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Authors
Seeman, Teresa E
Berkman, Lisa F
Kohout, Frank
et al.

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Intercommunity Variations in the Association between Social Ties and Mortality in the Elderly

A Comparative Analysis of Three Communities

TERESA E. SEEMAN, PHD, LISA F. BERKMAN, PHD, FRANK KOHOUT, PHD, ANDREA LACROIX, PHD, ROBERT GLYNN, PHD, AND DAN BLAZER, MD, PHD

ABSTRACT *Identical measures of social ties obtained from three community-based cohorts aged 65 and over from East Boston, MA; New Haven, CT; and two rural counties in Iowa permit the first direct cross-community comparison of the hypothesis that social isolation increases 5-year mortality risks (1982 to 1987) for older men and women. In sex-specific proportional hazards analyses, social ties were significantly and inversely related to mortality independently of age in all three cohorts (e.g., relative hazard (RH) = 1.97 to 3.06 for men and women, comparing those with no ties to those with four types of ties). After controlling for age, pack-years of smoking, body mass, chronic conditions, angina, and physical and cognitive disability, social ties remain significant predictors of mortality risk for the men and women in New Haven (RH = 2.4 and 1.8) and for women in Iowa (RH = 1.9). For the men in Iowa (RH = 1.4) and the men and women in East Boston (RH = 1.0 and 1.3), the associations are weaker and nonsignificant. Ann Epidemiol 1993; 3:325–335.*

KEY WORDS: Aging, mortality, social ties.

INTRODUCTION

The past decade has seen a proliferation of epidemiologic research on the impact of social ties on both morbidity and mortality. The result of this research is a rapidly growing body of evidence indicating a protective effect of such ties with respect to both morbidity (1–7) and mortality (8–16). This research, while fairly consistent in its findings, provides more of a preliminary examination than a final accounting. Several major questions that have not been resolved by previous studies include (a) to what extent previously observed differences in the association between social isolation and mortality risks among community-based studies reflect the use of somewhat different measures of social ties as opposed to reflecting true, intercommunity differences; (b) to what extent these observed differentials may also reflect differential adjustments for possible confounding between social activities and health or functional status; and (c) whether the effects of social ties vary by sex and/or age.

A major problem in interpreting differential findings of epidemiologic research on social ties is the lack of standardized measures, most previous studies having used similar but not identical measures of social ties. These different studies have yielded somewhat differing conclusions regarding the association between social ties and lower mortality risks, some showing strong effects across different age and sex groups (10, 16), others showing significant effects only for specific sex, age, and/or racial subgroups (9, 11, 14). Urban versus more rural cohort differences have also been suggested as a possible source for interstudy differences in results (17). The lack of common measures of social ties across studies, however, has made it impossible to assess the degree to which interstudy differences reflect true differences or are artifacts of the variation in measurements of social ties.

A second issue for consideration is the question of possible confounding effects of health status and functional ability on any association between social ties and mortality. Previous studies have often included different measures of health status and other risk factors, which has contributed to the problems of evaluating differences in results. Furthermore, while most previous studies have attempted to control for subjects' health status using various measures of health conditions and health behaviors such as high blood pressure, obesity, and smoking, there has been less attention

From the Department of Epidemiology and Public Health, Yale University, New Haven, CT (T.E.S., L.F.B.); Preventive and Communicative Diseases, University of Iowa, Iowa City, IA (F.K.); Center for Health Studies, Seattle, WA (A.L.); Harvard Medical School, Brigham and Women's Hospital, Department of Medicine, Channing Laboratory, Brookline, MA (R.G.), and Duke University Medical Center, Durham, NC (D.B.).

Address reprint requests to: Teresa E. Seeman, PhD, Yale University, Department of Epidemiology and Public Health, 60 College Street, New Haven, CT 06510.

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to measures of actual physical and/or cognitive functioning. These latter factors may have important roles in determining levels and types of social engagements, particularly at older ages where such disability becomes more common.

A third issue regarding the association between social ties and mortality relates to possible age and/or sex differentials in this association. There is suggestive evidence that such differentials may exist. Much of the research on mortality, for example, has suggested that the protective effects are predominantly seen among men; the effects among women have been more inconsistent (10, 11, 14, 16, 18). The data on possible age differences, though sparse, do suggest that social ties continue to influence health risks at older ages (10, 11).

The question of whether social ties continue to have protective effects at older ages is important for several reasons. Current demographic trends are leading to a rapidly increasing population aged 65 and older. In addition, age may be associated with important patterns of change in social networks. Social networks represent a shifting mosaic of ties over the lifetime of an individual, with older age a likely time of greatest "losses" of network members (e.g., death of spouse, siblings, other relatives, and close friends) (19, 20). With age, one's social network ties may also be more likely to become "stressors" in their own right as network members themselves age and thus are more likely to become ill or disabled and require additional emotional and/or instrumental support (21). At the same time, as individuals age, their own need for support may increase as they experience declines in health status and functional ability.

Using longitudinal data from three large community-based cohorts of men and women aged 65 and older, the analyses presented here have the unique ability to address each of these questions.

MATERIALS AND METHODS

Data presented here are from the Established Populations for Epidemiologic Studies of the Elderly (EPESE), a series of collaborative longitudinal studies of community-dwelling older people. In 1981 to 1982, approximately 11,000 participants aged 65 years and older were enrolled at three sites located in New Haven, CT; East Boston, MA; and Iowa and Washington counties in rural Iowa. Of age-eligible community residents, 84% (n = 3809) were enrolled in East Boston and 80% (3673) in rural Iowa. The New Haven cohort was drawn from a random community sample stratified by public, private, and community housing, with an oversampling of men to obtain equal numbers of men and women; details of the New Haven sampling design have been described elsewhere (22). Of those eligible, 82% (n = 2812) were enrolled.

