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Social Network Diversity and Risks of Ischemic Heart Disease and Total Mortality: Findings from the Copenhagen City Heart Study

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Measures of various types of social contacts were used as predictors of ischemic heart disease events and total mortality in an age-stratified random sample of 9,573 adults enrolled in the Copenhagen City Heart Study (Copenhagen, Denmark). Baseline examinations were conducted in 1991–1994, and participants were followed until the end of 1997. Contacts with parents, children, family members, and friends were associated with better health. The presence of a spouse or partner was protective for men. Contacts with neighbors showed a trend toward a reversed pattern, and the effects of contacts with work colleagues and children differed by gender. Most types of contacts that occurred at least monthly were just as protective as those occurring more frequently. An index of intimate social contact diversity with family and friends had graded relations with both outcomes. Comparisons of persons reporting three or more types of contacts with those reporting fewer types yielded age- and gender-adjusted hazard ratios of 0.73 (95% confidence interval (CI): 0.64, 0.82) for mortality and 0.75 (95% CI: 0.61, 0.91) for ischemic heart disease. Comparable fully adjusted hazard ratios were 0.83 (95% CI: 0.73, 0.95) and 0.82 (95% CI: 0.67, 1.00). These data suggest that health benefits are derived from the diversity of social roles, especially those involving intimate relationships.

epidemiologic studies; heart diseases; mortality; myocardial ischemia; social support

Abbreviations: CI, confidence interval; HR, hazard ratio; IHD, ischemic heart disease.

A large number of prospective studies have examined the role of social networks in health (1). They have produced strong evidence that socially isolated persons are at elevated risk for cardiovascular disease and death. A number of network characteristics, such as network size, contact frequency, and type of social involvement, have been investigated. Most studies have aggregated data across the types of persons with whom the respondent has contact. One aspect of social networks that has received relatively little attention is the variety of relationships in the network. This has been termed "network diversity" (2) or "scope" (3). One study (3) demonstrated that network diversity was a predictor of lower mortality, and another found an association with susceptibility to the common cold (2). Neither examined components of the network individually. In the present investigation, we examined various sources of social contact both separately and in combination to evaluate their associations with mortality and cardiovascular outcomes.

One individual source of social contact that has received extensive attention is marital status. The predominant finding is that there is an interaction of marital status with gender. The presence of a spouse or partner seems to convey more health protection for men than it does for women (4, 5). This suggests that there may be gender differences in

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the impact of other aspects of the social network as well. Here, the evidence is not consistent, with some studies reporting no gender differences (6–8) and others reporting a greater protective effect for men (9, 10).

Another issue that has generated conflicting findings is whether the relation between social contacts and health risk takes the form of a threshold or a continuous relation. Some studies (9) have observed elevated risk for only the most isolated persons. Others have found graded associations between social network indicators and health outcomes (6, 10). With some exceptions (8), the form of the relation has not been explicitly tested.

This investigation utilized a large representative community sample to evaluate the potential impact of social contacts on the incidence of ischemic heart disease (IHD) and total mortality. It examined the individual contributions of family members (spouse, parents, children, other relatives) and acquaintances (friends, work colleagues, and neighbors) to the effect of the social network while controlling for established risk factors. The potential moderating role of gender and the form of the associations with the outcomes received special attention.

TABLE 1. Risk factor profile of the study sample, Copenhagen City Heart Study, 1991–1997

	Women (n = 5,336)	Men (n = 4,237)
Mean age (years)	58.2	56.5
Mean systolic blood pressure (mmHg)	137.3	140.4
Mean cholesterol level (mg/dl)		
Total cholesterol	243.2	230.1
High density lipoprotein cholesterol	66.5	53.4
Mean glucose level (mg/dl)	101.6	109.4
Smoking (%)	46.0	52.4
Mean body mass index*	25.2	26.1
Mean alcohol consumption (drinks/week)	5.8	13.8
Family history of ischemic heart disease (%)	21.3	18.1
Physical activity (%)		
Sedentary	12.2	12.5
Active	29.3	41.0
Self-reported good health (%)	78.6	76.3

* Weight (kg)/height (m)^2.

MATERIALS AND METHODS

Participants

The Copenhagen City Heart Study is an ongoing longitudinal study of an age-stratified random sample of adult residents of Copenhagen, Denmark (11). Examinations were conducted on 10,135 persons at the third study examination, in 1991–1994. The present analyses were based on the 9,573 participants in that examination who answered the social contact questionnaire and did not have missing data on key variables needed for the basic age- and gender-adjusted models. The final sample was composed of 5,336 women and 4,237 men aged 21–93 years, with a mean age of 57.5 years. All predictor variables were measured at baseline. Characteristics of the sample are presented in table 1.

