Negative Aspects of Close Relationships and Heart Disease

Roberto De Vogli, PhD, MPH; Tarani Chandola, DPhil; Michael Gideon Marmot, PhD, FRCP

Background: The aims of the study were to (1) analyze the association between negative aspects of close relationships and increased risk for coronary heart disease and (2) examine whether the association is stronger among women and people of lower social position.

Methods: Prospective cohort study of 9011 British civil servants (6114 men and 2897 women). Negative aspects of close relationships and other social support measures (confiding/emotional and practical) were assessed with the Close Persons Questionnaire during phase 2 (1989-1990) or phase 1 (1985-1988). Associations between negative aspects of close relationships and incident coronary events were determined during an average follow-up period of 12.2 years. Covariates included sociodemographic characteristics (age, sex, marital status, and employment grade), biological factors (obesity, hypertension, diabetes mellitus, and cholesterol level), psychosocial factors (negative affectivity, depression, and work stress), and health behaviors (smoking, alcohol intake, exercise, and fruit and vegetable consumption).

Results: After adjustment for sociodemographic characteristics, biological factors, and other dimensions of social support, individuals who experienced negative aspects of close relationships had a higher risk of incident coronary events (hazard ratio, 1.34; 95% confidence interval, 1.10-1.63). The association was attenuated but remained statistically significant after additional adjustment for negative affectivity and depression (hazard ratio, 1.25; 95% confidence interval, 1.02-1.55). Although women and men in a lower employment grade were more likely to be exposed to negative aspects of close relationships, sex and social position had no statistically significant interaction effects. Confiding/emotional and practical support were not associated with incident coronary events.

Conclusion: Adverse close relationships may increase the risk of heart disease.

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AN EXTENSIVE BODY OF RESEARCH shows that social relations are associated with better health[1,2] and reduced risks of cardiovascular disease.[3-6] However, contradictory findings on the health benefits of structural support[6] and the limited protective effect of marital status against cardiovascular disease among women[7,8] have stimulated further scientific inquiry into the quality of social relationships.

Emerging theoretical concepts and empirical evidence indicate that negative aspects of close relationships, although occurring less often than positive exchanges, have more potent effects in determining daily mood and well-being.[9-12] A longitudinal study of older adults, which evaluated comparable measures of positive and negative social exchanges, showed that negative exchanges were associated with negative affect both cross-sectionally and during a period of 3 months. Positive exchanges, however, exhibited only a cross-sectional association with positive affect but no association with negative affect cross-sectionally or longitudinally.[13] Other studies showed that negative interpersonal interactions are associated with poorer mental health, physical functioning,[14] and sickness absence.[15]

So far, little research has examined the association between negative aspects of close relationships and coronary heart disease (CHD). Poor marital quality was an important prognostic factor for myocardial infarction (MI)[16] and congestive heart failure.[17] A recent cohort study analyzing marital quality and the occurrence of the metabolic syndrome[18] (a cluster of risk factors for cardiovascular disease[19] and diabetes mellitus[20]) found that maritally dissatisfied women were 3 times more likely to have the metabolic syndrome than were maritally satisfied women.[21]

Evidence suggests that negative aspects of close relationships are more likely to be seen in women and people in lower social positions. Women are more likely

Author Affiliations:
International Institute for Society and Health, Department of Epidemiology and Public Health, University College London, London, England.

to be sensitive and invest more time and energy in social relationships than are men.[22] Women report higher psychological distress and negative social interactions, despite having more close relationships and giving and receiving more support than men.[23,24]

People of lower social position are generally more likely to be exposed to stressful socioeconomic circumstances[25] that can negatively influence interpersonal relationships. A recent study showed that financial strain was associated with negative interactions with relatives and depressive symptoms.[26] Another investigation showed that older adults living in deteriorated neighborhoods were more likely to encounter negative exchanges with family members and friends.[27] A prospective investigation among the elderly persons showed that cumulative exposure to negative interactions was associated with self-reported heart disease over a 6-year period, but only among the participants who had less than a high school education.[28]

The aims of the present study were to (1) analyze the association between negative aspects of close relationships and increased risk for CHD and (2) examine whether the association is stronger among women and people of lower social position.