The availability of common measures of not only social ties, but also health status and cognitive and physical functioning for three community-based cohorts also provides a unique opportunity to compare findings for three very different types of communities. The Iowa cohort represents a more rural community while the East Boston and New Haven cohorts reflect more urban milieux. The East Boston cohort is also unique in that it reflects a highly homogeneous community of Italian Americans while the New Haven cohort provides a more varied ethnic picture, including blacks (approximately 16%). Comparisons across these cohorts thus permit assessments of the consistency of associations not only among older men and women but also across communities characterized by varying degrees of urbanization and ethnic homogeneity.

Participants were interviewed in person in 1982, 1985, and 1988 and by telephone in intervening years. All predictor variables included in the following analyses are based on self-reports by respondents in their baseline interview in 1982.

Social Ties

Four measures of social ties examined in these analyses include (a) presence of a spouse, (b) reported contact with two or more close friends and/or relatives, (c) regular church attendance (i.e., at least once per month), and (d) membership in other types of groups. In addition to these individual measures of different types of ties, a summary measure of social ties was constructed to indicate the number of these different types of ties that each subject reported having; scores range from 0 (no ties) to 4 (all four types of ties are reported as being present). Subjects missing data for two or more of the four components were scored as "missing" on the summary index, eliminating 50 in East Boston, 44 in New Haven, and 576 in Iowa. The larger number of subjects eliminated from the Iowa cohort resulted from their more frequent use of proxy interviews for a few very ill and a larger number of busy subjects (e.g., farmers) and the fact that some of the social ties information was not obtained from these interviews.

Covariables

Additional covariates measuring health status, health behavior, and functional ability were included in the multivariate analyses in order to assess the association of social ties with mortality risk independent of these potential confounders. The measures of health status include (a) number of reported chronic conditions (sum of "yes" responses to items asking if a physician had ever told the subject that they had high blood pressure, a heart attack, cancer, diabetes, stroke, broken hip, or other broken bones), (b) self-reported angina pectoris based on the Rose angina questionnaire (23), (c) body mass (kg/m^2), and (d) pack-years of cigarette smoking. Measures of functional ability incude both cognitive and physical functioning. Cognitive functioning was measured by the Short Portable Mental Status Questionnaire (SPMSQ) (24). As suggested by Fillenbaum (25), "don't knows" and refusals were counted as incorrect. The skewed distribution of the scale led us to group SPMSQ scores into categories, rather than treating the scale as a normally distributed continuous variable. Scores were trichotomized as 0 to 1 errors, 2 to 3 errors, and 4 or more errors. These groups were chosen to be similar to cutpoints used by other investigators (26, 27). Physical disability was measured by three separate scales: (a) a basic activities of living scale based on seven items drawn from Katz's Activities of Daily Living scale (28), (b) a three-item scale of gross-mobility function developed from the work of Rosow and Breslau (29), and (c) a physical performance scale based on five items from Nagi (30). For the latter two scales, subjects were scored for the number of activities for which they reported having trouble. Due to the small number of individuals reporting any disability on the Katz Activities of Daily Living scale, scores were dichotomized to indicate none versus any reported disability.

Outcome

Vital status information during follow-up came first from interviews with proxies and from surveillance of local newspaper obituaries. Ascertainment through 5 years of follow-up was 100% complete in East Boston and Iowa and 99% complete in New Haven. Preliminary reports of death were followed up by requests for death certificates. The analyses presented here examine the 5-year mortality from all causes based on the death certificate data.

Analysis

For each cohort, unadjusted 5-year mortality rates were initially examined by level of overall social ties as well as for different types of ties. Proportional hazards models were used in the multivariate analyses to adjust for the full set of covariates. Since mortality is not a rare outcome in older age groups, proportional hazards modeling was used in preference to logistic regression in order to obtain more accurate estimates of relative risk. Tests of linearity were also examined for the summary measures of social ties (five levels) by comparing the improvement in the model χ^2 between a model that assumed linearity and one that allowed for deviations from linearity by including dummy variables to code separately for each level of the social ties (31).

Due to the stratified, random sampling design used in drawing the New Haven cohort (with oversampling of men and those living in age-segregated public and private housing), special "design-based" analysis techniques were used to obtain accurate variance estimates for tests of significance. Use of such design-based variance estimates is required since application of simple, random sampling assumptions to design-based data generally leads to underestimation of variances and overestimation of significance levels (32). The SURREGR program was used for tests of significance for the unadjusted mortality rates (33). Balanced Repeated Replication (BRR) technique was used to obtain accurate "design-based" variance estimates for tests of significance for parameters of the proportional hazards models (32, 34).

RESULTS

Distributions for the measures of social ties are most similar for the East Boston and New Haven cohorts. Iowans were less likely to report no ties (i.e., score 0 on the summary index) (Table 1). For the New Haven cohort, reported percentages are based on the weighted data which take into account the sampling design.[1] Unweighted N's are also presented to indicate actual numbers of respondents per category. Generally, for both the men and women, 10% or less reported no social ties. Among the men, those who reported at least one or more of the four types of ties were fairly evenly distributed across the remaining four categories. Among the women in East Boston and New Haven, proportionately fewer were found in the highest category. Like the men, however, the women generally were distributed fairly evenly across the remaining categories.