Analysis strategy

Cox proportional hazards models were fitted with total mortality or IHD incidence as the outcome. Persons with evidence of prior IHD (n = 513) were excluded from the IHD analyses. For each category of social contact, the models compared persons who had little or no contact (coded as 0) with those who had at least monthly contact (coded as 1). Three sets of models were fitted for each indicator of social contact. The first controlled for age and gender. The second also included traditional risk factors as covariates. Indicators of potential behavioral and psychological mediators were added in the third set of models. Missing data resulted in the loss of approximately 450 people for the fully adjusted models, but this varied slightly across the analyses of different predictor variables.

Additional models tested for interactions of individual categories of social contact with gender and for the possibility that a more graded measure of contact frequency would provide additional predictive information to that provided by the binary indicator of presence or absence of contact. We performed the latter tests by comparing the model chi-squares of the basic binary models to 3-df models that used four levels of contact (described below) as categorical independent variables.

Finally, we constructed models with two summary diversity indices that combined information from the various categories of social contacts. One summed across all sources of contact and the other used only those types of contact that were indicative of probable intimate relationships.

Effect sizes were expressed in terms of hazard ratios and 95 percent confidence intervals. The relations observed between the covariates and the outcomes were essentially as expected.

Social contact measures

Individual sources of contact. The social network measure contained a subset of questions drawn from an instrument used in a previous study by Orth-Gomer and Johnson (7). Participants were asked to indicate how frequently they had contact with persons in the following categories: parents, children, other family members, a spouse or partner, colleagues from work (after work), neighbors, friends from youth, other friends, and home help. The home help category was omitted because few respondents said that they had home help and because the presence of home help is a likely indicator of disability (12, 13). The categories of friends from youth and other friends were combined for these analyses to simplify their

TABLE 2. Prevalence (%) of contact with sources of social support, Copenhagen City Heart Study, 1991–1997

Source	Frequency of contact				
	Daily	Weekly	Monthly	Rarely/ never	No one available
Parents	5.5	16.2	10.5	6.7	61.1
Children	28.9	27.3	12.3	5.8	25.7
Family	5.2	18.6	34.6	36.2	5.5
Colleagues	2.4	6.7	15.1	39.4	36.4
Neighbors	12.7	21.9	16.7	45.6	3.2
Friends	7.4	26.6	39.1	23.3	3.7

presentation. Specific modes of contact (e.g., telephone vs. face-to-face) were not measured separately.

Response options were "daily," "weekly," "monthly," "rarely," "never," and "no one available." For initial analyses of binary contact variables, the responses of "no one available," "rarely," and "never" were combined into a "no contact" category. Responses of "daily," "weekly," and "monthly" were grouped into one category indicating that contact was present. A spouse or partner was available for 57 percent of the respondents. Frequencies of other types of contact are presented in table 2.

Diversity indices. In addition to examining each type of contact, we formed diversity indices by summing responses across multiple classes of contacts. The computation summed the binary contact indicators described above. Results from the models were not substantially different when "no one available" responses were excluded from the calculation of the index.

One index was based on all contact sources and another used only those types of contacts pertaining to relationships that were likely to be intimate. Probable intimate relationships were defined as those with parents, children, family, and friends, while work colleagues and neighbors were not included. These choices were supported by the participants' reports of the people they considered to be confidants. Spouses and partners were named as confidants by 83 percent of those who had spouses or partners available. This was followed by 56 percent for children, 53 percent for friends, and 32 percent for other family members. In contrast, only 18 percent of persons with work colleagues named them as confidants. For neighbors, the rate was only 8 percent.

Risk factor covariates

In addition to age and gender, more completely adjusted models included covariates for a number of known risk indicators. Education was defined as a continuous variable based on number of years of schooling. Body mass index was calculated as weight (kg) divided by height squared (m^2). Family history of coronary disease was coded positive if the respondent reported the presence of heart disease in either parent. Systolic blood pressure was measured in a sedentary position after 5 minutes' rest. A London School of Hygiene and Tropical Medicine sphygmomanometer was used. Measures of glucose, high density lipoprotein cholesterol, and total cholesterol were obtained from nonfasting blood samples.

