate fully in the detailed interview and examination during the period 1976 to 1980.

HHANES (MA), conducted from 1982 to 1983, was a probability survey of Mexican Americans in parts of selected areas of five southwestern states (Arizona, California, Colorado, New Mexico, and Texas). The HHANES (MA) sample is one of three special population subgroups surveyed for HHANES. Cuban Americans in Dade County, Florida, and Puerto Ricans in the New York City metropolitan area were also studied, but data from the latter portions of HHANES were not available at the time of this investigation. The HHANES (MA) sample consisted of civilian noninstitutionalized persons aged six months through 74 years whose reported family ancestry or national origin was one of the following: 1) Chicano; 2) Mexicano; 3) Mexican; 4) Mexican-American; or 5) other Spanish. Of the 4,027 adults aged 25 through 74 years sampled in HHANES (MA), 2,827 (70.2 per cent) agreed to full participation and were interviewed and examined.

Some differences in the prevalence of Rose Questionnaire angina among black and white persons (studied in 1976–1980) and Mexican-American persons (studied in 1982–1983) could arise from secular trends between NHANES II and HHANES (MA). Too few Mexican-American subjects were included in NHANES II to make reliable comparisons of angina prevalence in the two surveys.

For both NHANES II and HHANES (MA), the sample weights for each survey participant were based on the probabilities of selection, adjustment for nonresponse (and noncoverage in HHANES (MA)), and poststratification ratio adjustments. Details of the NHANES II and HHANES sample designs, selection procedures, operational plans, and quality control programs have been documented elsewhere (21, 22).

Data collection

Both NHANES II and HHANES (MA) included a household interview and medical examination component. Demographic and medical history data were obtained during household interviews with each participant. Mobile examination centers transported to each geographic location provided the sites for supplemental medical history interviews, standardized medical examinations,

and clinical testing, including anthropometric measurements, collection of serum for various laboratory measurements, and electrocardiograms.

The London School of Hygiene Chest Pain Questionnaire, known as the Rose Angina Questionnaire, was administered by trained interviewers as part of the medical history in both NHANES II and HHANES. The classification of angina using the Rose Questionnaire requires that six criteria be satisfied: 1) the historical presence of any chest pain or chest pressure; 2) when hurrying, walking uphill, or on level ground; 3) that requires the subject to stop, slow, or take medication; 4) and is subsequently relieved; 5) in 10 minutes or less; 6) with the chest pain located in the upper or middle sternum or the left anterior chest and left arm. The version of the Rose Questionnaire administered in NHANES II combined the first two of these criteria into the single question, "Have you ever had any trouble with pain, discomfort, or pressure in your chest when you walk fast or uphill?" In HHANES, the standard questions were used for these two criteria: "Have you ever had any pain or discomfort (pressure or heaviness) in your chest?" and "Do you get it when you walk uphill or hurry?" Otherwise, the NHANES II and HHANES versions of the Rose Questionnaire were very similar to each other and to the standard version published by the World Health Organization (23). In both surveys, the Rose Questionnaire was scored according to the World Health Organization recommended guidelines.

A standard 12-lead electrocardiogram was administered to examinees in both surveys, and the tracings were coded by computer using the Novacoder ECG Measurement and Classification Program at Dalhousie University in Halifax, Nova Scotia, Canada. The computerized electrocardiogram measurement methodology has been described in detail elsewhere (24, 25). Electrocardiographic findings indicative of definite and equivocal myocardial infarction were derived in each survey on the basis of the Minnesota code (26), using the international criteria established by the MONICA program (27). Definite electrocardiographic evidence of myocardial infarction was determined by the presence of Q- and QS-wave patterns (Minnesota codes 1-1-1 through 1-2-5 or 1-2-7), or ST segment elevation (code 9-2) plus T-wave codes 5-1 or 5-2. An equivocal electrocardiogram was defined by the presence of Q- and QS-wave patterns (codes 1-2-8 through 1-3-6), ST segment depression (codes 4-1 through 4-3), T-wave items (codes 5-1 through 5-3), or ST segment elevation (code 9-2).

The detailed medical history in both surveys contained items to identify the presence of a prior heart attack ("Has a doctor ever told you that you had a heart attack?") and history of diabetes ("Do you have diabetes or sugar diabetes?" and "Did a doctor tell you that you had it?"; a positive answer to both questions was required). The classification of cigarette smokers included persons who had smoked at least 100 cigarettes in the past and were currently smoking, and such persons were compared with nonsmokers and former smokers in these analyses. Educational attainment was classified on the basis of the number of completed years of formal schooling (range, 0 to ≥17 years). Information on dyspnea was only available in NHANES II. Dyspnea of a moderate to severe level was classified as present if at least one of the following two questions was answered positively: 1) "Do you have to stop for breath when walking at your own pace on level ground?" and 2) "Do you have to stop for breath after walking about 100 yards [91.4 m] or after a few minutes on level ground?"