Comparisons of the relative prevalence of the four types of ties across the three communities revealed both similarities and differences. Iowans (both men and women) were more likely to be married, and males in all three cohorts were more likely to be married: 66.0 to 81.8% as compared with 28.6 to 41.4% for the women. For ties with friends and/or relatives, both East Boston and Iowa cohorts reported a higher prevalence of such ties than did the New Haven subjects (71 to 75% versus 66 to 67%). By contrast, for church and other group ties, men and women in Iowa were more likely to report such ties than were their counterparts in the other two cohorts (63.5 to 77.0% versus 40.7 to 56.5% for church attendance and 55.3 to 67.3% versus 31.0 to 41.9% for group memberships). Females in all three communities were more likely to report regular church attendance while group membership showed no clear pattern. Cross-cohort comparisons of the distributions for health status, health behavior, and physical and cognitive functioning covariates included in the multivariate analyses showed generally similar distributions (see Appendix). The only marked differences were for the Iowa cohort where subjects were

[1] Weights were assigned to subjects according to the reciprocal of the probability of selection by housing stratum and sex, in addition to the poststratification factor of age- and sex-specific response rates. The weighted data provide representative estimates for the entire New Haven noninstitutionalized poulation aged 65 and over.

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TABLE 1. Sex-specific baseline social ties distributions for East Boston, Iowa, and New Haven EPESE Cohorts

	East Boston				Iowa				New Haven					
	Men		Women		Men		Women		Men			Women		
	N	%	*N*	%	*N*	%	*N*	%	*N* unwtd	*N* wtd	% wtd	*N* unwtd	*N* wtd	% wtd
Ties														
0	71	5.0	224	9.5	19	1.6	65	3.4	91	362	6.6	190	990	10.2
1	301	21.2	618	26.3	124	10.8	267	13.8	269	1150	20.9	412	2469	25.4
2	463	32.3	768	33.1	308	26.8	456	23.6	354	1665	30.3	548	3270	33.6
3	405	28.1	569	24.6	385	33.5	763	39.4	310	1631	29.7	381	2364	24.3
4	191	13.4	151	6.5	314	27.3	385	19.9	126	686	12.5	87	626	6.4
Marital														
Not married	454	31.4	1563	66.2	210	18.2	1139	58.6	482	1879	34.0	1260	6986	71.4
Married	997	68.7	793	33.8	945	81.8	803	41.4	675	3643	66.0	371	2792	28.6
Friends/relatives														
No	389	27.2	673	29.0	277	24.6	495	25.8	416	1846	33.6	606	3261	33.4
Yes	1039	72.8	1656	71.0	850	75.4	1423	74.2	732	3647	66.4	1017	6493	66.6
Church attendance														
No	841	59.3	1014	43.5	417	36.5	443	23.0	608	2880	52.5	738	4398	45.4
Yes	581	40.7	1302	56.5	725	63.5	1483	77.0	540	2610	47.5	876	5297	54.6
Group membership														
No	830	58.1	1612	69.0	515	44.7	633	32.7	682	3263	59.4	874	5664	58.4
Yes	601	41.9	720	31.0	637	55.3	1303	67.3	467	2230	40.6	739	4035	41.6

Unwtd = unweighted; wtd = weighted.

more likely to report higher levels of functioning and less cigarette smoking.

As one would expect, 5-year mortality was higher for the men in each cohort: 57.8 to 79.2 deaths per 1000 person-years among the men and 32.6 to 49.0 deaths per 1000 person-years among the women. As a preliminary test of the hypothesis that social ties protect against elevated mortality risk, mortality rates were compared for those with and those without specific types of ties as well as by level of the summary index of social ties. Results in all cases support the hypothesis that social ties have a protective effect: Those with more ties and with specific types of ties experienced significantly lower 5-year mortality rates. The summary measure of social ties showed significant effects for men and women in all three cohorts (Table 2). Those with no ties were two to three times more likely to die during the 5-year follow-up, with 69.34 to 161.28 deaths per 1000 person-years as compared with 16.28 to 50.45 deaths per 1000 person-years for those reporting all four types of ties. Examination of the mortality patterns by increasing levels of social ties revealed a generally consistent pattern of gradually *decreasing* mortality with more extensive social ties. Examination of each of the specific types of ties revealed significant associations in almost all cases. The sole exceptions were for the men in Iowa where neither marital status nor group membership showed significant associations (see Table 2).

The next step was to examine the extent to which these observed relationships with mortality were influenced by possible associations between levels of social engagement (i.e., numbers of ties) and health status and functional abilities. This issue is of particular importance for older cohorts since there is great variation in health status and degree of functional impairment at older ages, variation which could potentially impact on the type of social network a subject has. One could speculate, for example, that the differential

TABLE 2. Sex-specific 5-year mortality rates by social ties for East Boston, Iowa, and New Haven (per 1000 person-years)

	East Boston		Iowa		New Haven	
	Men	Women	Men	Women	Men	Women
Ties						
0	96.4[a]	90.1[a]	152.6[a]	103.8[a]	161.3[a]	69.3[a]
1	98.2	63.1	83.5	55.6	130.8	70.6
2	67.4	37.0	66.2	35.6	68.5	48.0
3	56.6	25.7	55.0	27.1	59.2	25.5
4	38.3	20.5	39.8	16.3	50.4	18.8
Marital						
Not married	77.9[d]	52.5[a]	68.8	41.5[a]	104.8[a]	53.7[b]
Married	64.3	28.2	55.5	20.3	67.5	35.6
Friends/relatives						
No	84.2[b]	62.7[a]	73.1[c]	48.9[a]	103.8[a]	57.1[c]
Yes	59.6	38.0	51.4	27.3	68.4	43.9
Church attendance						
No	79.6[a]	61.9[a]	78.6[a]	50.1[a]	94.6[b]	65.9[a]
Yes	48.6	30.0	46.5	27.1	65.0	34.2
Group membership						
No	73.5[c]	47.4[b]	62.2	40.0[b]	96.2[a]	57.0[a]
Yes	58.8	35.4	53.8	28.8	58.2	35.2
Total rates	68.5	44.0	57.8	32.6	79.2	49.0