Potential mediators

In the third set of analyses, we also controlled for health behaviors and psychological factors that might be mediators of the effects of social contacts. Smoking was measured as a three-level variable (nonsmoker, ex-smoker, or current smoker). Alcohol consumption was also defined as a three-level variable separating nondrinkers, moderate drinkers (1–21 drinks per week), and heavy drinkers (>21 drinks per week). This was based on the sum of reported servings of beer, wine, and spirits. Physical activity in leisure time was measured in four categories of weekly activity: sedentary or light exercise for less than 2 hours, light activity for 2–4 hours, light activity for more than 4 hours or strenuous activity for 2–4 hours, and more than 4 hours of strenuous activity.

Self-rated health was also included as a covariate. This measure came from a rating scale with the categories "extremely good," "good," "not so well/feeling bad," and "terrible." This was treated as a four-level variable. It can be argued that self-rated health is an indicator of baseline physical health and should be considered a baseline confounder. However, measures of self-rated health are heavily influenced by psychological well-being (14, 15), which might be a product of social contacts. Therefore, it could also be classed as a potential mediator.

Endpoints

Participants were followed via the National Board of Health Registry and the National Hospital Discharge Registry for mortality and incident IHD until December 31, 1997. IHD was defined as *International Classification of Diseases*, Eighth Revision, codes 410–414 until January 1, 1994, and *International Classification of Diseases*, Tenth Revision, codes 121–125 thereafter. There were 1,089 deaths and 427 new cases of IHD during the follow-up period. These outcomes were evaluated in separate models. The mean duration of follow-up for living participants was 5.7 years, and duration ranged up to 7.2 years.

RESULTS

Categories of contacts and health outcomes

Table 3 summarizes the hazard ratios and 95 percent confidence intervals for each source of social contact. All sources of contact except neighbors and work colleagues were significantly associated with mortality and/or IHD in at least one of the models. The model for children was only marginally significant. Post hoc inspection of those data reveals that the trend is diluted by the relatively large number of people in the "no contact" category who do not have children but do have low incidences of events. If these persons are omitted from the no-contact category, the age- and gender-adjusted models for child contact become

TABLE 3. Hazard ratios associated with the main effects of frequency of contact with sources of social support (at least monthly vs. rarely/never), Copenhagen City Heart Study, 1991–1997

Source	Model					
	Age and gender adjusted		Risk-factor adjusted*		Full model†	
	HR‡	95% CI‡	HR	95% CI	HR	95% CI
			Mortality			
Parents	0.74	0.58, 0.95	0.74	0.57, 0.96	0.82	0.63, 1.05
Children	0.89	0.78, 1.01	0.90	0.79, 1.03	0.95	0.83, 1.09
Family	0.81	0.71, 0.91	0.82	0.73, 0.93	0.89	0.78, 1.01
Colleagues	0.97	0.81, 1.16	1.01	0.85, 1.21	1.06	0.89, 1.27
Neighbors	1.01	0.90, 1.14	1.04	0.92, 1.17	1.09	0.96, 1.23
Friends	0.84	0.74, 0.95	0.86	0.76, 0.98	0.95	0.91, 1.08
Spouse/partner	0.81	0.72, 0.92	0.85	0.75, 0.97	0.91	0.81, 1.05
			Ischemic heart disease			
Parents	0.48	0.32, 0.73	0.58	0.39, 0.88	0.63	0.42, 0.95
Children	0.83	0.68, 1.01	0.81	0.66, 1.00	0.85	0.89, 1.04
Family	0.79	0.65, 0.96	0.79	0.65, 0.96	0.83	0.68, 1.01
Colleagues	1.00	0.76, 1.30	1.07	0.82, 1.41	1.09	0.83, 1.43
Neighbors	1.10	0.91, 1.34	1.13	0.93, 1.37	1.15	0.95, 1.40
Friends	0.83	0.68, 1.02	0.86	0.70, 1.05	0.91	0.74, 1.12
Spouse/partner	0.96	0.79, 1.18	0.96	0.78, 1.17	0.99	0.80, 1.22

* Adjusted for age, gender, education, body mass index, family history of coronary disease, systolic blood pressure, glucose, high density lipoprotein cholesterol, and total cholesterol.

† Additionally adjusted for smoking, alcohol consumption, physical activity, and self-rated health.

‡ HR, hazard ratio; CI, confidence interval.

clearly significant, with hazard ratios of 0.72 (95 percent confidence interval (CI): 0.59, 0.88) for mortality and 0.59 (95 percent CI: 0.32, 0.86) for IHD.

