

# Social Functioning and Overall Mortality: Prospective Evidence from the Kuopio Ischemic Heart Disease Risk Factor Study

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We studied the associations between 11 scales of social functioning and risk of death over an average follow-up time of 71 months in 42- to 60-year-old men in the Kuopio Ischemic Heart Disease Risk Factor Study. In age-adjusted analyses, men were at increased risk of death if they reported few persons to whom they gave or received social support, nonparticipation in organizations, low quality of social relationships, a small number of friends, or not currently being married. Frequency of interaction, shyness, and use of emotional support when troubled were not associated with risk

of death; the use of instrumental support when troubled was associated with increased risk. There was little evidence of confounding of these associations by the presence of 31 chronic or acute conditions, perceived health status, or six risk factors. Consistent associations were found in a healthy subgroup. These data add to the growing body of literature linking mortality risk with social functioning, especially in relation to organizational participation and quality of relationships. (Epidemiology 1994;5:495-500)

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A substantial body of epidemiologic evidence indicates an inverse association between the amount of social interaction in which an individual engages and the risk of death from all causes, cardiovascular disease, and cancer.<sup>1-15</sup> There are also indications that aspects of social interaction may be associated with various morbidities and survival from cardiovascular disease, and that changes in social activity are prospectively associated with risk of death.<sup>8,13,16</sup> Although the cumulative evidence regarding these associations is impressive, there are many unanswered questions concerning the nature of the association. For example, the critical

health-related aspects of social relationships are not known, there have been inconsistencies in findings for particular groups or people in particular geographic locations, and the underlying biologic and physiologic mechanisms that could account for these associations are unknown.

The present study addresses the first of these issues. Although it is widely recognized that the social connections between people can be described along many dimensions, most epidemiologic studies, with a few exceptions,<sup>4,8,10</sup> have focused only on the "structural" features of such connections, including features such as the size, scope, density, and reciprocity of relationships.<sup>17</sup> Other aspects of social connections such as global measures of social support, measures of specific functions provided by social support, or measures of the "functional" aspects of social connections have not been examined in population-based studies, although there is reason to think that they might be important.<sup>10</sup>

The present study examines the associations between a variety of structural and functional measures of social connections and risk of death from all causes for participants in the Kuopio Ischemic Heart Disease Risk Factor Study, a population-based study of 42- to 60-year-old men in eastern Finland. The Kuopio study is specifically designed to investigate previously unestablished but promising risk factors for ischemic heart

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disease and extracoronary atherosclerosis. As such, it includes a large number of questions and scales relevant to both functional and structural aspects of social connections.

## Methods

### STUDY POPULATION

The Kuopio study examined two cohorts of men, randomly selected from the Kuopio region in eastern Finland. There were 1,166 54-year-old men in the first cohort, out of a possible eligible sample of 1,399 (83.3%). There were 1,516 42-, 48-, 54-, and 60-year-old men in the second cohort, out of a total of 1,836 eligible (82.6%). The total sample numbered 2,682, and the present analysis is based on totals of respondents ranging from 2,354 to 2,503 who had no missing values on the outcome, individual social functioning indices, or covariates.

### OUTCOME

All-cause mortality was ascertained by linkage to the national death registry. All deaths that occurred between entry into the study and December 31, 1992, were included ( $N = 167$ ), for an average follow-up time of 71 months.

### SOCIAL CONNECTIONS SCALES

There is no gold standard for the measurement of social connections, with a plethora of scales being used in different studies.<sup>18,19</sup> In the Kuopio study, a number of existing scales, items from existing scales, and new items were selected in order to tap various aspects of social connections. Many of the items are equivalent in meaning, if not exact wording, to those used in other studies that have examined the association between measures of social connections and risk of death. Items originally in English were translated into Finnish by consensus among several speakers fluent in both languages and were back-translated to assure equivalency of meaning. Items that were idiomatic were excluded. There were 69 items related to extent, quality, or satisfaction with social connections, marital status, religious practices, and shyness.