[a] $P \leq 0.001$.
[b] $0.001 < P \leq 0.01$.
[c] $0.01 < P < 0.05$.
[d] $0.05 < P < 0.10$.

mortality risks associated with the presence of larger versus smaller social networks may simply reflect underlying differences in health status and disability associated with maintaining these different types of networks. Table 3 presents the results of proportional hazards models which address this question, estimating the relative hazards associated with larger versus smaller social networks after adjusting for age and then simultaneously for age, chronic conditions, angina, body mass, pack years smoking, functional and cognitive disability. Table 3 also presents the relative hazards estimates from the full model for each of the covariates.

The results of these analyses indicate that the magnitude of the relative hazards associated with network size are indeed reduced with the addition of these covariates to the models for the men and women in the three cohorts. This was particularly true for men where only the New Haven cohort continues to exhibit a significant association between social ties and mortality risk (Relative Hazard [RH] = 2.40; 95% CI = 1.35–3.07) comparing those with no ties to those with all four types. For women, the association remained significant in Iowa (RH = 1.89; 95% CI = 1.18–3.04) and New Haven (RH = 1.78; 95% CI = 1.05–3.03). With the single exception of men in East Boston, tests of linearity for the summary measure showed no evidence of significant deviations from linearity for the association with mortality. The nonlinearity for the men in East Boston stems from the unexpectedly low mortality of those with no ties (Figure 1).

More graphic views of these associations are shown in Figures 1 thorough 3 where 5-year, adjusted survival curves for men and women in each cohort are presented by level of social ties. All curves are adjusted for the full set of health status, health behavior, and functional ability covariates using the overall mean values for the combined samples for each covariate. As expected, based on the results presented above, these curves generally show decreasing survival with fewer social ties. Interestingly, however, these adjusted curves also indicate that the major differences between communities are not for the groups with more ties (for whom the survival curves look quite similar); the differences appear for those with few if any ties. For these more isolated individuals, survival is worse in those cohorts where significant associations were found (i.e., men and women in New Haven and women in Iowa) as compared with survival for those classified as isolated in East Boston, where no significant independent associations were found. Comparisons of Figures 1 and 3, for example, shows that among men in East Boston, over 70% of those reporting no ties survived through the 5-year follow-up while for men in New Haven who reported no ties, less than 60% survived. For the men in Iowa, though the association between ties and mortality does not achieve statistical significance, the pattern of the

TABLE 3. Sex-specific proportional hazards models for 5-year mortality by social ties adjusting for all covariates[a]

	East Boston				Iowa				New Haven			
	Men		Women		Men		Women		Men		Women	
	RH	(95% CI)	RH	(95% CI)	RH	(95% CI)	RH	(95% CI)	RH	(95% CI)	RH	(95% CI)
Model 1 (age-adjusted only)												
Ties (0/4)	1.97	(1.37, 2.78)	2.51	(1.73, 3.64)	2.18	(1.95, 2.44)	3.00	(2.69, 3.36)	2.92	(1.97, 4.31)	3.06	(1.95, 4.81)
Model 2												
Ties 2 (0/4)	0.99	(0.66, 1.51)	1.28	(0.79, 2.03)	1.42	(0.87, 2.32)	1.89	(1.18, 3.04)	2.40	(1.35, 3.07)	1.78	(1.05, 3.03)
Age												
per y	1.05	(1.04, 1.07)	1.05	(1.03, 1.07)	1.04	(1.02, 1.06)	1.06	(1.04, 1.08)	1.06	(1.04, 1.09)	1.04	(1.01, 1.07)
per 10 y	(1.67)	(1.43, 1.95)	(1.68)	(1.39, 2.04)	(1.55)	(1.28, 1.88)	(1.77)	(1.44, 2.19)	(1.87)	(1.54, 2.26)	(1.50)	(1.12, 2.01)
No. of chronic conditions												
(per condition)	1.19	(1.08, 1.31)	1.21	(1.09, 1.34)	1.25	(1.11, 1.41)	1.25	(1.12, 1.4)	1.05	(0.94, 1.17)	1.19	(1.06, 1.34)
Body mass index												
(per unit = kg/m^2)	0.94	(0.91, 0.96)	0.96	(0.94, 0.98)	0.96	(0.93, 0.99)	1.00	(0.97, 1.03)	0.94	(0.90, 0.97)	0.96	(0.93, 0.99)
Angina (yes/no)	1.70	(1.19, 2.43)	1.08	(0.71, 1.63)	1.26	(0.84, 1.87)	1.41	(0.89, 2.21)	1.18	(0.78, 2.04)	1.04	(0.58, 1.86)
Pack-years												
per y	1.004	(1.002, 1.006)	1.004	(0.99, 1.01)	1.004	(1.001, 1.007)	1.01	(1.005, 1.02)	1.004	(1.002, 1.006)	1.01	(1.00, 1.01)
per 10 y	(1.04)	(1.02, 1.06)	(1.04)	(0.99, 1.09)	(1.04)	(1.01, 1.07)	(1.12)	(1.05, 1.2)	(1.04)	(1.02, 1.06)	(1.05)	(1.00, 1.11)
Katz disability (yes/no)	1.17	(0.84, 1.62)	1.86	(1.38, 2.51)	1.63	(1.01, 2.64)	1.21	(0.83, 1.78)	1.56	(0.98, 2.45)	0.77	(0.46, 1.31)
Rosow-Breslau												
(per disability)	1.19	(1.08, 1.31)	1.38	(1.20, 1.59)	1.27	(1.08, 1.50)	1.39	(1.20, 1.61)	1.24	(1.03, 1.50)	1.51	(1.17, 1.94)
Nagi (per disability)	1.08	(0.97, 1.19)	0.91	(0.82, 1.01)	1.06	(0.94, 1.19)	1.11	(0.99, 1.24)	0.95	(0.79, 1.15)	1.00	(0.85, 1.18)
Pfeiffer score												
0–1 errors = reference												
2–3 errors	1.34	(1.05, 1.70)	1.16	(0.9, 1.49)	1.37	(1.02, 1.85)	1.02	(0.72, 1.45)	1.61	(1.24, 2.08)	1.07	(0.72, 1.58)
4+ errors	1.74	(1.17, 2.58)	1.21	(0.79, 1.85)	2.13	(0.94, 4.85)	1.87	(0.97, 3.59)	1.16	(0.64, 2.09)	1.81	(1.09, 3.00)