Interactions with gender

There was a significant gender × contact interaction for the category of spouse/partner ($p < 0.001$) after adjustment for age. As expected on the basis of previous literature (4, 5), the presence of a partner was associated with a lower mortality hazard ratio for men (hazard ratio (HR) = 0.70, 95 percent CI: 0.60, 0.82) than for women (HR = 1.06, 95 percent CI: 0.86, 1.29). The hazard ratios in the fully adjusted models were 0.84 (95 percent CI: 0.71, 0.99) for men and 1.09 (95 percent CI: 0.89, 1.34) for women. Similar but weaker results were observed for the IHD outcome. The hazard ratio for men was 0.79 (95 percent CI: 0.61, 1.03), while a trend in the opposite direction was observed for women (HR = 1.29, 95 percent CI: 0.96, 1.74). Effects were not significant for either gender after full adjustment. Hazard ratios were 0.83 (95 percent CI: 0.66, 1.14) for men and 1.25 (95 percent CI: 0.83, 1.72) for women.

Another interaction observed in the age- and gender-adjusted models was an interaction for work colleagues. Although there were no main effects for this category and no significant interaction for mortality, there was a gender interaction for IHD ($p < 0.003$). This was based on a trend toward lower risk with more frequent contact in women (HR = 0.56, 95 percent CI: 0.34, 0.93) but an opposite trend in men (HR = 1.37, 95 percent CI: 0.99, 1.90). The interactions were somewhat more apparent if persons with no available colleagues were omitted from the analysis. In those models, the interaction for mortality ($p < 0.02$) was based on hazard ratios of 0.76 (95 percent CI: 0.55, 1.05) for women and 1.21 (95 percent CI: 0.95, 1.54) for men. For IHD, the interaction had a p value of 0.001, with hazard ratios of 0.51 (95 percent CI: 0.30, 0.87) for women and 1.41 (95 percent CI: 0.99, 2.02) for men.

Finally, there was a weak interaction between gender and contact with children ($p = 0.04$) for mortality when results were adjusted for age. This model showed a tendency for contact with children to be more beneficial for men (HR = 0.80, 95 percent CI: 0.67, 0.94) than for women (HR = 1.06, 95 percent CI: 0.87, 1.31). This interaction was not significant if persons with no children available were omitted, as they were in the analyses described above.

Continuity of effects across the range of contact frequencies

For each contact source and outcome, models using a dichotomous indicator of contact frequency (rarely/never

TABLE 4. Hazard ratios for each level of contact with sources of social support in models with significant nonbinary effects, Copenhagen City Heart Study, 1991–1997*

Source	Outcome	Frequency of contact						
		Daily		Weekly		Monthly		Rarely/never (referent)
		HR†	95% CI†	HR	95% CI	HR	95% CI	
Parents	Ischemic heart disease	0.15	0.03, 0.64	0.43	0.33, 0.86	0.71	0.36, 1.41	1.0
Neighbors	Mortality	1.19	1.00, 1.41	1.06	0.91, 1.24	0.85	0.69, 1.03	1.0
Friends	Mortality	1.12	0.88, 1.43	0.91	0.77, 1.08	0.77	0.66, 0.90	1.0

* All models included adjustment for age and gender.
† HR, hazard ratio; CI, confidence interval.

vs. at least monthly) were compared with models containing four categorical levels of contact frequency. Tests were based on comparisons of the log likelihoods of the binary and multilevel age- and gender-adjusted models. The addition of graded indicators of contact frequency did not improve the predictions of most of the binary models. Only three of the 12 models showed a significantly better fit than the corresponding binary models. Trends for these effects are presented in table 4. No such analysis was possible for the spouse/partner variable, because it was only measured dichotomously.

The association between frequency of parental contact and IHD incidence was stronger in the four-level model than in the binary model ($p = 0.03$). The effect showed a graded relation with contact frequency.