In addition to cigarette smoking, several other risk factors for cardiovascular disease were ascertained among examinees in both surveys. Three arterial blood pressure recordings (two with the subject seated and one with the subject supine) were taken by physicians according to American Heart Association guidelines (28). The average of two blood pressure recordings, both taken

with the participant seated during the physical examination, were used in this report. Elevated blood pressure was classified as present when the average systolic blood pressure was at least 140 mmHg, the average diastolic blood pressure was at least 90 mmHg, or the subject was currently taking antihypertensive medication (28, 29).

Serum cholesterol concentrations (mg/dl) were determined in both surveys with serum calibrators referenced to the standard Abell-Kendall method (30). High risk serum cholesterol levels were classified on the basis of guidelines provided by the December 1984 National Institutes of Health Consensus Development Conference on Lowering Blood Cholesterol (>220 mg/dl for persons aged 20–29 years, >240 mg/dl for persons aged 30–39 years, and >260 mg/dl for persons aged ≥40 years) (31). In NHANES II, high density lipoprotein cholesterol levels were determined from stored frozen serum on a subset of persons for whom serum cholesterol levels were ascertained. The beta quantification procedure, which involved both a combination of preparative ultracentrifugation and heparin-manganese precipitation (32), was used to determine high density lipoprotein cholesterol levels. It is known that high density lipoprotein cholesterol values can change during the storage of unfractionated plasma and that the effect of freezing on high density lipoprotein cholesterol levels is about 1–2 per cent (mg/dl) (33, 34). In selected analyses, the ratio of total serum cholesterol to high density lipoprotein cholesterol was investigated for this subset of the NHANES II sample.

Body mass index (weight (kg)/height $(m)^2$) was calculated in both surveys and provided the basis for classification of overweight using the guidelines established by the National Center for Health Statistics and espoused by the National Institutes of Health Consensus Conference on Obesity (≥27.8 kg/m^2 for men and ≥27.3 kg/m^2 for women) (35, 36).

Among women in both surveys, current use of oral contraceptives ("Are you taking birth control pills now?") and menopausal status ("Have your periods stopped entirely—not counting during pregnancy?") were also investigated in relation to Rose angina.

Study populations

The study populations for this report comprised 1,135 black persons (54.4 per cent women), 8,323 white persons (52.2 per cent women), and 2,775 Mexican-American persons (55.2 per cent women) aged 25–74 years. In NHANES II, exclusions from the analytic sample included 471 subjects of Hispanic origin, 239 subjects whose origin was unknown, 154 subjects from racial groups other than black or white, 73 women who were pregnant or lactating, and 55 persons with missing data on the Rose Questionnaire. In HHANES (MA), exclusions from the analytic sample included 47 women who were pregnant or lactating and five subjects with missing data on the Rose Questionnaire.

We investigated potential selection bias that could arise from nonparticipation in the clinic examination or from the small amount of missing data on particular medical history or examination variables by comparing means and proportions for major study variables among three overlapping subgroups of participants: 1) all persons who received an interview; 2) persons who were both interviewed and examined; and 3) persons included in the final analytic sample. Such comparisons were performed separately for the six race/ethnic and sex subgroups and revealed no differences or only slight differences between these groups in mean age and educational level and in the proportions reporting Rose Questionnaire angina, dyspnea (NHANES II only), current cigarette smoking, history of diabetes, history of hypertension, and use of antihypertensive medication. Therefore, bias from selective nonresponse to survey components among this study population was assumed to be negligible.

Both NHANES II and HHANES (MA)

are cross-sectional surveys with all data collected on individuals at one point in time. Therefore, any associations observed between Rose angina and cardiovascular correlates in this study should not be interpreted as causal relations. Such associations (or lack of associations) may arise from selective survival in cross-sectional studies or from changes in both biologic and behavioral risk factors that occur after the development of a disease condition such as angina.

Statistical methods

Initially, prevalence estimates were calculated for specific sex and age groups of black, white, and Mexican-American persons. For each of the six sex and race/ethnic subgroups, an age-adjusted estimate of Rose Questionnaire angina prevalence was calculated by the direct method using the 1980 US population as the standard. A t test was used to compare point estimates of prevalence. The p values reported are those obtained directly from the t tests, without adjustment for multiple comparisons. For age and race/ethnic subgroups, differences between the prevalence rates of Rose angina for women as compared with men are also reported with 95 per cent confidence intervals. Prevalence of Rose angina was also investigated within categories of educational attainment.

Prevalence estimates of high risk levels of four cardiovascular risk factors were compared among Rose angina cases and noncases by sex and by race/ethnic group. The risk factors included were cigarette smoking, overweight, high risk serum cholesterol, and elevated blood pressure. The prevalence of elevations in two or more of these risk factors was similarly investigated.