All responses to questions were recoded, so the highest numeric value indicated the highest level of "social integration," and the lowest value indicated the lowest level of "social integration." Responses to all questions were standardized to have a range of 0 to 10. Because many of the questions measure similar or overlapping constructs, we used exploratory factor analysis to suggest groupings of items into relatively homogeneous scales. Principal components analysis

with a varimax rotation was applied to a correlation matrix of all items and was used to suggest scales, based on factor loadings and content.

Scale scores were based on the sum of standardized individual items. If half or more of the items were missing, the scale value was considered missing for that individual; otherwise, the scale score was weighted proportionally to the number of items available. Questions were also included concerning marital status and degree of religiosity. A scale based on a factor that seems to measure shyness or introversion was examined to test the possibility that personality-like dispositions toward social situations might be important.

For the purpose of analyses, scales were divided into quartiles, except where distributions suggested trichotomous or dichotomous divisions. For the scale that measured participation and leadership role in social organizations, those who reported no such activities were retained in one category, and the remaining distribution was divided into tertiles.

### COVARIATES

#### *Health Status*

At the baseline examination, the Kuopio study participants provided information about their medical history, and a medical examination was carried out. For the current analyses, we considered reported diagnoses of 31 chronic or acute conditions and self-reported health in the analyses.

#### *Risk Factors*

We categorized smoking status as never, former, or current. We measured alcohol intake in grams per week based on 1-year recall using the Nordic Alcohol Consumption Inventory.<sup>20</sup> Coffee consumption in grams per day was assessed by a 4-day diary. A combined index of leisure-time physical activity and physical activity at work was utilized.<sup>21</sup> We calculated body mass index as weight in kilograms divided by height in meters squared. Lipoprotein separations were carried out from unfrozen plasma samples using standard methods.<sup>22</sup> Income level was based on reported personal income over the past 12 months.

### STATISTICAL ANALYSIS

The association between social connections scales and risk of death from all causes was assessed using the Cox proportional hazards model.<sup>23</sup> We fit age-adjusted models for each scale, represented by a series of categorical variables, with the presumed lowest risk group as the reference category. Next, we fit separate models in which income, chronic and acute conditions, or risk

factors were separately included. To determine whether health conditions were potential confounders, we examined the association between the disease/condition and all-cause mortality in age-adjusted models that included each scale. If the relative hazard (highest vs lowest risk group) for that scale was reduced by 10% or more by inclusion of the health problem, we retained it as a potential confounder in subsequent analyses. Only three of the 31 health problems met this criterion (perceived health, history of myocardial infarction, and history of diagnosis of angina pectoris). Additional analyses restricted the sample to those who did not report a history of diagnosis of angina pectoris or myocardial infarction, and who did not rate their health as "quite bad" or "very bad."

## Results

### SCALES

Ten scales were developed, which were labeled based on content. A score reflecting the total amount of support given and received ("Total Social Support") was also developed by adding the "Receive Social Support" and the "Give Social Support" scales. The titles, means, standard deviations, and Chronbach's  $\alpha$  for these 11 scales are given in Table 1, and the items for each scale are available from the corresponding author.

For the most part, the correlations between the scales are low. Excluding correlations between scales that have some overlap in items, there were only three correlation coefficients  $\geq 0.4$ . Having a larger number of friends was associated with giving and receiving more support ( $r = 0.45$  and  $0.44$ , respectively). Receiving and giving social support were highly correlated ( $r = 0.76$ ).