The neighbor contact indicator was also significantly improved in its association with mortality when the four levels were considered ($p = 0.01$), but the form of the association appears to be opposite of that expected. There was a trend for more frequent contact to be associated with higher mortality, but the effect was not strong. The hazard ratio for the daily contact indicator approached statistical

TABLE 5. Hazard ratios for the index of contacts across all sources of social support, Copenhagen City Heart Study, 1991–1997

Contact diversity index score	Model					
	Age and gender adjusted		Risk-factor adjusted*		Full model†	
	HR‡	95% CI‡	HR	95% CI	HR	95% CI
Mortality						
6–7	0.57	0.37, 0.87	0.60	0.38, 0.94	0.81	0.51, 1.27
5	0.67	0.53, 0.87	0.73	0.56, 0.94	0.90	0.70, 1.17
4	0.75	0.62, 0.92	0.82	0.67, 1.01	0.99	0.80, 1.23
3	0.66	0.54, 0.80	0.68	0.56, 0.84	0.78	0.64, 0.96
2	0.86	0.71, 1.04	0.90	0.73, 1.09	0.98	0.80, 1.20
0–1	1.00		1.00		1.00	
Linearity *p* value	<0.001		0.01		0.37	
Ischemic heart disease						
6–7	0.49	0.24, 1.01	0.56	0.22, 1.14	0.67	0.33, 1.39
5	0.89	0.61, 1.29	0.87	0.59, 1.29	0.98	0.66, 1.45
4	0.65	0.45, 0.91	0.67	0.47, 0.94	0.74	0.52, 1.05
3	0.85	0.63, 1.16	0.83	0.60, 1.13	0.89	0.65, 1.23
2	0.83	0.61, 1.15	0.83	0.60, 1.15	0.86	0.62, 1.20
0–1	1.00		1.00		1.00	
Linearity *p* value	0.06		0.12		0.36	

* Adjusted for age, gender, education, body mass index, family history of coronary disease, systolic blood pressure, glucose, high density lipoprotein cholesterol, and total cholesterol.
† Additionally adjusted for smoking, alcohol consumption, physical activity, and self-rated health.
‡ HR, hazard ratio; CI, confidence interval.

TABLE 6. Hazard ratios for the index of contacts with intimate sources of social support, Copenhagen City Heart Study, 1991–1997

Contact diversity index score	Model					
	Age and gender adjusted		Risk-factor adjusted*		Full model†	
	HR‡	95% CI‡	HR	95% CI	HR	95% CI
			Mortality			
5	0.28	0.16, 0.51	0.32	0.17, 0.59	0.46	0.25, 0.85
4	0.53	0.39, 0.70	0.59	0.43, 0.79	0.79	0.58, 1.08
3	0.47	0.36, 0.62	0.53	0.39, 0.70	0.66	0.49, 0.89
2	0.62	0.47, 0.81	0.66	0.52, 0.91	0.82	0.61, 1.09
1	0.68	0.51, 0.90	0.74	0.55, 1.00	0.84	0.62, 1.13
0	1.00		1.00		1.00	
Linearity *p* value	<0.001		<0.001		0.01	
			Ischemic heart disease			
5	0.24	0.09, 0.65	0.31	0.11, 0.83	0.39	0.14, 1.06
4	0.59	0.36, 0.96	0.62	0.37, 1.03	0.75	0.44, 1.26
3	0.59	0.37, 0.93	0.64	0.40, 1.05	0.75	0.46, 1.22
2	0.75	0.48, 1.17	0.79	0.49, 1.28	0.88	0.54, 1.43
1	0.76	0.47, 1.24	0.85	0.51, 1.42	0.93	0.55, 1.55
0	1.00		1.00		1.00	
Linearity *p* value	0.002		0.007		0.04	

* Adjusted for age, gender, education, body mass index, family history of coronary disease, systolic blood pressure, glucose, high density lipoprotein cholesterol, and total cholesterol.

† Additionally adjusted for smoking, alcohol consumption, physical activity, and self-rated health.

‡ HR, hazard ratio; CI, confidence interval.

significance, showing elevated risk for persons with that response. A potential explanation for this trend is that persons who are disabled or in poor health may have neighbors who monitor their well-being frequently. This speculation receives some support from the observation that more participants who reported daily contact rated their health during the last year as ''fair or poor'' as compared with those who saw neighbors weekly or monthly (30.2 percent vs. 25.4 percent; $p = 0.001$).

The pattern of significant associations in the multi-category model of friend contact and mortality ($p = 0.005$) was difficult to interpret. Occasional (monthly) contact with friends was associated with lower mortality risk, but more frequent contacts were not. As with the neighbor contact variable, persons who had daily contact with friends were more likely to report fair or poor health than persons in the weekly or monthly contact category (30.7 percent vs. 24.6 percent; $p = 0.001$). In summary, findings regarding both neighbors and friends suggest a U-shaped function, with some contact being better than none but daily contact perhaps being indicative of poor health.