[a] Relative hazards (RH) estimated from the full model are provided, including RH for social ties index as well as each covariate.
CI = confidence interval.

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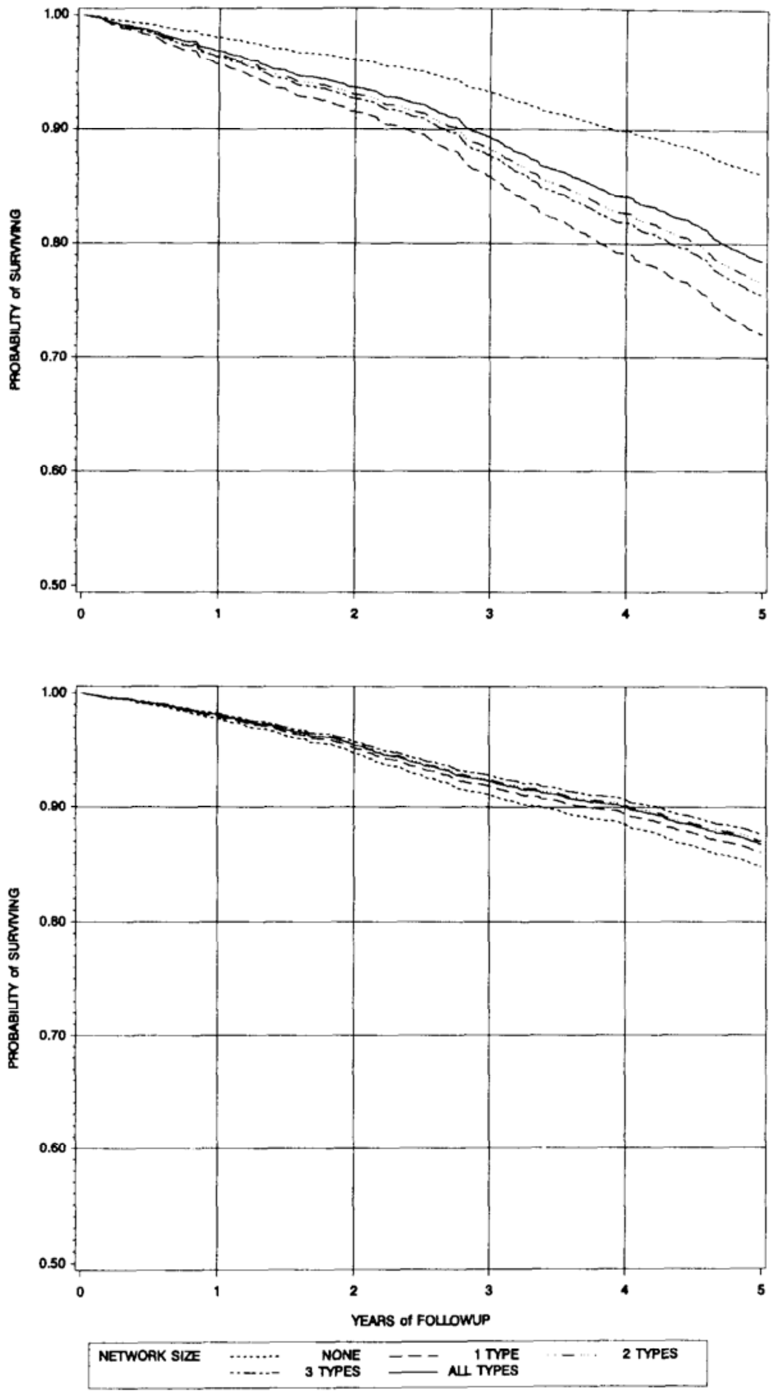

FIGURE 1. Five-year survival (1982 to 1985) by network size for men (*top*) and women (*bottom*) in the East Boston EPESE cohort, adjusted for age, chronic conditions, angina, body mass, pack-years of smoking, and functional and cognitive disability.

survival curves appears more similar to that of the New Haven men, showing decreasing survival across levels of social ties, with less than 70% of those reporting no ties surviving through the 5-year follow-up. Cross-site comparisons for women reporting no social ties indicate smaller differences in survival; though again, women in New Haven and Iowa, where significant associations were found, showed somewhat worse survival (approximately 79% and 83%, respectively) as compared with women in East Boston who reported no social ties where approximately 85% survived through the 5-year follow-up.