TABLE 1. Means, Standard Deviations, and Internal Reliability (Chronbach's  $\alpha$ ) of Scales

Scale (Number of Items)	Mean	Standard Deviation	$\alpha$
1 Shyness (17)	6.9	2.0	0.79
2 Receive Social Support (3)	4.8	2.6	0.76
3 Give Social Support (3)	5.0	2.6	0.76
4 Total Social Support (6)	4.9	2.4	0.87
5 Organizational Participation (6)	2.9	2.7	0.82
6 Quality of Relationships (8)	7.1	1.3	0.74
7 Satisfaction with Support (4)	8.9	2.2	0.67
8 Seek Emotional Support When Troubled (2)	7.3	3.0	0.24
9 Seek Instrumental Support When Troubled (3)	8.9	2.3	0.57
10 Frequency of Interaction (5)	4.2	2.1	0.59
11 Number of Friends (3)	5.0	2.4	0.59

### AGE-ADJUSTED MODELS

During the follow-up period, there were 167 deaths, with a mean time to death of 42.1 months. Table 2 presents the results of the Cox proportional hazards analyses for each scale. The strongest age-adjusted associations were seen for the scales that measured participation in organizations, quality of relationships, total social support given and received, as well as being divorced or widowed. Those who were in the bottom category with respect to membership and participation in organizations were at 2.1 times (95% confidence interval (CI) = 1.25-3.66) the risk of death compared with those who were in the top category, and the relative risk decreased with increasing amounts of participation.

Those who viewed the quality of their relationships as inadequate were also at increased risk. Those in the bottom quartile on this scale were at 1.83 times (95% CI = 1.14-3.55) the risk of death compared with those in the top quartile. Again, there was a gradient, with higher quartiles evincing lower relative risks.

The number of people one has available to give or receive support and the sum of these two were also associated with risk of death. The relative hazards associated with giving or receiving little social support were approximately the same (relative hazard = 1.46, 95% CI = 0.91-2.36; relative hazard = 1.64, 95% CI = 1.03-2.60, respectively) and did not appear to be additive, as those in the lowest quartile of the "Total Social Support" scale were also at roughly the same level of increased risk (relative hazard = 1.75, 95% CI = 1.09-2.81).

Consistent with findings in other studies of men, being married seemed to be protective. Those who were never married or who were divorced or separated had increased risk of death compared with those who were currently married (relative hazard = 1.62, 95% CI = 0.93-2.82; relative hazard = 1.98, 95% CI = 1.21-3.26, respectively).

Not seeking instrumental support, for example, seeking concrete help, in situations that felt difficult or worrisome was associated with *decreased* risk relative to those who indicated that they did seek help (relative hazard = 0.68, 95% CI = 0.44-1.05). Not seeking emotional support for such situations was not associated with increased or decreased risk (relative hazard = 0.99, 95% CI = 0.80-1.56).

There was no important association for the scales related to shyness, frequency of interaction with friends, satisfaction with support, and religious orientation.

A final age-adjusted model included the "Organiza-

TABLE 2. Association between Social Scales and Risk of Death with Adjustment for Covariates