Subsequent analyses were restricted to white subjects from NHANES II, the only subgroup with a sample size and number of Rose angina cases adequate for further stratification and multivariate analyses. The relation of electrocardiographic evidence of myocardial infarction, self-reported heart attack, and dyspnea to Rose angina was evaluated by age and by sex. We developed multiple logistic regression models relating cardiovascular risk factors to Rose angina using a backwards elimination procedure for men and women separately, excluding persons who reported history of heart attack. For both sexes, initial models included age, serum cholesterol, systolic blood pressure, body mass index, history of diabetes, cigarette smoking, dyspnea, and years of education. For women, initial models also included oral contraceptive use, menopausal status, and interaction terms for both with age to determine whether associations of age with Rose angina differed by these factors. Because oral contraceptive use is known to influence serum cholesterol levels, an interaction term for these two factors was also examined in the initial models (37). On the basis of a logistic regression procedure incorporating the sampling weights, variables significant at the 0.10 level were retained in the model. We adjusted estimates of standard error for beta coefficients derived from these models to incorporate the complex survey design effects, using a computer program that supplements PROC LOGIST in SAS (38). We then derived odds ratios from the beta coefficients and calculated 95 per cent confidence intervals using the adjusted standard errors (39). To determine whether correlates of Rose angina differed within broad age categories, we repeated the same backwards elimination modeling procedure for two age groups (25–54 years and 55–74 years) within each sex group.

All analyses in this report take into consideration the sampling weights and complex design of each survey using programs accessible through SAS (40). The sampling weights affect point estimates (e.g., means, proportions, and odds ratios), while the complex survey design effects influence estimates of variance (e.g., standard errors, confidence intervals, and tests of statistical significance). Detailed descriptions of the rationale, importance, and methods for using sampling weights and design effects in

the statistical analysis of NHANES data have been discussed elsewhere (41, 42). Unweighted sample sizes underlying estimates of prevalence have also been provided.

RESULTS

Prevalence of Rose Questionnaire angina

The age-adjusted prevalence of Rose Questionnaire angina was similar among women in the three race/ethnic groups (table 2), ranging between 5.4 per cent in Mexican-American women, 6.3 per cent in white women, and 6.8 per cent in black women. Among men, age-adjusted rates were lowest among the Mexican Americans (2.8 per cent) and highest among black men (6.2 per cent), with an intermediate rate observed among white men (3.9 per cent). Among women, age-specific prevalence rates seen in table 2 show a narrow range in prevalence, with a slight increase in rates from the youngest to the oldest age groups. For example, prevalence rates across age groups ranged from 5.2 to 7.5 per cent in white women aged 25–34 years and 55–74 years, respectively. Among men, prevalence rates showed a wider range across age groups for white men and Mexican-American men. For example, among white men, the prevalence of Rose angina was 2.0 per cent in the youngest age group and 6.9 per cent in the oldest age group. Among black men, no consistent gradient of prevalence of Rose angina across age groups was observed.

TABLE 2

Prevalence of Rose Questionnaire angina among black, white, and Mexican-American persons aged 25–74 years: Second National Health and Nutrition Examination Survey, 1976–1980, and Hispanic Health and Nutrition Examination Survey, Mexican-American portion, 1982–1983

Race/ethnicity and age (years)	Men			Women			Prevalence difference (women − men)	95% confidence limits
	Sample size	%	SE*	Sample size	%	SE*		
Black								
25–34	135	5.1	2.1	138	5.2	1.9	0.2	−5.4, 5.7
35–54	127	7.3	2.4	199	6.8	1.7	−0.5	−6.2, 5.2
55–74	254	6.0	1.3	282	8.5	2.4	2.5	−2.9, 7.8
Age-adjusted total	516	6.2	1.1	619	6.8	1.1		
Population estimate (in thousands)		4,939			6,092			
White								
25–34	832	2.0	0.4	843	5.2	0.8	3.3	1.4, 5.1
35–54	1,158	3.1	0.6	1,235	6.1	0.8	3.0	1.1, 4.9
55–74	1,988	6.9	0.7	2,267	7.5	0.8	0.6	−1.5, 2.8
Age-adjusted total	3,978	3.9	0.4	4,345	6.3	0.5		
Population estimate (in thousands)		44,277			47,022			
Mexican-American								
25–34	437	1.9	0.7	493	4.5	1.1	2.7	0.2, 5.2
35–54	526	2.3	0.7	695	6.0	1.0	3.7	1.3, 6.2
55–74	279	4.5	1.4	345	5.4	1.4	0.8	−3.0, 4.7
Age-adjusted total	1,242	2.8	0.4	1,533	5.4	0.7		
Population estimate (in thousands)		2,055			1,996			

* SE, standard error.

Sex differentials were observed for white and Mexican-American subjects in the younger age groups, with a higher prevalence among women. Prevalence rates among white women and Mexican-American women were three to four percentage points higher than those among their male counterparts in the two younger age groups. The corresponding 95 per cent confidence intervals for these prevalence differences do not include the null value of zero, indicating that these sex differentials were statistically significant (table 2). These differences correspond to prevalence rates two to three times higher in white women and Mexican-American women as compared with men below age 55 years. Little difference in prevalence rates was observed between men and women in the older age group (table 2). In contrast, among black men and women, there were no sex differences in the younger age groups and there was a female excess of 2.5 per cent (8.5 per cent minus 6.0 per cent) in the oldest age group. The 95 per cent confidence intervals for these differences among black men and women are wide, reflecting the greater variability of the prevalence rates due to the small sample size of black persons in NHANES II.

