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# Informal Caregiving and the Risk for Coronary Heart Disease: The Whitehall II Study

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**Background.** The stress associated with informal caregiving has been shown to be associated with poor health, including coronary heart disease (CHD). However, it is unclear if the risk of CHD is attributable to caregiving or prior poor health of the caregiver.

**Methods.** We used data from the Whitehall II cohort study. Caregiving and caregiver's health (using 3 measures: self-rated health, mental health using the General Health Questionnaire, and physical component score of the SF-36) were assessed in 1991–1993 among 5,468 men and 2,457 women aged 39–63 years. CHD (fatal CHD, clinically verified nonfatal myocardial infarction, and definite angina) incidence was recorded for a mean 17 years; sociodemographic variables, health behaviors, and cardiovascular risk factors were included as covariates.

**Results.** Cox regression showed the risk of CHD in caregivers not to be higher (hazard ratio = 1.18; 95% CI: 0.96, 1.45) compared with noncaregivers. Analyses stratified by health status showed that compared with noncaregivers in good health, caregivers with poor self-rated (hazard ratio = 2.00; 95% CI: 1.44, 2.78), mental (hazard ratio = 1.63; 95% CI: 1.16, 2.30), or physical (hazard ratio = 1.87; 95% CI: 1.34, 2.62) health had greater risk of CHD. A similar elevated risk was observed in noncaregivers with poor health; no excess risk was observed among caregivers reporting good health, and the combined effect of poor health and caregiving did not exceed their independent effects.

**Conclusions.** Caregiving in midlife is not in itself associated with greater risk of CHD, but it is associated with increased risk for CHD among caregivers who report being in poor health.

**Key Words:** Coronary heart disease—Stress—Caregiver.

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PROVIDING regular assistance to a disabled or an elderly person is seen to be a chronic stressor for the caregiver (1,2). A growing body of research indicates that caregivers experience higher risk of depression (3), cognitive decline, and dementia (4,5). Besides negative repercussions on mental health and functioning, there is some evidence to suggest that caregiving increases the risk for somatic illness such as coronary heart disease (CHD; [6,7]). An adverse cardiovascular profile due to poor health behaviors and disengagement from self-care among caregivers is one of the hypothesized pathways linking caregiving to cardiovascular disease (8,9). Chronic stress induced by caregiving activity may also be to blame as it is associated with several pathophysiological changes such as increased sympathetic nervous system activity (10), proinflammatory and coagulation biomarkers (11), and endothelial dysfunction (12,13). These findings suggest that informal caregivers may be at higher risk of developing atherosclerosis and its

clinical manifestations (14). However, most research in this domain is based on elderly individuals, composed primarily of female spousal caregivers, with short-term follow-ups, not allowing firm conclusions to be drawn on the long-term impact of caregiving on CHD in nonelderly populations.

There is also some evidence to suggest that caregiving does not necessarily have a negative impact on all individuals (15). The negative impact of caregiving on health does not extend to individuals who report caregiving not to be stressful (16,17). These divergent findings emphasize the need to consider caregivers as a heterogeneous population. It is possible that the mental and physical health status of the caregiver is an important factor in determining the risk for future poor health outcomes such as CHD (18–20). “Healthy caregivers” may not necessarily experience the adverse consequences of caregiving on their future health. The primary objective of this article is to examine the association between informal caregiving and incident CHD

followed up for almost two decades in middle-aged men and women. A further objective is to evaluate whether this association varies as a function of the health status of the caregiver.

## METHODS

### *Study Sample and Design*

Data are drawn from the Whitehall II study, a prospective cohort established in 1985 among office workers from 20 London-based civil service departments. A total of 10,308 participants, 6,995 men and 3,413 women aged 35–55 years were recruited into the study (response rate = 73%). Details concerning study design, characteristics of the participants, and key findings have been described elsewhere (21). Briefly, baseline examination (1985–1988) involved a clinical examination and a self-administered questionnaire containing sections on demographic characteristics, health, lifestyle factors, work characteristics, social support, and life events. Subsequent phases of data collection have alternated between postal questionnaire alone (Phases 2 [1989–1990], 4 [1995–1996], 6 [2001], and 8 [2006]) and postal questionnaire plus a clinical examination (Phases 3 [1991–1993], 5 [1997–1999], 7 [2002–2004], and 9 [2007–2009]). All participants provided written consent and the University College London ethics committee approved this study.