Scale	Number of Respondents*	Adjusted for:							
		Age		Age + Disease		Age + Risk Factors		Age + Income	
		RH <sup>†</sup>	95% CI	RH	95% CI	RH	95% CI	RH	95% CI
Shyness <sup>‡</sup>	2,464	1.07	0.67-1.72	0.98	0.61-1.58	1.01	0.63-1.63	1.01	0.63-1.62
Availability of Social Support <sup>‡</sup>	2,478	1.64	1.03-2.60	1.58	0.99-2.51	1.64	1.03-2.61	1.47	0.92-2.33
Give Social Support <sup>‡</sup>	2,436	1.46	0.91-2.36	1.44	0.89-2.33	1.47	0.91-2.37	1.27	0.78-2.05
Total Social Support (2 + 3) <sup>‡</sup>	2,455	1.75	1.09-2.81	1.71	1.06-2.74	1.76	1.09-2.82	1.55	0.96-2.48
Organizational Participation <sup>§</sup>	2,494	2.14	1.25-3.66	1.80	1.04-3.09	1.79	1.03-3.08	1.51	0.87-2.64
Quality of Relationships <sup>‡</sup>	2,473	1.83	1.14-2.92	1.60	1.00-2.58	1.61	1.00-2.58	1.66	1.04-2.66
Satisfaction with Support <sup>  </sup>	2,494	1.19	0.83-1.71	1.05	0.73-1.51	1.24	0.86-1.78	1.15	0.80-1.66
Seek Emotional Support When Troubled <sup>  </sup>	2,354	1.12	0.80-1.56	1.12	0.80-1.57	1.09	0.78-1.53	1.12	0.80-1.57
Seek Instrumental Support When Troubled <sup>  </sup>	2,410	0.68	0.44-1.05	0.68	0.44-1.06	0.62	0.40-0.96	0.66	0.43-1.03
Frequency of Interaction <sup>‡</sup>	2,501	0.89	0.57-1.39	0.91	0.58-1.43	1.17	0.73-1.87	0.85	0.54-1.34
Number of Friends <sup>‡</sup>	2,497	1.51	0.95-2.38	1.50	0.95-2.37	1.47	0.93-2.33	1.57	1.00-2.48
Marital Status <sup>¶</sup>	2,503								
Never married		1.62	0.93-2.82	1.68	0.96-2.92	1.58	0.90-2.77	1.19	0.67-2.10
Divorced/widowed		1.98	1.21-3.26	1.77	1.08-2.92	1.61	0.97-2.66	1.77	1.07-2.91
Religiosity <sup>**</sup>	2,499								
Belong but don't believe		1.55	0.63-3.78	1.48	0.60-3.61	1.19	0.48-2.95	1.42	0.58-3.49
Don't belong or atheist		2.10	0.80-5.51	1.98	0.75-5.21	1.44	0.54-3.85	1.84	0.70-4.84

\* Number of respondents is constant across rows.

<sup>†</sup> Relative hazard.

<sup>‡</sup> Lowest quartile compared with highest quartile.

<sup>§</sup> No participation compared with highest tertile of participation.

<sup>||</sup> Below median compared with above median.

<sup>¶</sup> Compared with currently married.

<sup>\*\*</sup> Compared with belong and practice.

tional Participation," "Total Social Support," and "Quality of Relationships" scales, as well as marital status. Although there was some reduction in the strength of the associations and loss of precision, reflecting a degree of co-linearity, the "Organizational Participation," "Quality of Relationships," and "Total Social Support" scales were still associated with risk of death, as was being divorced or widowed. Those who reported no participation in organizations were at 1.75-fold increased risk (95% CI = 0.98-3.12). Similarly, those who ranked in the lowest quartile on the "Quality of Relationships" scale were at 1.54-fold increased risk of death (95% CI = 0.94-2.54). Divorced or widowed persons continued to be at increased risk (relative hazard<sub>divorced/widowed vs current</sub> = 1.86, 95% CI = 1.12-3.08).

#### EFFECT OF ADJUSTMENT FOR COVARIATES

The "Social Organizations" scale was the only scale for which there was substantial evidence for confounding by the three health conditions (Table 2). The increased risk associated with nonparticipation in organizations was reduced by 16%, indicating that there was a higher proportion of illness among those who reported no

participation in social organizations. Adjustment for risk factors also reduced the increased relative risk associated with nonparticipation in social organizations by approximately the same amount.

Although there was some decrease in the precision of estimation of the associations between other scales and risk of death with adjustment for risk factors, inspection of Table 2 indicates that the magnitudes of these associations were not importantly altered by adjustment for these risk factors.

There was considerable confounding due to income level for several of the scales. With adjustment for income, the increased risk associated with nonparticipation in social organizations, compared with the top tertile of participation, was reduced by 29%; and the increased risk associated with never being married was reduced by 26%.

