Lack of Social Support and Incidence of Coronary Heart Disease in Middle-Aged Swedish Men

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Lack of social support has been found to predict all causes of mortality in population studies. It has often been assumed that the lack of social ties is associated with the general social conditions related to mortality and has little to do with specific disease etiology. So far, the association between lack of support and cardiovascular disease incidence has not been demonstrated.

We have measured both emotional support from very close persons ("attachment") and the support provided by the extended network ("social integration"). This measure was applied along with standard measures of traditional risk factors to a random sample of 50-year-old men born in Gothenborg in 1933. All men ($n = 736$) were followed for 6 years and the incidence of myocardial infarction and death from coronary heart disease (CHD) was determined.

Both "attachment" and "social integration" were lower in men who contracted CHD, with a significant effect for social integration ($p = 0.04$) and an almost significant effect for attachment ($p = 0.07$). When controlling for other risk factors in multiple logistic regression analyses, both factors remained as significant predictors of new CHD events. Smoking and lack of social support were the two leading risk factors for CHD in these middle-aged men.

Key words: coronary heart disease; social support; smoking; lipids.

INTRODUCTION

Research on social support has convincingly demonstrated an association between weak social networks and adverse health outcomes. Several prospective population studies have shown an increased mortality from all causes in subjects with few social ties, even after controlling for a number of critical covariates. Remarkably similar patterns have been observed with some variations by race, sex, and geographic locale (1–6). According to a recent review, the magnitude of the risk associated with lack of support is comparable to the risk of smoking (7). This conclusion was based on seven population studies, two of them from Sweden (5, 6).

It has been argued, however, that effects on all cause mortality may be ascribed to a number of underlying factors that were not accounted for in these studies. So far, no evidence of an effect on disease specific incidence has been found. Furthermore, we know little about *what* it is about people who lack ties or support that is conducive to premature mortality, because the psychological and social context of the associations has not been investigated. One would assume that the crucial factor for maintenance of good health is not the *quantity* of social ties but the *functions* and *quality* of the relationships.

These issues were addressed in the third generation of the Gothenborg studies of 50-year-old men, i.e., the men born in 1933. In this study we analyzed the impact of a well documented, predominantly functional and qualitative measure of social support, on the 6-year incidence of coronary heart disease (CHD), taking traditional risk factors into full account.

POPULATION AND METHODS

The study group consisted of a random sample of half of the men born in 1933 in Gothenborg. Through the census register of the city, 1016 men were contacted and invited to participate in the investigation, which included both questionnaires and physical examination procedures. Seven hundred seventy-six men (76%) responded and came to the examination. After exclusion of men who had a history of a previous myocardial infarction (MI), the remaining study group consisted of 736 men, (72%), who had filled out questionnaires, undergone physical examinations, and were found to be free from heart disease.

Fasting venous blood samples were drawn in the morning Plasma levels of cholesterol, and triglycerides, were analyzed by means of standardized laboratory procedures Fibrinogen in plasma was analysed with a polymerisation method as originally described by Clauss (8). Blood pressure was measured with a mercury sphygmomanometer in a sitting position after five min-

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utes of rest. Body mass index (BMI) was calculated as weight (kg)/height^2 (m).

A history of smoking habits and of physical exercise habits during leisure time was obtained. Respondents were classified into smokers and nonsmokers. Leisure time physical activity was coded according to a four-point scale, with 1) representing sedentary activity and 4) indicating regular, very strenuous activity. Treatment for hypertension, family history of MI, and diabetes was recorded by way of a postal questionnaire issued to the men in the sample before the examination.

Occupational status was coded according to a widely used socioeconomic classification system (SEI), which has been developed by Statistics Sweden (9). It consists of five grades: 1) unskilled and semi-skilled workers, 2) skilled workers, 3) foremen in industrial production and assistant nonmanual employees, 4) intermediate nonmanual employees, 5) employed and self-employed professionals, higher civil servants, executives.

A recently presented measure of both structural and functional aspects of social support was used, the "Interview Schedule for Social Interaction" (10). From an original rather lengthy questionnaire, which was first developed in an Australian population sample, a condensed version was extracted. This short version was examined for validity and reliability as well as predictive capacity of cardiovascular risk in a previously reported Swedish pilot study (11). The instrument yields two scales describing availability of deep emotional relationships or "attachment" on one hand, and availability of more peripheral contacts of social networks and "social integration" on the other. The items of the two scales are presented in Table 1.