Age-adjusted prevalence rates of Rose Questionnaire angina among women, by three categories of educational attainment, are shown in figure 1. Among black women and white women, prevalence rates of Rose angina were highest among women with six or fewer years of education (10.1 per cent and 14.7 per cent among black women and white women, respectively) and lowest among women with 12 or more years of education (3.2 per cent and 5.1 per cent, respectively). No relation between years of education and Rose angina prevalence was observed among Mexican-American women. Corresponding prevalence rates among men, not shown in figure 1, reveal a similar inverse association of education with angina prevalence among white men,

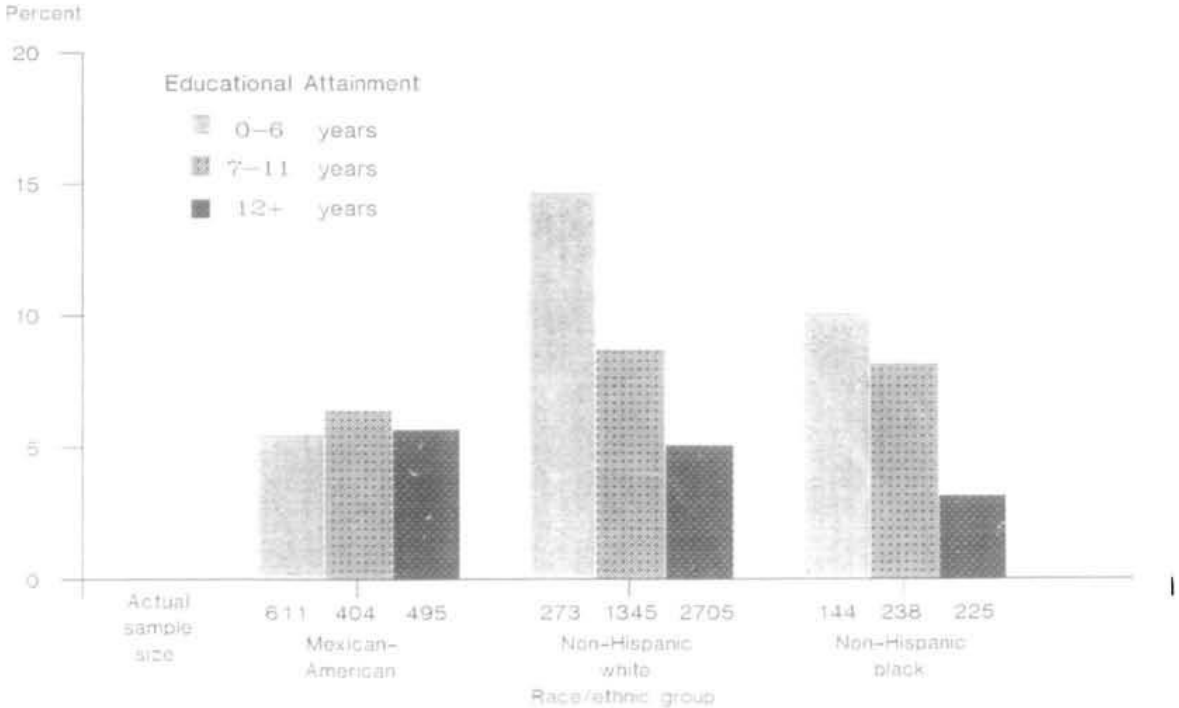

FIGURE 1. Age-adjusted prevalence of Rose Questionnaire angina according to level of educational attainment among women aged 25 to 74 years, by race/ethnicity: NHANES II, 1976–1980, and HHANES (MA), 1982–1983.

with the highest rates in those with the least education (8.1 per cent) and the lowest rates in those with at least 12 years of education (3.4 per cent). Little or no difference in angina prevalence across strata of educational attainment was found in black men or Mexican-American men.

Rose Questionnaire angina and cardiovascular risk factors

The relation of elevations in cardiovascular risk factors to Rose Questionnaire angina is summarized in figure 2, which presents the age-adjusted prevalence rates of elevations in at least two of four standard risk factors (serum cholesterol, overweight, current cigarette smoking, and hypertension) among cases and noncases of Rose angina for women in each race/ethnic group. Overall, regardless of angina status, black women had the highest prevalence rate of two or more cardiovascular risk factor elevations (49.6 per cent), and Mexican-American women had the lowest rate (28.7 per cent), while white women had an intermediate rate (32.3 per cent). For each group, the prevalence rate of elevations in two or more risk factors was higher among women reporting angina than among those without such chest pain. Among white women with Rose angina present, 47.2 per cent had elevations in two or more of the risk factors studied, in contrast to 31.3 per cent among women without Rose angina ($p < 0.05$). Differences in age-adjusted prevalence of elevated cardiovascular risk factors by angina status among white women were present and significant for each of the risk factors examined, with the largest difference observed for overweight status. The differences between cases and noncases were about 8 per cent for black women and Mexican-American women and did not reach statistical significance at the 0.05 level. Corresponding rates for men (not shown in figure 2) indicated small, nonsignificant differences in the prevalence of risk factor elevations between angina cases and noncases.