METHODS

STUDY POPULATION

The target population of the Whitehall II study, a prospective cohort study, is all nonindustrial civil servants aged 35 to 55 years who worked in the London offices of 20 civil service departments at baseline (1985-1988). Full details of the methods of the final cohort, which consisted of 10 308 subjects (3414 women), are reported elsewhere.[29] The present study included 9011 respondents (6114 men and 2897 women) with available information on negative aspects of close relationships in phase 2 (1989-1990) or phase 1 (1985-1988) and no history of CHD events in phase 2. The association between negative aspects of close relationships and incident CHD events was determined over an average follow-up period of 12.2 years.

NEGATIVE ASPECTS OF CLOSE RELATIONSHIPS AND SOCIAL SUPPORT

In phase 2, 7907 participants completed the Close Persons Questionnaire (available from the authors on request), which includes 15 items about negative aspects of close relationships, confiding/emotional support, and practical support received in the past 12 months. In phase 1, 7669 participants completed the questionnaire (only 74.39% of respondents were asked to complete it). The 3 subscales were derived from the items using factor analysis.[30] Although the questionnaire assesses social relationships relative to a maximum of 4 close relationships, our analyses focused on the first close relationship only, for which the reliability was the highest.[30] Negative aspects of close relationships, a 4-item scale, refer to adverse exchanges and conflict within a relationship nominated by the respondents as their closest one. Sources of negative aspects of close relationships were divided into 2 categories: partner or not partner. Confiding/emotional support is a 7-item scale measuring wanting to confide, confiding, sharing interests, boosting self-esteem, and reciprocity relative to the first close relationship. Practical support, also referred to as instrumental support, is a 3-item scale that measures major and minor practical help or support received from the closest person.[30] Each item of the 3 social support measures has been evaluated on a Likert scale from 1 to 4, with higher scores indicating more negative aspects for the negative aspect items or more positive support for scales of confiding/emotional and practical support. The Likert-scaled responses for the items of each social support scale were summed. For those with missing scores at phase 2, we used information from phase 1 when available. The final scores were grouped into tertiles representing different levels of exposure to negative aspects of close relationships, confiding/emotional, and practical support.

The Close Persons Questionnaire has been validated in terms of reliability and validity. Cronbach α was 0.63 for negative aspects of close relationships, 0.85 for confiding/emotional support, and 0.82 for practical support. A retest reliability study of 4-week intervals showed moderately high agreement for negative close relationships (r=0.72) and practical support (r=0.71), and high agreement for confiding/emotional support (r=0.88). To evaluate validity, the questionnaire was sent to the person closest to each of the last 60 interviewees who nominated a close relationship. Negative aspects of close relationships showed the best agreement between the report of respondent and the first close relationship (r=0.65 for female spouse and r=0.40 for male spouse).[30]

INCIDENT CORONARY EVENTS

The main outcome variable was a measure of incident coronary events between phase 2 (1989-1990) and the end of phase 7 (2003-2004), including fatal MI, nonfatal MI, or angina from clinical records (electrocardiograms [ECGs] and hospital or general practitioner records) and excluding those events that were self-reported. To assess fatal MI, participants' records were flagged for mortality at the National Health Service Central Registry (mortality data were corroborated by other sources including the death certificate). Deaths resulting from MI were given codes 410-414 from the *International Classification of Diseases, 9th Revision*.[15] Potential new cases of nonfatal MI were ascertained with questionnaire items on chest pain[16] and physician's diagnosis of heart attack. Details of physician diagnoses and investigation results were sought from medical records for all potential cases of MI. Resting ECGs were performed (Siemens Mingorec, Siemens Medical Solutions, Erlangen, Germany) and assigned Minnesota codes.[17] Based on all available data (from questionnaire, study ECGs, hospital acute ECGs, and cardiac enzymes), nonfatal MI was defined using MONICA (Multinational Monitoring of Trends and Determinants in Cardiovascular Disease) criteria.[18] Classification of MI was carried out blind to other study data independently by 2 trained coders, with adjudication by a third in the (rare) event of disagreement. Angina was initially assessed through participants' reports of symptoms[19] and then corroborated by medical records or abnormalities on a resting ECG, exercise ECG, or coronary angiogram. The outcome was composed of clinically verified incident coronary events only.[31] Actual dates of events were used from National Health Service records.