The "attachment" scale describes the availability of emotional support—whether there is someone really close, whether there is someone to share both happiness and sorrows with, whether there is someone to lean on in difficult times, whether someone is available to the respondent for comfort. The scores on each of the items are summarized (range 0–6).

The "social integration" scale describes both the quantitative characteristics of the extended network and its function. Functions include belongingness, practical help, and appraisal support. The aspects of confidence are also covered, i.e., to what extent one can be open and sincere with network members. The scores on each of the items are summarized (range 0–26).

Based on our previous psychometric studies we decided to utilize the full scale score yielded by both scales. Four out of six "social integration" items used an interval response scale score, each one coded from 1 to 6. The remaining two items were of such nature that yes/no coding had to be applied. Thus, the four quantitative items have a stronger weight in this subscale than the two qualitative items. The attachment items were all dichotomized and coded yes/no.

The original social support scale also contained two subscales describing "adequacy of social integration" and "adequacy" of attachment. However, in a large scale population study like the present one, the number of tests that can be used is limited. Therefore, these and other lengthy psychosocial measures, such as hostility or Type A behavior scales were omitted. A brief assessment of household size was included as a proxy for marital status and family structure. It has been previously used in 50-year-old Gothenburg men and shown to predict all cause mortality (5).

TABLE 1. Items Included in the Two Social Support Subscales

Availability of social integration[a]
1. Number of people met during an ordinary week.
2. Number of people with whom respondent shares interests.
3. Number of friends who at any time would come and visit respondent's home and wouldn't be embarassed if it were untidy.
4. Number of friends or family members with whom respondent can talk frankly.
5. Someone available whom respondent can ask small favors.
6. Someone available—apart from family—to whom respondent can turn in times of difficulties.
Availability of attachment
1. Someone special, whom respondent can lean on.
2. Someone who feels very close to respondent.
3. Someone to share feelings with.
4. Someone to confide in.
5. Someone to hold and comfort respondent.
6. Someone at home, who really appreciates what respondent does for him/her.

[a] Responses to items 1–4 were classified into 6 categories, from 0 to more than 15. All other items were coded yes/no.

FOLLOW-UP PROCEDURE

The initial examination was performed in 1983. During the 6-year follow-up period, a total of 25 men out of the 736 who were initially free from heart disease developed a major coronary event (either nonfatal MI, or death attributed to CHD). A nonfatal MI was defined as admission to hospital for a clinically diagnosed infarction and fulfillment of two or more of the following criteria: a) central chest pain, shock syncope or pulmonary edema suggesting MI; b) typical enzyme changes; c) typical ECG changes with occurrence of Q waves and/or localized S-T segment variations. The MI was considered nonfatal if the subject was discharged from hospital, or alive in hospital 4 weeks after the infarction.

Coronary death was defined as all cases of death attributed to coronary atherosclerosis, i.e., fatal MI, arteriosclerotic heart disease and sudden coronary death. Copies of official death certificates were continuously collected throughout the follow-up period and the Swedish national cause-specific death register was matched against the computer file of the study. There was no loss of data with regard to vital status of either participants or nonparticipants in the study. Thus, only "hard" CHD-end points were considered as cases in the follow-up (12).

STATISTICAL METHODS

Fisher's exact test was used to test differences between the two groups in a fourfold table. Possible associations between continuous and/or graded variables were tested using Pitman's nonparametric permutation test (13). Logistic regression was used to identify independent factors and to adjust for the influence of other co-variables. Those risk factors that were found in the univariate analyses to be significant, or almost significant predictors were included in the model. Unconditional likelihood estimators were calculated as measures of the association between

risk factors and CHD (14). Two-tailed tests were used and p values below 0.05 were considered statistically significant.

RESULTS

The associations between the two social support measures, ("social integration" and "attachment") and CHD incidence are illustrated in Figs. 1 and 2. The scale scores of "social integration" were normally distributed and a comparison was made between men with low scores (lower quartile), men with middle scores (middle two quartiles), and men with high scores (upper quartile) (Fig. 1).

The attachment scale was unevenly distributed and skewed toward the right side of the scale, which means that a majority of men reported high attachment. Therefore, we choose to compare the lower quartile of the distribution with the upper three quartiles (Fig. 2).