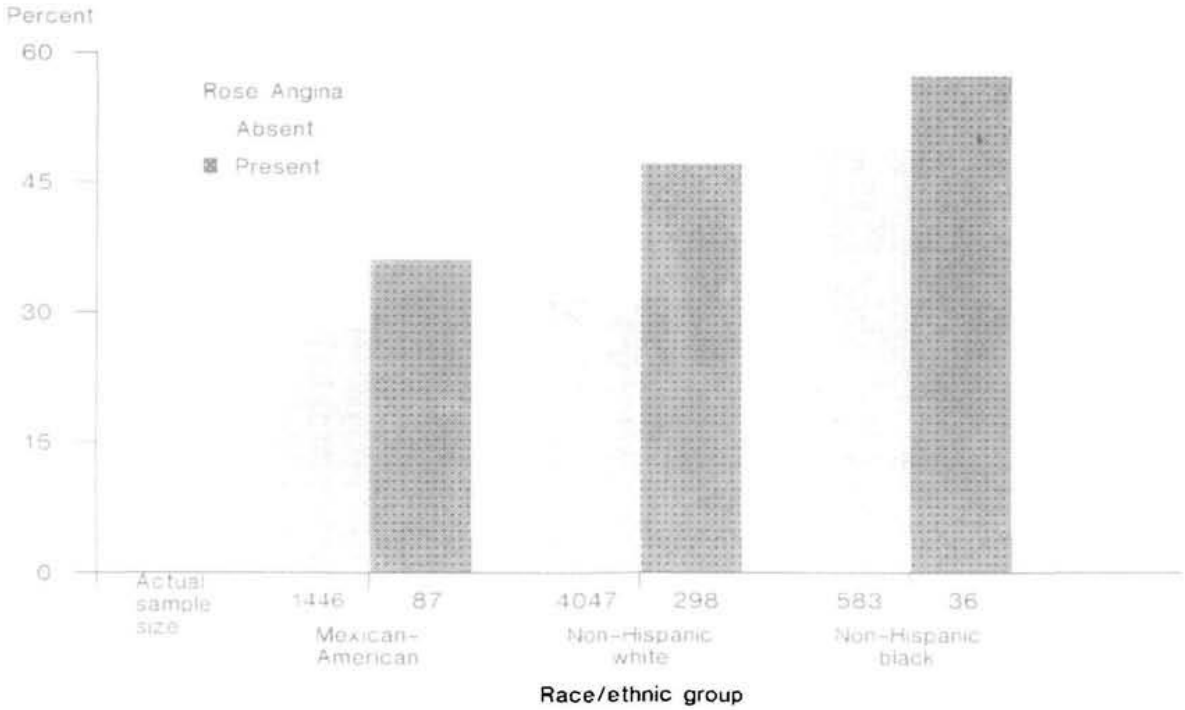

FIGURE 2. Age-adjusted prevalence of elevations in two or more cardiovascular risk factors according to Rose Questionnaire angina classification among women aged 25 to 74 years, by race/ethnicity: NHANES II, 1976–1980, and HHANES (MA), 1982–1983.

Rose Questionnaire angina and coronary heart disease manifestations

The relation of prevalent Rose Questionnaire angina to electrocardiographic evidence of myocardial infarction, self-reported heart attack, and dyspnea symptoms was examined by age among white women and men (table 3). Older women and men reporting Rose angina had a prevalence rate of definite myocardial infarction on the electrocardiogram that was two to three times higher than that among older subjects without angina; however, overall there were few women in any age group with definite myocardial infarction on the electrocardiogram. Similar differences in the prevalence of equivocal electrocardiographic findings (indicative of a past myocardial infarction) were present among older women and men with and without Rose angina. Older persons with angina, regardless of sex, had a prevalence rate of self-reported heart attack that was five to six times higher than that among older persons without angina ($p < 0.05$), although, as expected, rates of previous heart attack were higher for men than for women in each angina category (present and absent, respectively). Self-reported dyspnea was a strong correlate of angina status for women of all ages and for older men. About 30 per cent of women and men in the older age group with Rose angina also reported severe dyspnea (requiring the subject to stop for breath when walking on level ground), whereas the rates of dyspnea among those without angina were about 7 per cent regardless of sex.

Correlates of Rose Questionnaire angina in multivariate analyses

Coronary heart disease risk factors that predicted prevalent Rose Questionnaire an-

TABLE 3

Prevalence of electrocardiographic evidence of definite or equivocal myocardial infarction, self-reported heart attack, and dyspnea according to Rose Questionnaire angina classification among NHANES II white persons aged 25–74 years, by sex and by age

Age (years)	Men				Women			
	Angina present		Angina absent		Angina present		Angina absent	
	%	SE*	%	SE	%	SE	%	SE
Definite myocardial infarction								
25–54	4.2	2.9	1.6	0.3	—†		1.2	0.3
55–74	15.2	2.7	4.9	0.5	5.2	2.5	2.0	0.3
Total	9.9	2.1	2.5	0.3	2.7	1.1	1.5	0.2
Equivocal myocardial infarction								
25–54	10.9	4.6	9.8	0.7	10.0	2.4	8.9	0.8
55–74	25.8	4.5	18.5	1.1	35.8	4.5	24.9	1.4
Total	18.7	3.3	12.3	0.6	20.3	2.2	14.2	0.7
Self-reported heart attack								
25–54	14.4	4.7	1.6	0.3	3.1	1.8	0.7	0.2
55–74	51.3	5.9	10.2	0.9	24.0	3.8	3.8	0.6
Total	33.9	4.4	4.1	0.4	11.5	1.9	1.8	0.2
Dyspnea								
25–54	4.5	2.5	1.7	0.3	20.5	3.9	2.9	0.4
55–74	31.8	5.4	6.7	0.7	27.3	4.1	7.6	0.7
Total	18.9	3.9	3.2	0.3	23.2	3.1	4.5	0.4

* SE, standard error.