DISCUSSION

As indicated, the analyses presented here were designed to answer three questions relating to the possible relationship between social ties and mortality risk: (a) Are there consis-

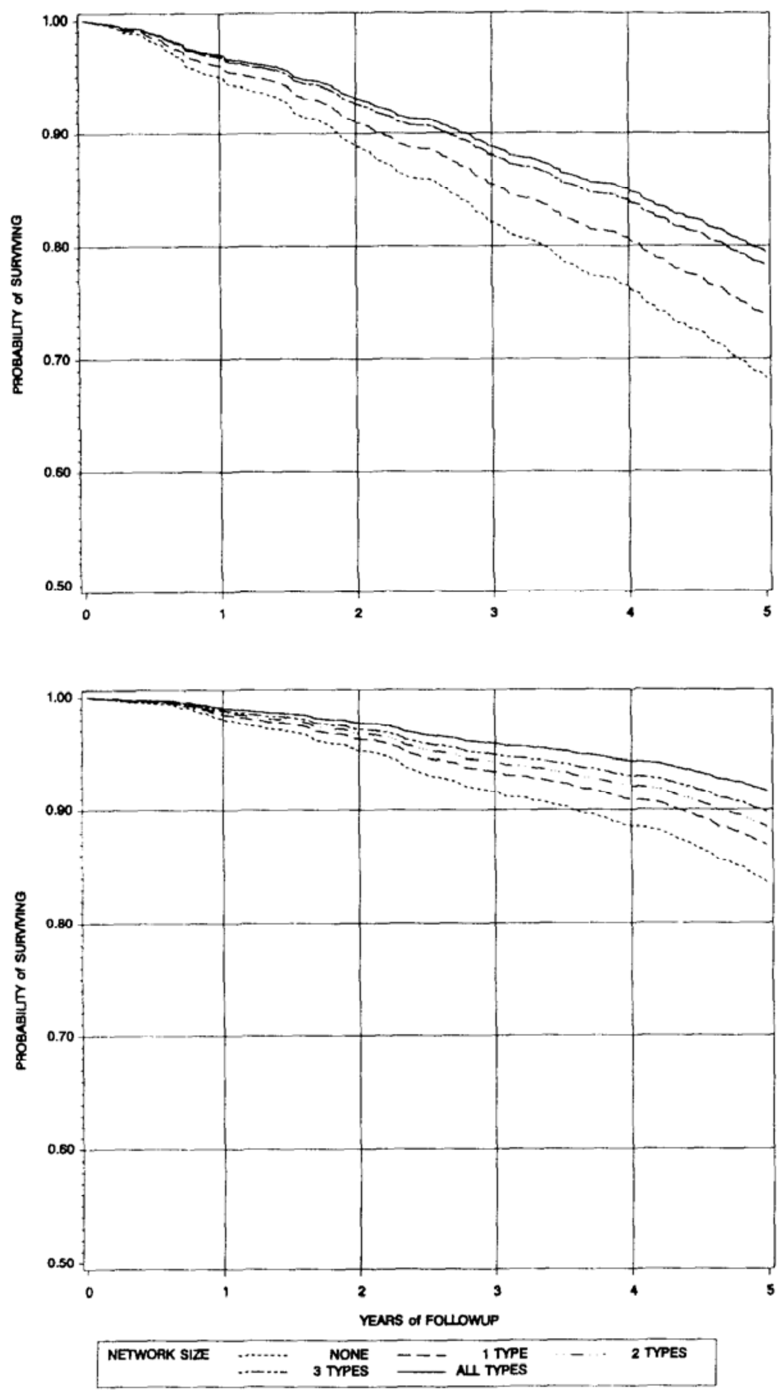

FIGURE 2. Five-year survival (1982 to 1985) by network size for men (*top*) and women (*bottom*) in the Iowa EPESE cohort, adjusted for age, chronic conditions, angina, body mass, pack-years of smoking, and functional and cognitive disability.

tent patterns of association across communities when common measures of social ties are used, (b) are these associations independent of health status and functional ability, and (c) are there sex differences in the patterns of association?

First, the data indicate that a summary measure of social ties is associated with significantly lower mortality risks for those aged 65 and older but that there are intercommunity differences in the strength of the association. For both men and women in New Haven and women in Iowa, the estimated effects showing approximately a twofold increased risk of 5-year mortality for those with no reported ties as compared with those classified into the highest social ties group are consistent with previous studies where relative risks in the range of 1.7 to 2.0 have been reported (17). Explanations for previous differential findings from community studies have included both differences in the measures used to assess social ties and differential "sociocultural" envi-