Overall differences between men who remained healthy and men who suffered a heart attack are shown in Table 2. Of social risk factors, the best predictor was lack of "social integration." The proportion of men with a low social integration score was almost twice as large among CHD cases as among healthy men ($p = 0.04$). A similar finding was made for "attachment," but the latter difference

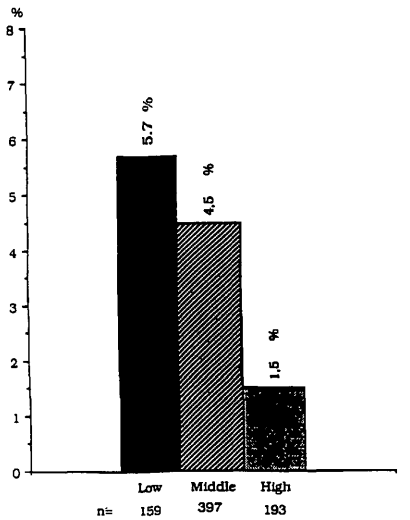

Fig. 1. Six-year incidence of coronary heart disease by social integration.

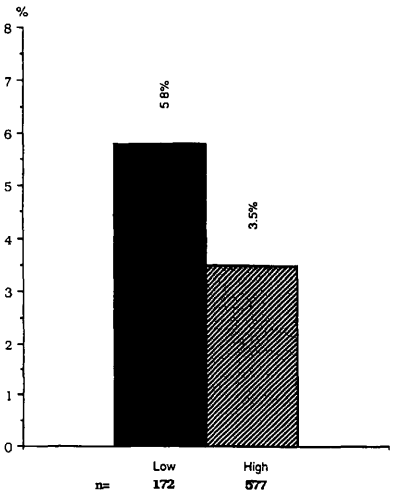

Fig. 2. Six-year incidence of coronary heart disease by attachment.

TABLE 2. Cardiovascular Risk Factors at Entry by Outcome after 6 Years' Follow-Up

	No CHD $n = 711$	CHD $n = 25$	p value for trend[a]
Percent subjects in lower quartile of integration score (n)	20.8 (148)	36.0 (9)	0.04
Percent subjects in lower quartile of attachment score (n)	22.1 (157)	40.0 (10)	0.07
Low (1.2) occupational class, per cent (n)	39.5 (281)	44.0 (11)	0.36
Living alone, percent (n)	18.1 (129)	16.0 (4)	0.48
Systolic BP, mean (SD), mm Hg	134.3 (16.7)	134.8 (19.2)	0.87
Serum cholesterol, mean (SD), mmol/liter	6 10 (1.12)	6.64 (1.23)	0.02
Serum triglyceride, mean (SD), mmol/liter	1.43 (1.07)	1.92 (1.79)	0 04
Plasma fibrinogen,[b] mean (SD), g/liter	3.12 (0.77)	3.54 (0.97)	0.02
Body mass index, mean (SD), kg/m^2	25.6 (3.4)	26.7 (3.1)	0.12
Waist-hip ratio	0.93 (0.06)	0.95 (0.05)	0.23
Smokers, percent (n)	35.4 (251)	64.0 (16)	0.00
Treatment for hypertension, percent (n)	9.3 (66)	20.0 (5)	0.17
Diabetes, percent (n)	2.8 (20)	12.0 (3)	0.02
Family history of MI, percent (n)	25.2 (179)	32.0 (8)	0.57
Low (score 1) physical activity, percent (n)	21.1 (150)	36.0 (9)	0.16

[a] Calculated with the full range of scores, where appropriate.
[b] Missing data for 98 subjects.

did not quite reach statistical significance ($p = 0.07$) in univariate analysis. Low occupational class tended to be more common in CHD men, but no statistical difference was found ($p = 0.36$). Similarly, there was no difference between cases and noncases in household size. The proportion of men living alone was the same in both groups ($p = 0.48$).

Among standard risk factors (Table 2), smoking was the best CHD predictor, the prevalence of smoking being almost twice as high among future CHD cases ($p < 0.01$). Significant differences between CHD cases and men who remained healthy were also found for total S-cholesterol, and total S-triglycerides ($p = 0.02$ and $p = 0.04$, respectively). In addition, an increased prevalence of diabetes ($p = 0.02$) and significantly elevated plasma fibrinogen levels were found in CHD-cases ($p = 0.02$). Systolic blood pressure did not differ between the groups, but treatment for hypertension was more than twice as common among future CHD cases. Statistical significance, however, was not reached ($p = 0.17$).