*Caregiving status* was assessed first at Phase 3 (1991–1993), making it the baseline of our analysis. Participants were asked “Are you currently providing any personal care to an aged or disabled relative(s)?” Those who answered “yes” were defined as caregivers.

*Health status* was assessed using three measures:

*Self-rated health*—assessed using the question “Over the last 12 months would you say your health has been” with responses “very good” or “good” classified as good health and “average,” “poor,” or “very poor” classified as poor health.

*Mental health*—assessed using the 30-item General Health Questionnaire (22). This questionnaire was validated against the clinical interview in a subsample (23). The General Health Questionnaire is a well-established screening questionnaire for psychological distress, suitable for use in general population studies. Participants scoring 5 or more were considered to have poor mental health.

*Physical health*—assessed using the Short Form 36 General Health Survey (SF-36 [24]). The SF-36 is a widely used, multipurpose health survey composed of 36 questions. It yields an 8-scale profile that is used to construct a physical component summary score, ranging from 0 to 100, with low scores implying low functioning. In accordance with prior studies in the Whitehall II cohort (25,26), participants were classified as having poor physical health if they were in the lowest quartile of the physical component summary score distribution.

### *Coronary Heart Disease*

CHD diagnoses included fatal CHD (ICD 9 codes 410–414 or ICD 10 codes I20–I25), nonfatal myocardial infarction, and “definite” angina. Information on nonfatal myocardial infarction and angina is obtained from several sources. From 1989 onward, the NHS Hospital Episode Statistics database has provided reports of participants’ diagnoses on discharge and procedure codes for all National Health Service (NHS) hospitals in England and Wales. Participants also self-report CHD events in our health survey questionnaires. These are then validated using the study resting electrocardiograms, the Hospital Episode Statistics database, and by contacting general practitioners for confirmation when no other external source exists. “Definite” angina included self-reported cases of angina (27) only if they were subsequently validated by these other sources. CHD incidence was assessed between Phase 3 (1991–1993) and Phase 9 (2007–2009).

### *Covariates (1991–1993)*

*Sociodemographic characteristics* included age, sex, ethnicity (white, nonwhite), marital status (married or cohabiting, other), and socioeconomic position, assessed using occupational position, which is a comprehensive marker of socioeconomic position in the Whitehall II study and is related to salary, social status, and level of responsibility at work. This is a three-level variable representing high (administrative grades), intermediate (professional or executive grades), and low (clerical or support grades) position.

*Health behaviors* included smoking status (never, past smoker, current smoker), alcohol consumption (abstainer: 0 unit of alcohol per week; moderate drinker: 1–21 units/wk for men and 1–14 units/wk for women; heavy drinker: >21 units/wk for men and >14 units/wk for women), daily fruit and vegetables consumption (less than twice/d, twice, or more/d), and physical activity coded as a three-level variable: sufficiently active ( $\geq 2.5$  h/wk of moderate physical activity or  $\geq 1$  h/wk of vigorous physical activity), sedentary (<1 h/wk of moderate physical activity and <1 h/wk of vigorous physical activity), or insufficiently active (if not sufficiently active and not sedentary).