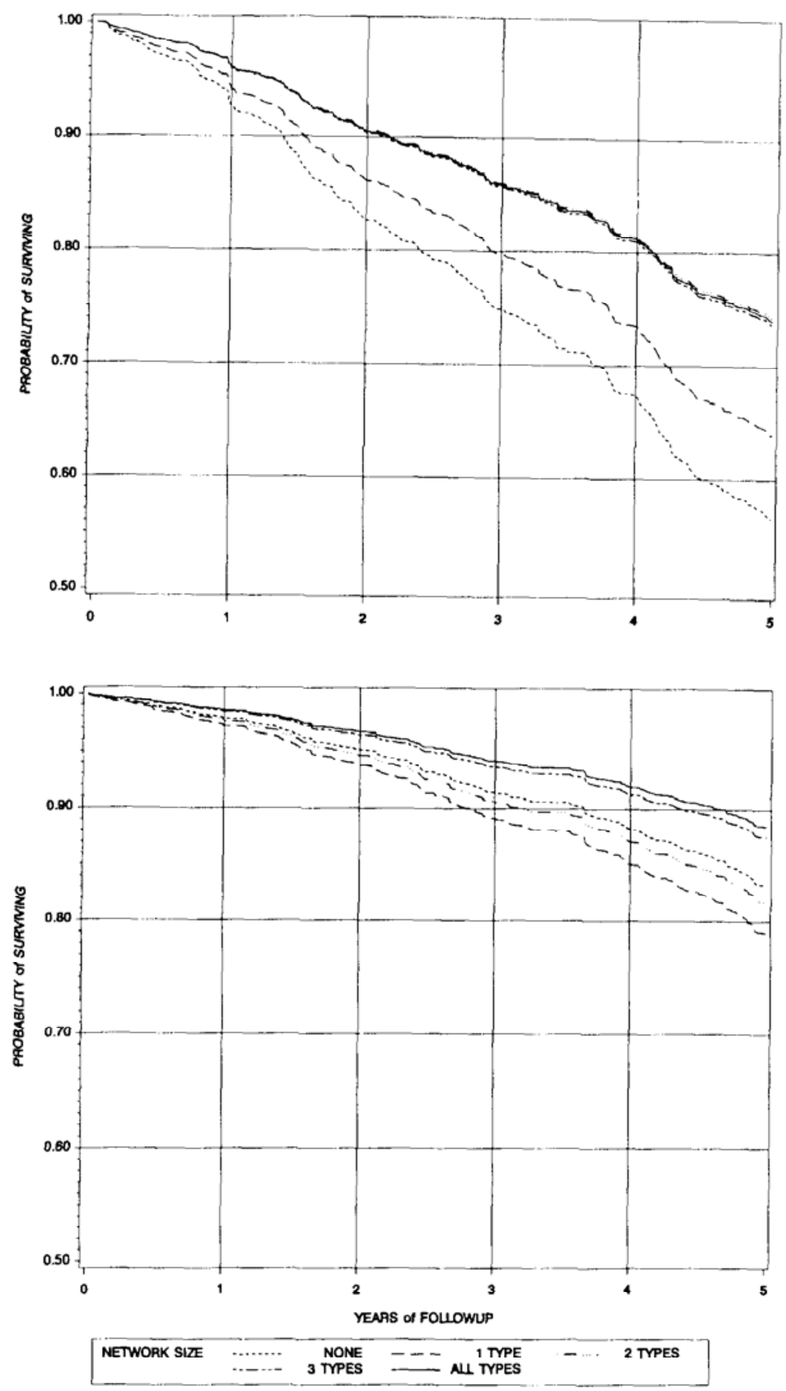

FIGURE 3. Five-year survival (1982 to 1985) by network size for men (*top*) and women (*bottom*) in the New Haven EPESE cohort, adjusted for age, chronic conditions, angina, body mass, pack-years of smoking, and functional and cognitive disability.

ronments. The intercommunity differences presented here cannot be explained by the first hypothesis since social ties were assessed by a single, standard protocol in all cohorts. "Sociocultural" differences across these communities, however, may account for at least some differential results. Examination of the pattern of results suggests that it is not the adjustments for health and functioning that lead to the intercommunity differences, as all cohort subgroups show fairly large (and proportionally similar) reductions after these adjustments. Rather, in the East Boston cohort where the association between social ties and mortality is reduced to nonsignificance for both men and women, the "unadjusted" associations were weakest to begin with when compared with those seen for men and women in Iowa and New Haven.

The fact that both the men and the women in East Boston show the weakest (and ultimately nonsignificant) associations is consistent with a possible "sociocultural" explanation. This community is both very geographically circumscribed and ethnically homogeneous (southern Italian). As noted earlier, the adjusted survival curves suggest that the difference between East Boston and New Haven appears to lie in the relatively better survival among men and women in East Boston who have few if any social ties. One possible explanation for this is that in East Boston there are a variety of other sources of social integration that our measures did not tap (i.e., the individuals classified by our scale as having few if any ties in fact had other unmeasured ties and/or social contacts). As a result, individuals classified by our measures as having fewer ties were, in fact, protected against mortality risk. In the more geographically dispersed communities represented by the Iowa and New Haven cohorts, the measures used in these analyses may more accurately reflect not only the existing social network but social contacts as well.

Although the Iowa cohort represents a more rural milieux, their differential results for men and women make a global sociocultural explanation for their patterns of association somewhat less plausible. However, there are several possible reasons for the weaker association among the men, including gender differences in sociocultural influences. First, there are many fewer men in the zero-ties category in Iowa and this may have contributed to weaker statistical significance tests for the men. Their weaker overall association also appears to result, in part, from the weaker associations of certain of the four types of ties with mortality risk among the men. As seen in Table 2, the only nonsignificant associations were those for marital status and group memberships for men in Iowa. By contrast, ties with friends and relatives and church attendance were significant predictors for the men (and remain so even after adjustment for the health and functioning covariates; data not shown). It is possible that the more rural, agricultural/farming milieux of the Iowa cohort contributes to these differences, having a greater impact on men's patterns of socializing because of the stringent occupational and time demands associated with farming. Consistent with this latter possibility, the Iowa cohort had proportionately greater loss of social ties data for men who were reportedly too busy with their farming activities to participate fully as respondents in these EPESE studies. The loss of data for such individuals may have contributed to the weaker findings for social ties among Iowa men since healthier, more active men would tend to be under-represented, possibly biasing estimates of mortality rates upward. Indeed, data from the proxy interviews indicated that a greater proportion of the men with proxy interviews appeared to be "healthy" (i.e., were reported to have no disability or chronic conditions; 45 versus 12% among women with proxy interviews). Also, the 5-year mortality for these "healthy" male respondents with proxy interviews was lower than the overall mortality for men included in the social ties analyses (29 versus 40.9%) and quite comparable to that of similarly "healthy" men included in the analyses (26%). Overall, despite the nonsignificance of the association among the men in Iowa, the pattern of their survival curves was more like those of the New Haven men, showing a general decreasing trend for survival among men reporting fewer ties.