† Too few cases of definite myocardial infarction on the electrocardiogram occurred to yield reliable estimates.

gina in multivariate logistic models among white women without previous history of heart attack (on the medical history) are shown in table 4. All variables that were significant at the 0.10 level in logistic models that incorporated the sampling weights (normalized to the actual sample size) have been presented. We calculated the 95 per cent confidence intervals taking the complex survey design effects into consideration. Among women aged 25–74 years, serum cholesterol, body mass index, current cigarette smoking, and dyspnea were each independently associated with prevalent angina. The association of serum cholesterol with Rose angina was confined to younger women (under age 55 years), with about a 30 per cent increase in risk of prevalent angina associated with a change of 40 mg/dl in cholesterol. A similar association was found for body mass index, with only younger women having about a 60 per cent increased risk of prevalent angina associated with a change of 10 kg/m^2 in body mass index. Dyspnea was a strong correlate of prevalent angina among women in both age groups, and it was the only correlate that achieved statistical significance among older women in this population. When the modeling procedure was repeated for women excluding dyspnea from the list of initial variables, the resulting models were similar to those shown in table 4 except that years of education was retained in the final model for women aged 25–74 years, with an odds ratio of 0.69 for a six-year difference in education ($p = 0.07$). Current smoking was significantly related to angina in the model for all ages combined, with an odds ratio of 1.44. Although the direction of association was also positive in the age-stratified models, current smoking did not reach statistical significance in these models.

Similar associations with prevalent Rose angina were observed among white men aged 25–74 years for serum cholesterol, cigarette smoking, and dyspnea in the multivariate analyses (table 5). Risk factors found to be independently associated with Rose angina among men but not women include a positive association for age and inverse associations for systolic blood pressure and years of education. Current smoking was a correlate of angina only among younger men, as was history of diabetes. Body mass index was a correlate of prevalent angina only among older men, with about a twofold increased risk of prevalent angina associated with a change of 10

TABLE 4

Logistic regression odds ratio estimates† for the association of Rose Questionnaire angina with selected coronary heart disease risk factors among NHANES II white women aged 25–74 years, by age‡

Risk factor§	Total (age 25–74 years)		Age 25–54 years		Age 55–74 years	
	OR‖	95% CI‖	OR	95% CI	OR	95% CI
Serum cholesterol (mg/dl)	1.13	0.99–1.29*	1.28	1.08–1.52**	0.92	0.78–1.08
Body mass index (weight (kg)/ height (m)^2)	1.38	1.06–1.80*	1.63	1.20–2.20**	0.83	0.51–1.34
Cigarette smoking (currently smoking vs. not smoking)	1.44	1.06–1.97*	1.30	0.84–2.03	1.36	0.81–2.28
Dyspnea (yes vs. no)	5.36	3.64–7.88**	6.78	4.10–11.20**	4.31	2.38–7.81**
No. of angina cases/total sample no.	258/4,202		114/2,059		144/2,143	

* $p < 0.10$; ** $p < 0.01$.

† Odds ratio estimates refer to differences of 40 mg/dl for serum cholesterol and 10 kg/m^2 for body mass index.

‡ Excluding persons with self-reported history of heart attack.

§ Variables significantly related to Rose Questionnaire angina ($p < 0.10$) in the model for all ages combined or in either age subgroup were forced into the final models presented.

‖ OR, odds ratio; CI, confidence interval.

TABLE 5

Logistic regression odds ratio estimates† for the association of Rose Questionnaire angina with selected coronary heart disease risk factors among NHANES II white men aged 25–74 years, by age‡

Risk factor§	Total (age 25–74 years)		Age 25–54 years		Age 55–74 years	
	OR‖	95% CI‖	OR	95% CI	OR	95% CI
Age (years)	1.25	1.07–1.47**	1.32	0.86–2.04	1.93	1.10–3.41*
Serum cholesterol (mg/dl)	1.21	0.96–1.52	1.10	0.78–1.56	1.43	1.16–1.75**
Systolic blood pressure (mmHg)	0.81	0.69–0.94**	0.80	0.62–1.03*	0.79	0.68–0.92**
Body mass index (weight (kg)/ height (m)^2)	0.86	0.35–2.10	0.55	0.12–2.44	1.90	0.91–3.95*
History of diabetes (yes vs. no)	1.79	0.67–4.80	3.80	0.89–16.17*	0.73	0.23–2.30
Cigarette smoking (currently smoking vs. not smoking)	1.55	0.98–2.45*	2.36	1.40–3.98**	0.74	0.37–1.48
Dyspnea (yes vs. no)	3.88	2.09–7.20**	2.13	0.68–6.66	6.19	2.93–13.07**
Education (years)	0.68	0.41–1.13	0.76	0.33–1.75	0.52	0.29–0.91*
No. of angina cases/total sample no.	119/3,653		43/1,951		76/1,702	

* $p < 0.10$; ** $p < 0.01$.