COVARIATES

Covariates at baseline included sociodemographic characteristics such as age, sex, marital status (married or cohabiting; never married; and separated, widowed, or divorced), and employment grade (administrative, executive, and clerical), as well as biological, psychosocial, and behavioral factors. Biological factors were measured in phase 1 and included hypertension (use of antihypertensive medication or systolic/diastolic blood pressure >140/90 mm Hg vs others), serum total cholesterol concentration (measured in millimoles per liter), obesity (body mass index [calculated as weight in kilograms divided by height in meters squared] >30), and self-reported diabetes mellitus.

Psychosocial factors included depression, negative affectivity, and work stress, and were measured in phase 2 or phase 1. Negative affectivity was measured by the negative affect subscale of the Affect Balance Scale.[32] Participants were divided into 3 tertiles of negative affectivity (lowest, middle, and highest). Depression was assessed by the depression subscale of the General Health Questionnaire.[33] The scores on the General Health Questionnaire depression subscale ranged from 0 to 12, with those scoring 4 or higher being classified as "depressed." Measures of work stress (high demands and low job control) were assessed by an adapted version of the job content instrument.[34] For each participant, we calculated the means of job demands and job control scores and assigned them in the lowest, middle, or highest tertile. For those participants with missing items in phase 2 in any of the psychosocial factors, we used information from phase 1.

Health behaviors were measured in phase 2 and included smoking (smoker or nonsmoker), alcohol intake (none, moderate [1-21 units/wk for men and 1-14 units/wk for women], and heavy drinking [>21 units/wk for men and >14 for women]), exercise (vigorous or >1.5 h/wk of vigorous activity, moderate or >1.5 h/wk of moderate activity, and none/mild or <1.5 h/wk of moderate or vigorous activity), and fruit and vegetable consumption (daily vs not daily). Missing data in phase 2 were replaced by equivalent behavioral data from phase 1.

STATISTICAL ANALYSIS

The χ^2 test for trend, the test for heterogeneity, and the analysis of variance were used to assess the linearity or differences across categories of negative aspects of close relationships by sex. Survival analyses using Cox proportional hazards models were used to analyze the association between negative close relationships and incident coronary events during follow-up after adjustment for other covariates. The proportional hazards assumption was checked by examining the interaction term between each of the covariates and time. None of these interaction term regression coefficients were significantly different from zero. In addition, multicollinearity assumptions were examined through a correlation matrix of regression coefficients. In model 1, the association between adverse close relationships and heart disease was adjusted for sociodemographic characteristics, biological factors, and source of support. Additional adjustments for negative affectivity and depression were made in model 2. In model 3, measures of work stress (job demands and job control) were added to the model. Model 4 additionally adjusted for health behaviors (smoking, exercise, alcohol intake, and fruit and vegetable consumption).

The role of sex, social position, and other potential effect modifiers (source of support, marital status, confiding/emotional support, and practical support) were tested by analyzing the statistical significance of age-adjusted interaction terms. All P values (2-tailed) below .05 were considered to be statistically significant. The relation between negative close relationships and coronary events was analyzed using samples less than the total sample size because fully adjusted models included only participants with no missing data on all covariates. Participants with a history of coronary events in phase 2 were excluded from the analyses. All analyses were performed using the software package SPSS, version 11.0 (SPSS Inc, Chicago, Illinois).

RESULTS

Table 1 shows characteristics of the participants by different levels of exposure to negative close relationships and by sex. Negative close relationships were more likely to be experienced by younger individuals, women (data not shown), and men in the lower employment grade, and were less likely to be reported by people who were never married. Exposure to negative close exchanges was also associated with negative affectivity, depression, work stress, low confiding/emotional support, and partner as a source of support. Men experiencing adverse close relationships were less likely to consume fruit and vegetables daily. There were no statistically significant differences in terms of practical support, smoking, exercise, and alcohol intake.