*Cardiovascular risk factors.*—Systolic blood pressure and diastolic blood pressure were measured twice with the participant sitting after a 5-minute rest using the Hawksley random zero sphygmomanometer (Lynjay Services Ltd, Worthing, UK). The average of these two readings was taken to be the measured blood pressure. Hypertension was defined as either systolic blood pressure  $\geq 140$  mm Hg or diastolic blood pressure  $\geq 90$  mm Hg or intake of antihypertensive drugs. Diabetes was defined as fasting glucose  $\geq 7.0$  mmol/L or 2-hour postload glucose  $\geq 11.1$  mmol/L or intake of antidiabetic drugs or self-reported diabetes. Data on serum cholesterol and triglycerides were available for a

subsample of participants ( $n = 7,506$ ). Dyslipidemia was defined as either HDL cholesterol  $< 1.04$  mmol/L for men or  $< 1.29$  mmol/L for women, or triglycerides  $\geq 1.7$  mmol/L, or intake of lipid-lowering drugs.

### Statistical Analysis

We first examined the cross-sectional associations at baseline between caregiving status and characteristics of the participants using chi-square tests and analysis of variance as appropriate. The association between caregiving and health (self-rated, mental, and physical health) at baseline was examined using logistic regression. We then examined the association between caregiving and CHD using Cox regression. Three levels of adjustment were used in the multivariate analysis: Model 1 included sociodemographic characteristics (age, sex, ethnicity, socioeconomic position); Model 2 additionally included health behaviors (tobacco, alcohol, and fruit and vegetables consumption, physical activity); finally, Model 3 additionally included prevalent chronic diseases and risk factors (hypertension, diabetes, and dyslipidemia).

In sensitivity analyses, we assessed the effect of burden (using hours of caregiving  $\leq 5$  or  $> 5$  h/wk in 1991–1993) and duration (using assessment of caregiving status from 1991–1993 to 1995–1996) on risk of CHD. The next step involved examining whether the association between caregiving and CHD was influenced by health at baseline. We categorized participants into four groups based on cross-classification of health (good or poor) and caregiving (yes or no) status at baseline. This categorization was done first using self-rated health and then repeated with mental and physical health. Noncaregivers reporting good health were the reference group in these analyses. The proportional hazard assumptions for Cox regression models, tested using Schoenfeld residuals, were found not to be violated. Statistical tests were two sided, a  $p$  value of less than .05 was considered statistically significant; statistical analyses were performed using SAS 9.2 (SAS Institute, Cary, NC).

## RESULTS

Of the 10,308 participants at study recruitment (1985–1988), 8,815 participated in the study when caregiving status was first assessed (1991–1993). Of these 8,273 (93.9%) individuals had complete data on caregiving and health status. Subsequently, participants were excluded because of missing data on covariates ( $n = 87$ ) or prevalent CHD at start of the follow-up ( $n = 261$ ), leaving a final sample of 7,925 participants. Compared with participants not included in the analysis, the study sample was younger (49.5 vs 51.4 years in 1991–1993,  $p < .001$ ) and composed of fewer women (31.0% vs 40.1%,  $p < .001$ ). The participants included in this analysis were also more likely to be in the highest socioeconomic group (31.5% vs 22.3%,  $p < .001$ ), more likely to be nonsmokers (84.7% vs 71.0%,  $p < .001$ ), more likely to be

alcohol consumers (83.2% vs 76.5%,  $p < .001$ ), less likely to be overweight or obese (37.7% vs 44.3%,  $p < .001$ ), and more likely to be hypertensive (17.9% vs 26.7%,  $p < .001$ ).

Of the 7,925 participants included, 862 (10.9%) were caregivers at baseline. Caregivers were more likely than noncaregivers to be older, women, and in intermediate or low socioeconomic positions but less likely to be heavy alcohol drinkers (Table 1). There were no differences between caregivers and noncaregivers in terms of smoking status and prevalence of overweight or obesity, hypertension, diabetes, and dyslipidemia. However, caregivers were more likely to report poor self-rated health (29.1% vs 23.8%,  $p < .001$ ), physical health (29.1% vs 24.5%,  $p = .003$ ), and mental health (28.4% vs 21.2%,  $p < .001$ ; Table 1). In analyses adjusted for sociodemographic measures and health behaviors, these translated to greater likelihood of poor self-rated health (odds ratio = 1.28; 95% confidence interval [CI]: 1.09, 1.50) and poor mental (odds ratio = 1.53; 95% CI: 1.30, 1.80) but not physical health (odds ratio = 1.15; 95% CI: 0.98, 1.35) among caregivers.