† Odds ratio estimates refer to differences of 40 mg/dl for serum cholesterol, six years for education, and 10 units for age (years), systolic blood pressure (mmHg), and body mass index (kg/m^2).

‡ Excluding persons with self-reported history of heart attack.

§ Variables significantly related to Rose Questionnaire angina ($p < 0.10$) in the model for all ages combined or in either age subgroup were forced into the final models presented.

‖ OR, odds ratio; CI, confidence interval.

kg/m^2 in body mass index. Similarly, dyspnea was associated with nearly six times the risk of prevalent angina among older men. The inverse association of education with prevalent angina was present in both age groups but significant only in older men. Age was positively associated with prevalent angina in both age groups; however, the association was stronger and statistically significant only among older men. Systolic blood pressure was negatively associated with Rose angina in both younger and older men. This inverse association of systolic blood pressure with prevalent angina was also observed in further analyses with diastolic blood pressure, and it persisted when treated hypertensives were excluded from the sample. Serum cholesterol was significantly associated with prevalent angina only among older men, with about a 40 per cent increase in risk associated with a change of 40 mg/dl in cholesterol. In the subset of NHANES II persons in which high density lipoprotein cholesterol determinations were available, the ratio of total cholesterol to high density lipoprotein cholesterol was significantly associated with prevalent angina in models analogous to those seen in tables 4 and 5 (but not shown) for both sexes. An increase of 4.0 in the total cholesterol:high density lipoprotein cholesterol ratio was associated with 1.5 times the risk of prevalent angina in women ($p < 0.05$) and 2.0 times the risk in men ($p < 0.05$).

DISCUSSION

The prevalence rates of Rose Questionnaire angina among women observed in other studies of US samples were comparable to estimates from the present study of representative populations of US women (table 1). Rates among British and Norwegian women who had migrated to the United States ranged from 3 per cent to 5 per cent (11), and rates among women in the Lipid Research Clinics Program Prevalence Study ranged from 3 per cent to 6 per cent (17). Prevalence of Rose Questionnaire angina among women in Sweden, South Wales, and Africa have been much higher (12, 19, 20), ranging as high as 24

per cent in South Wales among women aged 45–74 years (12). Moreover, great variation can exist in reported prevalence rates of angina within countries. For example, Swedish estimates of Rose angina among women have been reported in the range of 13 per cent for women aged 55 years (19) and in the range of 0.3 per cent to 3.9 per cent among women aged 38 and 50 years (15).

Sex differentials in the prevalence of Rose angina among younger men and women have also been reported in some populations (11, 15–17) but have not been observed in others (43). When this sex differential was further investigated in the Lipid Research Clinics Program Prevalence Study, no differences were found between younger men and women in the reporting of "any chest pain" (17). The sex differential in the Lipid Research Clinics population became apparent with the second Rose Questionnaire criterion, which identifies exertional chest pain. In NHANES II, the first and second Rose Questionnaire criteria were combined into a single question on exertional chest pain, and with the use of this item, the sex differential among younger white men and women was also apparent in the present study. Furthermore, sex differentials in the Lipid Research Clinics Program Prevalence Study were not due to differences between men and women in questionnaire or test-retest reliability (44).

In contrast, the noted sex differential in the prevalence of Rose angina was absent among younger black men and women in the present study because of higher prevalence rates of Rose angina among black men as compared with white men and Mexican-American men. Although the apparently greater prevalence of Rose angina among younger black men must be interpreted cautiously because of the small sample size and the wide confidence intervals associated with these prevalence estimates, the known greater prevalence of left ventricular hypertrophy in younger black men as compared with white men is one possible explanation (45, 46). Such angina could be caused by reduced coronary reserve in young black men with left ventricular hypertrophy (47).

Several other findings of the present study for white women and men are also similar to relations observed in the Lipid Research Clinics Program Prevalence Study (17). Electrocardiographic abnormalities associated with coronary disease were related to prevalence of Rose angina in both studies, but only among older subjects. The presence of such abnormalities was rare among younger women, regardless of angina (17). Self-reported heart attack was similarly associated with prevalent angina among older women in both studies and was infrequently reported by younger women (17).

Dyspnea was strongly associated with prevalent angina in both the present study and the Lipid Research Clinics Program Prevalence Study among both men and women (17). Like angina, dyspnea is a transient and subjective symptom that is subject to similar recall and reporting factors. The definition of dyspnea in the present study required the shortness of breath to cause a limitation in activity, that is, the need to stop for breath when walking at one's own pace, or after walking for several minutes or about 100 yards (91.4 m). One interpretation of these observations is that the two symptoms are similar in the way they are perceived and reported, or that they often occur together. The experience of angina may produce hyperventilation (perceived as dyspnea) as a result of the anxiety induced by the pain (17, 48). It is also possible that both angina and dyspnea may be related to the same underlying cardiovascular or pulmonary conditions (48). Among younger women in the present study, the combination of elevated serum cholesterol, overweight, current cigarette smoking, and dyspnea was related to angina. Although these factors may influence risk of future coronary events, none of these

associations preclude a noncoronary disease etiology for angina symptoms in younger women (18).