#### ANALYSES IN THE "HEALTHIER" SUBSAMPLE

Less than half of the deaths occurred among the approximately two-thirds of the Kuopio study participants who reported at baseline that their health was average or better and who had no history of myocardial infarction or angina pectoris. The magnitudes of the

associations were generally consistent in this subpopulation, but the estimates were less precise. Those who indicated low relationship quality were at almost three-fold increased risk (relative hazard = 2.90, 95% CI = 1.34-6.26). With adjustment for risk factors and for income, this association was reduced to 2.64 (95% CI = 1.21-5.77) and 2.68 (95% CI = 1.23-5.82), respectively. In addition, those who reported no organizational participation were at 2.27 times (95% CI = 1.05-4.91) the risk of death; the magnitude of the association was substantially reduced by adjustment for income (-26%), but not by adjustment for risk factors (-10%). The association for "Availability of Social Support" was increased in this subgroup. Those who ranked in the bottom tertile in terms of the number of persons who provide social support to them were at over twice (relative hazard = 2.1, 95% CI = 1.06-4.33) the risk of death, and there was little evidence for confounding from risk factors or income. There was no longer an increased risk associated with the use of instrumental social support when troubled (relative hazard = 1.02, 95% CI = 0.58-1.80). Other associations were not markedly different in this subgroup of healthier persons.

## Discussion

As in previous studies, nonparticipation in organizations, number of friends, and unmarried status were associated with increased risk of death. In addition, dimensions of social functioning related to the number of persons with whom one is potentially involved in supportive relationships, and the quality of those relationships, were related to risk of death. Although these aspects of social functioning have been thought to be important determinants of health status, there have been very few epidemiologic data with which to assess their significance. The present results indicate that quality of relationships may be of particular significance.

It is likely that health status influences many aspects of social functioning. Nevertheless, the present results, as well as our previous analyses of a different Finnish cohort,<sup>6</sup> do not support the possibility that social functioning is a proxy for health status. Neither an extensive examination of potential health status confounders nor an analysis of a healthier subgroup indicated any evidence for this possibility. In fact, the associations tended to be stronger in the healthier subsample. For example, the relative hazard for low compared with high levels on the "Quality of Relationships" scale was almost three times greater among the healthier group.

With a few exceptions,<sup>24</sup> studies of the association between measures of social connections and risk of death have not tended to report in any detail on the confounding role of socioeconomic level. In the present study, however, there is considerable confounding related to income level, particularly with respect to the "Organizational Participation" scale and marital status. These results are consistent with a view that socioeconomic factors may be both causal, antecedent variables as well as mediating variables.

Although the present analyses are generally consistent with previous research and speculation, there were two surprising results. In several analyses,<sup>3,5-7,13,14</sup> including one involving a Finnish cohort from eastern Finland,<sup>6</sup> measures of frequency of interaction with others were associated with risk of death. In the present study, however, a very similar measure was not associated with risk of death. Examination of age-adjusted proportional hazard analyses (not shown) for each of the items on this scale did not indicate that the scale construction was masking any otherwise important associations between individual items and risk of death. Analyses (not shown) of the Finnish data used in the study by Kaplan *et al*<sup>6</sup> indicated that similar questions were all associated with risk of death from all causes. Given that the age range, length of follow-up, and geographic location of participants in the previous study and the present study were similar, it is surprising that the results with respect to this question are discrepant. The only major difference between these two eastern Finnish studies is that the measurement of social activities was done in 1972 and 1977 in our previous study<sup>6</sup> and between 1984 and 1989 in the present study. Thus, the health effects of social activity or other unmeasured aspects related to social activity may have changed over time in eastern Finland. Although the results for other measures are similar in the two studies, we are unable to detect any reasons for these discrepancies.

It is also surprising that the use of instrumental support during times of trouble would be associated with increased risk of death. It may be that the use of instrumental support is closely related to the health-related need for such support. The fact that this association was substantially reduced in the analyses of the healthier subgroup lends some support to this view.

Although the current results lend further weight to the evidence that social factors are of public health significance, they do not clarify the biologic mechanisms that are the interface between the social and biologic worlds.<sup>25</sup> Further work currently under way

as part of the Kuopio Ischemic Heart Disease Risk Factor Study is directed at understanding the role of both atherosclerotic and non-atherosclerotic pathways in explaining the associations between measures of social functioning, such as those used in this study, and the development and progression of cardiovascular disease.

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