With respect to the question of whether social ties confer a protective effect, independent of possible associations with better health status and functional ability, our data suggest the answer is a qualified yes. Not surprisingly, social network size was positively correlated with better health status and functional ability; subjects reporting larger networks were also more likely to report better health and functional abilities. However, as seen in the multivariate models, the data indicate that social ties do contribute independently to longevity at older ages in women and, more selectively, for men. It is also worth noting that our analytic approach provides conservative estimates of the relationship between social network ties and mortality risks since many of the covariates included in the multivariate models may well represent intermediaries through which social ties also exert a protective effect (e.g., promoting better health and functioning which is in turn associated with reduced mortality risks).

With regard to the question of sex differences in the association between social ties and lower mortality risks, the data indicate that the associations are stronger and more consistent for women, with two of the three cohorts showing significant and larger independent effects relative to mortality risk. For men, only the New Haven cohort shows a significant association for the summary index independent of health status and functional ability. This pattern of results contrasts with the results of earlier studies in younger cohorts where significant associations for social ties were seen among men rather than women (9, 11, 14). This pattern of findings may reflect the relatively greater effect of prior mortality among the men, possibly selecting *out* those men at greatest "social" risk. Thus, when looking at men and women aged 65 or older, the women may represent a less "selected" group, one where the mortality risks associated with social isolation appear to have greater impact. The stronger effects observed for the women in our older cohorts (as compared with results from earlier studies including younger women) may also reflect the overall greater mortality in these older cohorts of women, resulting in greater numbers of deaths during follow-up. As seen in earlier studies of younger cohorts (9, 14), women's lower mortality risks resulted in fewer deaths among women. This may have contributed to greater instability in risk estimates associated with social ties (i.e., estimates with wider associated statistical confidence intervals and nonsignificant *P* values). It is also possible that the effects of social ties on women's mortality risks actually shift with age, with older women reaping relatively greater benefits from their social network than do younger women. Older women, for example, may be subject to fewer demands for child care or fewer conflicts from multiple roles associated with family and work. Such age-related shifts in the effects of social ties on women's health risks certainly merit further consideration.

The overall pattern of findings suggests that maintaining a network of social ties can contribute to lower mortality risk among those over 65 years old. However, these data also indicate that previous inconsistencies in findings from different studies may indeed reflect sociocultural differences between the various samples. Future research should consider further how age and sex may interact with sociocultural and other life-style characteristics to modify risk relationships between social network ties and mortality.

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APPENDIX Sex-specific baseline covariate risk factor distributions for East Boston, Iowa, and New Haven EPESE Cohorts

	East Boston[a]		Iowa[a]		New Haven[b]	
	Men	Women	Men	Women	Men	Women
1. Age ($\bar{x}$)	73.9	74.4	74.2	75.3	73.4	74.3
2. No. of chronic conditions ($\bar{x}$)	0.95	1.2	1.0	1.2	1.4	1.7
3. Pack-years of smoking ($\bar{x}$)	42.1	11.3	27.4	3.4	37.4	12.9
4. Body mass index ($\bar{x}$)	26.3	27.0	25.5	24.9	25.7	25.6
5. Angina (% yes)	6.3 (88)	7.3 (167)	7.6 (87)	4.6 (88)	5.4 (302) (59)	5.9 (580) (114)
6. Disability						
(a) Katz (% yes)	13.8 (199)	18.8 (441)	4.5 (52)	6.2 (121)	11.2 (620) (152)	14.1 (1384) (252)
(b) Rosow-Breslau						
0	59.2 (851)	45.3 (1061)	65.6 (756)	60.1 (1162)	67.0 (3696) (729)	54.0 (5269) (821)
1	23.4 (337)	24.2 (566)	21.6 (249)	20.9 (403)	19.6 (1078) (241)	21.6 (2102) (356)
2	10.2 (147)	15.5 (363)	9.5 (109)	11.6 (224)	7.7 (424) (95)	12.7 (1238) (228)
3	7.2 (103)	15.0 (351)	3.3 (38)	7.4 (143)	5.7 (314) (91)	11.7 (1140) (221)
(c) Nagi						
0	50.4 (697)	25.8 (582)	44.5 (513)	31.7 (613)	58.5 (3226) (629)	40.1 (3922) (609)
1	21.3 (294)	21.4 (483)	26.7 (308)	25.0 (483)	23.9 (1318) (285)	24.1 (2356) (377)
2	14.8 (205)	24.5 (552)	16.6 (191)	24.0 (464)	11.3 (623) (149)	19.7 (1931) (338)
3	9.0 (124)	17.8 (400)	7.8 (90)	11.3 (220)	3.6 (196) (59)	10.4 (1021) (203)
4	4.5 (62)	10.4 (235)	4.3 (50)	8.0 (156)	2.7 (149) (34)	5.6 (550) (103)
(d) Pfeiffer scores (no. of errors)						
(0–1) = good	70.0 (972)	69.3 (1572)	83.0 (952)	85.8 (1658)	77.9 (4227) (850)	74.9 (7285) (1173)
(2–3)	24.3 (337)	23.3 (529)	15.6 (179)	12.4 (240)	18.6 (1012) (235)	18.6 (1812) (335)
(4+) = poor	5.7 (80)	7.4 (168)	1.4 (16)	1.8 (35)	3.5 (188) (60)	6.4 (627) (118)

[a] Data for items 5 and 6 are percentages with *N* in parentheses.
[b] Data for items 5 and 6 are percentages with weighted *N* and unweighted *N* in parentheses, respectively.