To examine whether the effects of lack of social support could be explained by an association with other risk factors, standard risk factor levels were compared in men with low, intermediate and high "social integration" (Table 3), and in men with low and high "attachment" (Table 4).

Among men reporting low "social integration," plasma fibrinogen was higher ($p < 0.001$) and smoking was more prevalent ($p = 0.04$) (Table 3). A pronounced difference was also found for lack of leisure time physical activity which was twice as common among low scorers ($p < 0.001$). A borderline association in the reverse direction was found for S-cholesterol ($p = 0.06$), with lower lipid levels in men with low support. Likewise, BMI was slightly lower in men with low support, the difference approaching statistical significance ($p = 0.07$). Conversely, diabetes was more than three times as prevalent in low support as in high support men, but the difference was not quite statistically significant ($p = 0.08$).

The "attachment" scale (Table 4) was significantly associated with systolic blood pressure and S-cholesterol, also in the reverse direction: high levels were found in high support men ($p = 0.03$ and $p < 0.001$, respectively). Lack of leisure time physical

TABLE 4. Cardiovascular Risk Factors by Attachment Score

	1 (low) $n = 167$	2 (high) $n = 567$	p value for trend[a]
Systolic BP, mean (SD), mm Hg	131.9 (15.6)	135.0 (17.1)	0.03
Serum cholesterol, mean (SD), mmol/liter	5.88 (1.18)	6.19 (1.09)	0.00
Serum triglyceride, mean (SD), mmol/liter	1.43 (1.00)	1.45 (1.13)	0.85
Plasma fibrinogen, mean (SD), g/liter	3.13 (0.80)	3.13 (0.77)	0.95
Body mass index, mean (SD), kg/m^2	25.3 (3.6)	25.7 (3.4)	0.20
Waist-hip ratio	0.93 (0.05)	0.93 (0.06)	0.57
Smokers, percent (n)	40.1 (67)	35.1 (199)	0.27
Treatment for hypertension, percent (n)	7.2 (12)	10.4 (59)	0.28
Diabetes, percent (n)	3.6 (6)	3.0 (17)	0.86
Family history of MI, percent (n)	22.8 (38)	26.1 (148)	0.45
Low (score 1) physical activity, percent (n)	27.5 (46)	19.9 (113)	0.03

[a] p values calculated with the full range of scores, where appropriate.

TABLE 3. Cardiovascular Risk Factors by Social Integration Score

	1 (low) $n = 157$	2 (intermediate) $n = 387$	3 (high) $n = 192$	p value for trend[a]
Systolic BP, mean (SD), mm Hg	133.3 (17.8)	134.9 (16.5)	133.9 (16.5)	0.80
Serum cholesterol, mean (SD), mmol/liter	5.95 (1.22)	6.16 (1.14)	6.19 (1.02)	0.06
Serum triglyceride, mean (SD), mmol/liter	1.44 (1.06)	1.48 (1.25)	1 40 (0.77)	0.71
Plasma fibrinogen, mean (SD), g/liter[2]	3.30 (0.74)	3.12 (0.80)	3.01 (0.74)	0.00
Body mass index, mean (SD), kg/m^2	25.0 (3.5)	25 8 (3.4)	25.7 (3.3)	0.07
Waist-hip ratio	0.93 (0.05)	0 94 (0.06)	0.93 (0.07)	0.72
Smokers, percent (n)	42.7 (67)	36.0 (139)	31.8 (61)	0.04
Treatment for hypertension, percent (n)	9.6 (15)	9.8 (38)	9.4 (18)	0.98
Diabetes, percent (n)	5.1 (8)	3.1 (12)	1.6 (3)	0.08
Family history of MI, percent (n)	26.8 (42)	27.1 (105)	20.8 (40)	0.20
Low (score 1) physical activity, percent (n)	33.1 (52)	20.2 (78)	15.1 (29)	0.00

[a] p values calculated with the full range of scores, where appropriate.

activity was more common in men reporting low "attachment" ($p = 0.03$).