Of 8499 participants free of CHD at baseline and with no missing values on all covariates, 589 reported a coronary event. **Table 2** displays the hazard ratios of incident CHD by reports of negative aspects of close relationships and other measures of social support (confiding/emotional and practical). After adjustment for age, sex, marital status, employment grade, obesity, hypertension, diabetes mellitus, cholesterol level, social support dimension, and source of support (model 1), a dose-response association was seen between greater reports of stressful close relationships and incident CHD. Individuals who experienced a high level of negative aspects of close relationships were 1.34 times (95% confidence interval, 1.10-1.63) more likely to experience an incident CHD event compared with those with a low level of negative close relationships. When additionally adjusting for negative affectivity and depression (model 2), the relationship was attenuated (HR, 1.25; 95% confidence interval, 1.02-1.55) but remained statistically significant. The effect size of the relationship remained unchanged when measures of work stress such as job demands and job control (model 3) were included. Additional adjustment for health-related behaviors (exercise, smoking, alcohol intake, and fruit and vegetable consumption) (model 4) had little effect on the relationship. Confiding/emotional and practical support were not associated with incident coronary events.

Table 3 examines the association between negative aspects of close relationships and incident coronary events by sex and employment grade. No statistically significant interaction effects were found for either. We also analyzed additional interaction terms (marital status, source of support, confiding/emotional support, practical support, negative affectivity, depression, and work stress). Interaction effects were observed in some cases: the association between negative close relationships and incident coronary events was higher among individuals reporting their partner as a first close relationship, those with higher confidential/emotional and practical support, and those who were widowed, divorced, or separated. However, none of the interaction terms reached statistical significance (P > .10 for all).

COMMENT

Results of this study indicate that negative interactions in close relationships increase the risk of incident CHD. The effect is independent of sociodemographic characteristics (age, sex, marital status, and employment grade), biological factors (obesity, hypertension, diabetes mellitus, and cholesterol level), psychosocial factors (negative affectivity, depression, and work stress), and health-

Table 1. Characteristics of Participants by Levels of Negative Aspects of Close Relationships by Sex

		Negative Aspects of Close Relationships								
		Men, %					Women, %			
		Tertile					Tertile			
Characteristic	No.	Lowest (n = 2096)	Middle (n = 2031)	Highest (n = 1987)	*P* for Trend	No.	Lowest (n = 1036)	Middle (n = 909)	Highest (n = 952)	*P* for Trend
Mean age, y	6114	44.4	43.6	43.7	<.001[a]	2897	45.9	44.6	44.7	<.001[a]
Employment grade					<.001					.45
Administrative	2398	36.1	34.2	29.7		341	30.5	37.0	32.6	
Professional	3227	33.5	33.3	33.2		1175	35.2	33.4	31.4	
Clerical	489	30.9	27.8	41.3		1381	37.5	28.3	34.2	
Marital status					<.001[b]					.18[b]
Married/cohabiting	4987	33.7	33.1	33.2		1771	34.8	30.7	34.5	
Never married	798	40.4	33.5	26.2		626	38.8	33.7	27.5	
Divorced/widowed/separated	315	28.9	34.6	36.5		485	34.8	30.5	34.6	
Confiding/emotional support					<.001					<.001
Lowest tertile	2306	30.2	31.7	38.0		938	29.9	32.1	38.1	
Middle tertile	1935	29.4	36.0	34.6		1006	33.5	32.2	34.3	
Highest tertile	2306	44.4	32.2	23.4		946	44.2	29.8	26.0	
Practical support					.99					.97
Lowest tertile	2083	35.6	33.4	31.0		1276	36.0	32.4	31.7	
Middle tertile	1605	31.3	32.3	36.4		743	32.7	32.6	34.7	
Highest tertile	2414	35.3	33.7	31.0		862	38.3	28.5	33.2	
Source of support					.001					.01
Not partner	4800	36.7	35.3	28.0		1332	36.9	33.3	29.8	
Partner	1307	33.6	32.6	33.7		1562	34.7	29.8	35.5	
Negative affectivity					<.001					<.001
Lowest tertile	2124	49.5	33.2	17.2		1000	50.0	31.9	18.1	
Middle tertile	2040	32.5	35.8	31.7		836	38.9	32.4	28.7	
Highest tertile	1929	19.6	30.5	49.9		1029	19.7	30.4	49.9	
Depression					<.001					<.001
Not depressed	4646	37.4	33.6	29.0		2044	39.7	31.7	28.6	
Depressed	1462	24.4	31.9	43.6		850	26.4	30.5	43.2	
Job demands					<.001					<.001
Lowest tertile	1203	36.6	32.7	30.8		877	39.2	30.8	30.0	
Middle tertile	2708	35.8	33.4	30.8		1218	36.2	31.6	32.2	
Highest tertile	2201	31.2	33.3	35.5		796	31.2	31.8	37.1	
Job control					<.001					.03
Lowest tertile	1277	31.3	30.2	38.4		1377	34.4	29.9	35.7	
Middle tertile	2096	32.9	34.1	33.1		865	37.3	32.8	29.8	
Highest tertile	2731	36.7	34.0	29.3		641	36.3	33.1	30.6	
Smoking					.08					.29
No	5245	34.5	33.8	31.6		2290	36.2	31.4	32.4	
Yes	780	32.3	30.3	37.7		590	34.1	31.5	34.4	
Exercise					.98					.39
Mild	1994	34.6	31.6	33.8		1349	33.1	33.7	33.2	
Moderate	2625	34.5	34.5	31.0		1198	38.6	29.3	32.1	
Vigorous	1399	33.7	33.0	33.4		261	33.7	30.7	35.6	
Alcohol consumption					.26[b]					.52[b]
Moderate	4165	34.9	33.3	31.8		1775	36.5	31.3	32.1	
Abstinent	834	32.6	30.8	36.6		889	35.3	29.9	34.8	
Heavy	1111	33.1	34.8	32.0		250	32.0	37.2	30.8	
Fruit and vegetables					<.001					.21
Daily	3433	36.0	35.0	29.0		1826	36.2	31.9	31.9	
Not daily	2668	32.1	31.0	36.9		1069	35.0	30.4	34.6	