There were both similarities and differences in the association of Rose Questionnaire angina with coronary risk factors in the present study and the Lipid Research Clinics study. Among women in the latter study, high density lipoprotein cholesterol was associated with prevalent angina among those not taking oral contraceptives or replacement estrogens (17). In the present study, the ratio of total cholesterol to high density lipoprotein cholesterol was also associated with angina in women. Furthermore, among women in the Lipid Research Clinics study, former smoking status was positively associated with prevalent angina in those taking estrogen-related hormones, while current cigarette smoking was inversely related to prevalent angina among women not taking estrogen-related hormones and among men (17). In the present study, current cigarette smoking was positively associated with prevalent angina in both men and women. This difference may arise from the inclusion of persons with a history of heart attack in the multivariate analyses of the Lipid Research Clinics study, if persons with both previous heart attack and prevalent angina were more likely to quit smoking.

In the present study, the multivariate analyses showed no association between systolic blood pressure and Rose angina among women and a paradoxical inverse relation between angina and systolic blood pressure among men. Since this is a cross-sectional study, it is possible that some proportion of those with Rose angina also have clinically diagnosed angina and may have been treated with drugs such as nitroglycerin and beta blockers that are known to lower blood pressure. Although the data are not available to directly evaluate this possibility, this could be one explanation for the lack of an association of Rose angina with blood pressure in women and the inverse association in men.

History of diabetes was positively associated with prevalent angina among younger men in the present study; however, no association was observed for women or older men. These findings are consistent with the relation of diabetes to 30-year incidence of uncomplicated angina pectoris in the Framingham Heart Study (49). In that study, diabetes was significantly related to uncomplicated angina in younger men (aged 35–64 years) but not in older men (aged 65–94 years), and no significant association between diabetes and angina was observed for younger or older women, after adjustment for standard coronary risk factors. In contrast, diabetes was significantly related to incidence of total coronary heart disease in the Framingham Study for both sexes, and the associations observed were stronger for women than for men.

Education was independently and inversely associated with prevalent angina among white men in the present study. However, education was not related to prevalent angina among women after the effects of serum cholesterol, current smoking, body mass index, and dyspnea were controlled. A recent Swedish prospective study of women found that incidence of Rose Questionnaire angina was inversely related to educational attainment even after adjustment for Swedish socioeconomic group and several coronary risk factors (50). The inverse association of education with prevalent angina among white men in the present study was stronger for older men and may be a reflection of socioeconomic differentials in prevalent coronary heart disease. Lower educational attainment has been associated previously with coronary heart disease (51) and more recently with total mortality among men in national (52) and community-based (53) prospective population studies. Also interesting, but unexplained, is the lack of association of education with prevalent Rose angina in Mexican-American men and women and black men. One possibility is that education may not be an equivalent

indicator of socioeconomic status among the three race/ethnic subgroups examined in this paper.

Among older women without a previous history of heart attack, only dyspnea was significantly related to prevalent Rose Questionnaire angina. The influence of selective survival may underlie the lack of association of other coronary risk factors with angina in older women. However, this explanation is not supported by the findings in men, for whom several cardiovascular risk factors were found to be associated with prevalent angina. Alternatively, the strength of association between cardiovascular risk factors and future manifestations of coronary disease may diminish with age among women. Another possible explanation is that the presence of Rose angina signifies a different disease process in older women than in older men.

As noted previously, the present study is limited by its cross-sectional design and its inability to distinguish antecedent from consequent relations. Furthermore, the relation of Rose angina to future risk of clinical coronary disease among women was not assessed and can only be clarified through longitudinal studies. Findings among black subjects of all ages and among older Mexican Americans were based upon small samples and therefore require cautious interpretation and replication in future studies. Finally, although the analytic strategy was preplanned and the number of variables studied was limited, multiple comparisons in the present study leave open the possibility of chance findings.

The findings of the present study may have implications for clinicians in the management of chest pain symptomatology in women. The present study found little difference in the prevalence rates of Rose Questionnaire angina among black, white, and Mexican-American women. Thus, this study found no evidence that race or ethnicity factors strongly influence the reporting of Rose angina among these groups of women in the United States. In a recent study in which nearly half of the women were black and Hispanic, physicians were about twice as likely to attribute chest pain reported by women (of all races and ethnic origins) to psychiatric and noncardiac causes as compared with men (54). This difference persisted among men and women found to have abnormal results on nuclear exercise studies (54). Since women in the US population differ little by race or ethnic category in their overall reporting of angina, these factors should not be assumed to influence the frequency of chest pain complaints.

Furthermore, the present study indicates that about one half of women reporting angina also have elevations in two or more standard coronary risk factors that are amenable to lifestyle and behavioral interventions. The fact that many of these women may see physicians about this chest pain presents an opportunity to go beyond simply ruling out the presence of underlying coronary disease by using the office visit to determine the presence of such risk factors and introducing the necessary interventions to reduce them.

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