Finally, the independent effects of traditional as well as social risk factors on CHD incidence were calculated by means of multiple logistic regression analyses (Table 5). As "social integration" and "attachment" were quite strongly intercorrelated ($r = 0.40$, $p < 0.001$), two separate models were analyzed, entering one of the two social factors at the time.

As the two social support scales were the only significant psychosocial predictors of CHD, their independent role with respect to significant standard risk factors was analyzed in the models. In both models, smoking was the most significant CHD predictor. The adjusted odds ratio (OR) for smoking, relative to nonsmoking, was around three (95% confidence interval 1.3; 7.2). For social integration (lower quartile vs. upper quartile), the OR was 3.8 (95% confidence interval 1.1; 13.9) and for attachment (lower quartile vs. upper three quartiles) OR = 3.1 (95% confidence interval 1.3; 7.6).

Neither blood pressure nor treatment for hypertension proved to be significant predictors in multivariate analyses. Elevated S-cholesterol and increased BMI were only marginally significant independent predictors, both with odds ratios lower than those for social support. Plasma fibrinogen was closely related to smoking habits in both models and did not emerge as an independent predictor. Also, adding plasma fibrinogen and S-triglycerides did not alter the role of other predictors in the model.

DISCUSSION

In the present study we have shown that lack of social support was associated with an increased future risk of an acute myocardial infarction and death from CHD. Lack of social support remained a significant predictor even when controlling for standard risk factors like hyperlipidemia, overweight, hypertension, diabetes and physical inactivity. As estimated by adjusted odds ratios, the impact on CHD risk was of similar magnitude as that of smoking.

We also found an association between measures of social support on the one hand and some of the well known cardiovascular risk factors on the other. Lack of social integration was associated with an unhealthy life style, manifest in a higher prevalence of smoking and lack of exercise.

Of biochemical risk factors, fibrinogen was most strongly related to social support. High levels were found in men lacking "social integration." This was largely explained by the association with smoking. Smoking men had both lower support and higher fibrinogen levels.

The "attachment" scale showed a similar relationship, but much weaker. Of lifestyle factors, only

TABLE 5. Multiple Logistic Regression of Coronary Heart Disease during 6 Years

Variable	Beta	SE	*p*	OR (95% confidence interval)
With social integration as the social support variable				
Serum cholesterol, mmol/liter lower vs. upper quintile	0.274	0.159	0.08	3.1 (0.9; 10.5)
Body mass index, kg/m^2 lower vs. upper quintile	0.105	0.059	0.07	2.3 (0.7; 7.9)
Smoking, yes vs. no.	1.150	0.443	0.01	2.9 (1.2; 6.8)
Treatment for hypertension, yes vs. no	0.646	0.551	0.24	2.7 (1.1; 7.0)
Diabetes, yes vs. no	1.097	0.739	0.13	3.1 (0.7; 12.8)
Physical activity, score 1–4. No activity in regular exercise	−0.128	0.370	0.73	1.7 (0.2; 15.2)
Social integration score, lower vs. upper quartile	−0.656	0.327	0.04	3.8 (1.1; 13.9)
With attachment as the social support variable				
Serum cholesterol, mmol/liter lower vs. upper quintile	0.311	0.162	0.04	3.7 (1.1; 12.5)
Body mass index, kg/m^2 lower vs. upper quintile	0.101	0 058	0.08	2.3 (0.7; 7.8)
Smoking, yes vs. no	1 198	0.446	0.01	3.0 (1.3; 7.2)
Treatment for hypertension, yes vs. no	0.752	0.557	0.17	3.0 (1.2; 7.6)
Diabetes, yes vs. no	1.176	0.749	0.11	3.6 (0.9; 14.7)
Physical activity	0.165	0.366	0.65	1.9 (0.2; 16.9)
Attachment score, lower vs upper three quartiles	1.042	0.441	0.01	3.1 (1.3; 7.6)

exercise was statistically associated with "attachment." Both blood pressure and cholesterol were positively associated with "attachment" in univariate analyses, and consequently concealing and counteracting part of the negative effects of lack of "attachment" on CHD incidence. When controlling for the standard risk factors, including lipids, in multivariate analyses, a significant independent effect of lack of "attachment" was suggested.