[a] Calculated using *F* test for linearity.
[b] Calculated using the test for heterogeneity.

related behaviors (smoking, alcohol intake, exercise, and fruit and vegetable consumption). In contrast to our original hypotheses, interaction effects by sex and social position were not statistically significant. Although our findings show that negative interactions in close relationships are more likely to occur to women and participants in lower employment grade, they produce similar effects on heart disease regardless of sex and social position. When we considered other potential effect modifiers, interaction effects were observed for marital status, source of support, and confiding/emotional and practical support, but they failed to reach statistical significance.

Table 2. Hazard Ratios (and 95% Confidence Intervals) of Incident Coronary Events

	Model 1[a]	Model 2[b]	Model 3[c]	Model 4[d]	Cases/No.
Negative aspects of close relationships					
Lowest tertile	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	186/2957
Middle tertile	1.19 (0.97-1.46)	1.16 (0.94-1.42)	1.16 (0.94-1.42)	1.15 (0.94-1.42)	189/2785
Highest tertile	1.34 (1.10-1.63)	1.25 (1.02-1.55)	1.25 (1.01-1.54)	1.23 (1.00-1.52)	214/2757
Negative affectivity					
Lowest tertile		1 [Reference]	1 [Reference]	1 [Reference]	206/3044
Middle tertile		1.03 (0.84-1.26)	1.01 (0.82-1.24)	1.02 (0.83-1.25)	188/2774
Highest tertile		1.15 (0.93-1.42)	1.10 (0.88-1.37)	1.09 (0.88-1.36)	207/2864
Depression					
Not depressed		1 [Reference]	1 [Reference]	1 [Reference]	436/6462
Depressed		1.16 (0.95-1.40)	1.15 (0.95-1.40)	1.14 (0.94-1.39)	165/2220
Confiding/emotional support					
Lowest tertile	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	201/2968
Middle tertile	1.05 (0.86-1.28)	1.07 (0.88-1.31)	1.06 (0.87-1.29)	1.06 (0.87-1.30)	186/2723
Highest tertile	1.05 (0.86-1.28)	1.09 (0.89-1.33)	1.08 (0.89-1.33)	1.09 (0.89-1.33)	202/2808
Negative affectivity					
Lowest tertile		1 [Reference]	1 [Reference]	1 [Reference]	200/2970
Middle tertile		1.08 (0.88-1.32)	1.05 (0.86-1.29)	1.06 (0.87-1.30)	186/2721
Highest tertile		1.24 (1.01-1.53)	1.19 (0.96-1.46)	1.17 (0.95-1.45)	202/2810
Depression					
Not depressed		1 [Reference]	1 [Reference]	1 [Reference]	431/6338
Depressed		1.18 (0.97-1.43)	1.17 (0.97-1.42)	1.16 (0.96-1.41)	158/2161
Practical support					
Lowest tertile	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	209/3210
Middle tertile	1.17 (0.95-1.44)	1.17 (0.95-1.44)	1.17 (0.95-1.44)	1.18 (0.96-1.46)	172/2201
Highest tertile	1.01 (0.83-1.24)	1.02 (0.84-1.25)	1.01 (0.83-1.24)	1.03 (0.84-1.26)	210/3100
Negative affectivity					
Lowest tertile		1 [Reference]	1 [Reference]	1 [Reference]	202/2957
Middle tertile		1.05 (0.86-1.29)	1.04 (0.85-1.27)	1.04 (0.85-1.28)	185/2719
Highest tertile		1.22 (1.00-1.50)	1.17 (0.95-1.45)	1.16 (0.94-1.44)	204/2817
Depression					
Not depressed		1 [Reference]	1 [Reference]	1 [Reference]	430/6350
Depressed		1.20 (0.99-1.46)	1.20 (0.99-1.45)	1.19 (0.98-1.44)	161/2161