Summary indices of social network diversity

We calculated one diversity index by summing the presence of contacts across all sources. The mean score on the scale was 3.6 (of a possible score of 7), with 7.5 percent of participants reporting one contact or no contacts and 9.9 percent reporting six or more sources of contact. Results from models using this index are presented in table 5. This index was related to mortality but not to IHD in age- and gender-adjusted models. There was no significant linear trend for either outcome in fully adjusted models. The hazard ratios for persons with five or more sources of contact as compared with two or fewer sources (approximately the top quartile vs. the bottom quartile) were 0.72 (95 percent CI: 0.59, 0.88) for mortality and 0.90 (95 percent CI: 0.66, 1.22) for IHD. Results were weaker in fully adjusted models. The effects of the index were not significant in either the mortality model (HR = 0.89, 95 percent CI: 0.73, 1.10) or the IHD model (HR = 1.01, 95 percent CI: 0.74, 1.39).

Stronger findings were obtained when the index was based on intimate relationships (table 6). The mean score on this index was 2.9 (of a possible score of 5), with 195 (2 percent) of the participants reporting no contacts and 799 (8 percent) reporting contacts in all categories. Except for the fully adjusted IHD model, the results clearly showed protective effects of multiple intimate contacts. A graded relation (evaluated with a chi-square test of linearity) was apparent, indicating that contacts with various sources were additive in their associations with health outcomes. Except for the full model with the IHD outcome, adjustments had only modest effects on the results, and there was evidence of linear trends in all models. In age- and gender-adjusted models, persons with three or more types of intimate contacts (62 percent of the sample) had hazard ratios of 0.73 (95 percent CI: 0.64, 0.82) for mortality and 0.75 (95 percent CI: 0.61, 0.91) for IHD in comparison with persons with less diversity. The corresponding hazard ratios from the fully adjusted model were 0.83 (95 percent CI: 0.73, 0.95) for mortality and 0.82 (95 percent CI: 0.67, 1.00) for IHD.

DISCUSSION

In this study, an index of diversity among intimate social contacts was found to have graded relations with both mortality and IHD incidence in a large representative community sample. This finding remained after results were controlled for an extensive battery of traditional risk factors and baseline health indicators. We emphasize that this index differs from most other social network measures, which are based on contact frequency rather than diversity.

Although there have been theoretical debates in the past about whether multiple social roles should be beneficial or detrimental to health (16), this finding and other findings (2, 3) suggest that a greater variety of intimate social contacts is associated with better health. It has been proposed that this could be due to feelings of self-worth and purpose associated with multiple roles that are translated into more positive affective experiences (16). These, in turn, could have beneficial physiologic consequences.

Of the seven types of social contact investigated, all but those with neighbors and work colleagues were associated as main effects with subsequent health. This argues for the special importance of intimate social ties such as those provided by a spouse (at least for men), friends, and family. However, this issue was not fully investigated in this study, because contacts with clubs and religious organizations were not measured. Those types of contacts have often been included in network measures used in previous studies.

With the exception of parents, contacts that occurred at least monthly were as strongly associated with favorable outcomes as those that were more numerous. This adds weight to the argument that the fulfillment of social roles is the critical psychosocial factor, even if those duties are performed only occasionally. This supports the notion that the diversity of social contacts rather than the frequency of contacts is important. However, this conclusion might not apply to persons who are severely isolated, who may have been underrepresented in this sample.

These data confirm previous findings that the presence of a spouse or partner has a greater health impact for men than for women (4, 5). However, the importance of other aspects of the social network appeared to be similar for both genders. One exception was a tendency for contact with work colleagues to be more beneficial for women. While speculative, it is possible that this reflects more affiliative relationships among women in the workplace. The reason why contacts with children were more beneficial for men than for women is not immediately apparent.

A variety of plausible mechanisms have been proposed as potential explanations for the health consequences of social participation (1). Both animal and human studies have documented that socially isolated individuals have heightened cardiovascular reactivity, which has been linked to atherosclerosis (17, 18). Some studies have reported associations between social isolation and neuroendocrine output (19, 20). In addition, there are studies suggesting that relatively isolated individuals have impaired immune system functioning (21, 22). Physiologic correlates of social network diversity should also be investigated.

In summary, these findings illustrate the significance of social ties for health and argue for the notion that the variety of social roles fulfilled, especially roles involving family and friends, is a key factor in this phenomenon. Further efforts to more precisely identify the aspects of social networks that carry the most health impact should help in evaluating the mechanisms responsible for their effects.

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