The supportive functions described in the "social integration" scale are provided by the extended social network members. They provide *appraisal support*, i.e., important feed-back and information, helpful to recognize and identify solutions to problems encountered. They also may provide *tangible support*, i.e., practical, instrumental help in situations of need. A further function provided by these network members is fulfillment of the need for *belongingness*, a sense of being part of a group, with which one can share values and interests. These functions give a sense of stability and coherence in life, and help support one's own sense of personal worth. The function described by the "attachment" scale is mostly provided by a spouse or partner. The important aspects include enhancement of *self-esteem*, a sense of *security*, *comfort*, and *love* (15, 16).

As previous population-based studies in the area have found an association between the number of ties and frequencies of interactions on the one hand and total mortality on the other, the findings of the present study represent a step toward a better understanding of the role of social support in disease etiology (2). Although the number of incident cases in the study is small ($n = 25$) and conclusions therefore need to be tentative, it is suggested that lack of social support has an effect on the risk of contracting fatal or nonfatal coronary heart disease.

One of our hypotheses was that men who lack social support would have an unhealthy life style. We found an association with both smoking and lack of exercise. Lipids, on the other hand, were positively correlated with social support, thus possibly balancing some of the negative effects. In the multivariate analyses, however, a significant independent effect was discovered for both social measures. So it is reasonable to assume that the major effect of lack of support is not mediated by standard CHD risk factors, but by other, less well-known pathogenetic mechanisms.

The effect of "attachment" on lipids is interesting. In a recent study a connection between treatment-induced low cholesterol levels and psychological measures, such as hostility, was suggested as an explanation of the excess mortality from violent causes in cholesterol treated groups (17). The possibility that a hostile personality is associated with lack of support, which in turn is related to low lipid levels, is suggested. This observation also underlines the need to consider multifactorial patterns of disease etiology. This seems to be particularly true for lack of social support. In a previous study we found that the combined effects of lack of social ties and the coronary prone behavior pattern was a better predictor than social isolation alone, explaining almost 70% of the mortality in male cardiac patients (18).

How do these findings relate to previous scientific evidence? Previous studies in the area have looked mainly at the quantitative aspects of social networks. Qualitative, functional aspects, however, have only been investigated in elderly men and women and not in connection with cardiovascular risk (4). In Sweden the issue of social networks and support was first addressed in the study of 50-year-old men born in 1913 and 1923 in Gothenburg (5). The measure of social support was a quantitative estimate of various social activities that the men used to engage in. Mortality after 10 and 20 years of follow-up was four times higher in socially inactive as compared with active men. The same social activity measure was also applied in the present cohort. The power of this quantitative measure to predict CHD incidence, however, was weaker than the functional social support measure presented in this report.

In another Swedish study, a representative sample of the entire national population between age 30 and 75 was followed for 6 years. Social network interaction was estimated by the number and frequency of contacts with network members. Those men and women who had scarce social networks had significantly increased mortality rates both from all causes and from cardiovascular diseases (6).

In a third Swedish study, elderly men (68 years old) born in the city of Malmoe in Southern Sweden were followed for 5 years. An increased mortality risk was found in men living alone, in men reporting low social participation and inadequate emotional support (19). Likewise, in an American study of elderly persons, the Durham County study, lack of emotional support was found to predict mortality (4). Apart from the latter two studies of elderly people, the functional role of social ties has not previously been addressed in large scale population studies.

In another Swedish study, using a similar measure of social activities, middle aged men *with* heart disease, who did not engage in any social activities, had

a 40% higher 10-year mortality than men who were socially active at least twice a month (20). In that study the influence of myocardial factors was studied in detail—in order to investigate the possibility that myocardial damage was the cause of both social inactivity and mortality. The latter explanation could be ruled out. In a larger American study of male post-MI patients, social isolation, which was most common in low educated men, was also an independent predictor of all cause mortality and sudden cardiac death (21).

These results, together with those from the present study, suggest that there may be concomitant and perhaps even interactive effects between lack of social support, excessive smoking and other life style factors. It is also clear that part of the effects of social support is mediated by a mechanism other than traditional CHD risk factors. In animal studies and in a recent study of humans, an increased sympathetic drive has been suggested as a correlate of low social support and a possible pathogenic mechanism for heart disease (22). Thus, more convincing evidence is beginning to accumulate that lack of social support provided by the extended network and close family members may be a potent, but so far unrecognized cardiovascular risk factor.

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