[a] Model 1 adjusts for age, sex, employment grade, marital status, obesity, hypertension, diabetes mellitus, cholesterol level, social support dimension, and source of support.
[b] Model 2 adjusts for model 1, negative affectivity, and depression.
[c] Model 3 adjusts for model 2, job demands, and job control.
[d] Model 4 adjusts for model 3, smoking, exercise, alcohol intake, and fruit and vegetable consumption.

Our findings expand and corroborate previous research on the effect of negative aspects of marital quality in influencing health[35] by showing that negative interactions in close relationships are determinants of coronary events. This was not the case for confiding/emotional support and practical support. The possibility that negative close relationships are more powerful predictors of health than other aspects of social support is consistent with previous research findings indicating that individuals tend to mentally replay negative encounters more than they replay positive ones.[36] It is possible that negative aspects of close relationships are more important for the health of individuals because of the power of negative close relationships to activate stronger emotions (worrying and anxiety) and the consequent physiological effects. In contrast, other more positive forms of support may not affect the physiology of individuals in a measurable or clinically relevant way.[37]

Pathways linking negative close interactions and heart disease may include behaviors, emotions, and biological reactions. Marital distress has been found to be associated with poor diet, lack of exercise,[8] substance abuse such as problem drinking in men,[38] and nonadherence

to medical regimens.[8] However, our results showed that the association between negative close relationships and heart disease remained virtually unchanged after controlling for health behaviors. When one considers emotional factors and their biological translation into the body, research shows that negative marital interactions are associated with depression, often in combination with reduced self-esteem[39] and/or higher levels of anger.[40] These emotional reactions have been found to influence CHD[41] through the cumulative "wear and tear" on organs and tissues caused by alterations of autonomic functions, neuroendocrine changes, disturbances in coagulation, and inflammatory and immune responses.[42] Our findings partially support the hypothesis that negative emotions may mediate the relationship between adverse negative relationships and heart disease. When we adjusted for emotional factors such as negative affectivity and depression, the relationship was attenuated.

This study has a number of shortcomings. Our measure of self-reported negative interactions in close relationships may not reflect an objective evaluation of this factor or may be influenced by personality traits or spe-

Table 3. Interaction Effects Among Negative Aspects of Close Relationships, Sex, and Social Position and Additional Interaction Terms

Characteristic	Negative Aspects of Close Relationships by Tertile, Age-Adjusted HR (95% CI)		
	Lowest	Middle	Highest
Sex			
Men	1 [Reference]	1.28 (1.02-1.61)	1.30 (1.04-1.63)
Women	1 [Reference]	0.99 (0.66-1.48)	1.31 (0.91-1.89)
P for interaction		.39[a]	
Employment grade			
High	1 [Reference]	1.39 (1.00-1.91)	1.09 (0.77-1.55)
Middle	1 [Reference]	1.13 (0.83-1.52)	1.48 (1.12-1.96)
Low	1 [Reference]	1.08 (0.69-1.69)	1.25 (0.83-1.88)
P for interaction		.96[b]	
Close relationship			
Close relationship or partner	1 [Reference]	1.26 (0.89-1.80)	1.04 (0.71-1.53)
Close relationship is partner	1 [Reference]	1.17 (0.93-1.49)	1.39 (1.11-1.74)
P for interaction		.23[a]	
Practical support			
Low	1 [Reference]	1.31 (0.95-1.80)	1.19 (0.86-1.66)
Medium	1 [Reference]	1.36 (0.94-1.96)	1.15 (0.79-1.67)
High	1 [Reference]	1.00 (0.71-1.41)	1.53 (1.12-2.09)
P for interaction		.11[b]	
Confiding/emotional support			
Low	1 [Reference]	1.06 (0.75-1.50)	1.18 (0.85-1.63)
Medium	1 [Reference]	1.27 (0.89-1.81)	1.34 (0.95-1.90)
High	1 [Reference]	1.32 (0.95-1.83)	1.44 (1.03-2.02)
P for interaction		.89[b]	
Marital status			
Married/cohabiting	1 [Reference]	1.20 (0.96-1.50)	1.32 (1.06-1.64)
Never married	1 [Reference]	1.20 (0.72-2.01)	1.09 (0.62-1.91)
Widowed/divorced/separated	1 [Reference]	1.36 (0.68-2.74)	1.43 (0.73-2.79)
P for interaction		.68[b]	

Abbreviations: CI, confidence interval; HR, hazard ratio.
[a] Interaction test between negative social support and covariate on 2 *df*.
[b] Interaction test between negative social support and covariate on 4 *df*.

cific characteristics of respondents.[30] Another limitation of our exposure measure is that it is based on the characteristics of the first close relationship only, of which 64.2% were spouses. This prevented us from investigating the health effects of negative social interactions in a more extended network. For the main predictor we used phase 1 information in cases in which phase 2 information was not available. This is a potential limitation because data may not be missing at random. Compared with participants with available information on adverse close relationships in both phases, those with missing information in phase 1 but available measures in phase 2 were slightly younger (44.1 years vs 45.0), more likely to be in a higher employment grade (*P* < .001), but similar in terms of sex, biological factors, and incident coronary events. This suggests that the missing respondents for the phase 1 measure of negative aspects of close relationships were largely similar to the analytical sample with

the exception of fewer respondents in the high employment grade. The different periods in which covariates were measured could be sources of bias because measures in phase 1 could conceivably have changed by phase 2. Time variability, together with the use of crude dichotomous and 3-category measures, may be responsible for the failure of some interaction terms to reach statistical significance because the strength of all associations could have been reduced. However, dichotomous and 3-category measures may be quite stable over time; when repeating the analysis with phase 2 or phase 1 data only, adjusted for biological factors in phase 1 and demographic, behavioral, and psychosocial factors in the respective phases, the associations of negative aspects of close relationships with incident coronary events were very similar. Finally, the generalization of results may also be questioned because British civil servants may not adequately represent the general population (industrial workers were not included). However, most of the working population is now employed in office jobs, and the exclusion of the upper and lower ends of the social hierarchy is likely to have produced an underestimation of the health effects of negative close relationships.

In conclusion, a person's heart condition seems to be influenced by negative intimate relationships. In this prospective cohort study, we showed that negative aspects of close relationships, not confiding/emotional support and practical support, are associated with CHD.

Correspondence: Roberto De Vogli, PhD, MPH, Department of Epidemiology and Public Health, University College London, 1-19 Torrington Pl, London WC1E 6BT, England (r.devogli@ucl.ac.uk).
Author Contributions: *Study concept and design:* De Vogli, Chandola, and Marmot. *Acquisition of data:* De Vogli, Chandola, and Marmot. *Analysis and interpretation of data:* De Vogli, Chandola, and Marmot. *Drafting of the manuscript:* De Vogli and Chandola. *Critical revision of the manuscript for important intellectual content*: Chandola and Marmot. *Statistical analysis:* De Vogli and Chandola. *Obtained funding:* Chandola. *Study supervision:* Marmot.

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