Over a median follow-up of 17.4 years, 832 incident CHD events were recorded (725 among noncaregivers and 107 among caregivers). Cox regression adjusted for age, sex, ethnicity, and socioeconomic position showed caregivers not to have increased risk for CHD (hazard ratio [HR] = 1.18; 95% CI: 0.96, 1.45, Model 1; Table 2). Further adjustment for health behaviors did not much change the results (HR = 1.20; 95% CI: 0.98, 1.47). Although the interaction terms did not show the association between caregiving and CHD to differ as a function of sociodemographic variables ( $p$  value between .07 and .48), we undertook stratified analyses to explore these effects (Table 2). There was some evidence of stronger effect of caregiving on CHD in older, female, married/cohabiting, nonwhite participants from the lower socioeconomic group.

Sensitivity analyses suggest that compared with noncaregivers, those providing up to 5 hours of care (HR = 1.18; 95% CI: 0.91, 1.52) had similar risk to those providing more than 5 h/wk of care (HR = 1.12; 95% CI: 0.82, 1.54). Similarly, those providing care at both Phases 3 (1991–1993) and 4 (1995–1996) did not have greater risk of CHD compared with noncaregivers (HR = 1.22; 95% CI: 0.88, 1.69).

Table 3 shows the HRs of CHD as a function of caregiving and health status. Compared with noncaregivers with good self-rated health, caregivers reporting poor self-rated health had a twofold higher risk of CHD (HR = 2.00; 95% CI: 1.44, 2.78). Similar patterns of associations were observed in the groups defined by caregiving and mental health (HR = 1.63; 95% CI: 1.16, 2.30) and in the groups defined by caregiving and physical health (HR = 1.87; 95% CI: 1.34, 2.62). Caregivers with good self-rated health (HR = 1.12; 95% CI: 0.87, 1.44), mental health (HR = 1.10; 95% CI: 0.86, 1.40), and physical health (HR = 1.16, 95% CI: 0.90, 1.50) did not have greater risk of CHD. Additional

Table 1. Sample Characteristics at Baseline According to Caregiving Status (Whitehall II Study, Phase 3 (1991–1993),  $N = 7,925$ )

Characteristics	Caregiving status			<i>p</i>
	Total ( $N = 7,925$ )	Noncaregivers ( $n = 7,063$ )	Caregivers ( $n = 862$ )	
Age, $y$ , $M \pm SD$	49.5 $\pm$ 6.1	49.3 $\pm$ 6.1	51.1 $\pm$ 5.8	<.001
Women, $n$ (%)	2,457 (31.1)	2,112 (29.9)	345 (40.0)	<.001
White ethnicity, $n$ (%)	7,206 (90.9)	6,387 (90.4)	819 (95.0)	<.001
Married or cohabiting, $n$ (%)	6,056 (76.4)	5,448 (77.2)	608 (70.5)	<.001
High occupational position, $n$ (%)	3,060 (38.6)	2,770 (39.2)	290 (33.6)	.006
Current smoker, $n$ (%)	1,203 (15.2)	1,070 (15.2)	133 (15.4)	.89
Heavy alcohol consumption,* $n$ (%)	1,238 (15.6)	1,133 (16.0)	105 (12.2)	.01
Fruit/vegetables <2 times/d, $n$ (%)	6,238 (78.7)	5,568 (78.8)	670 (77.7)	.45
Physical activity <sup>†</sup>				
Sedentary, $n$ (%)	2,111 (26.6)	1,874 (26.5)	237 (27.5)	.52
Poor self-rated health, <sup>‡</sup> $n$ (%)	1,929 (24.3)	1,678 (23.8)	251 (29.1)	<.001
Poor mental health, <sup>§</sup> $n$ (%)	1,742 (22.0)	1,497 (21.2)	245 (28.4)	<.001
Poor physical health, <sup>  </sup> $n$ (%)	1,979 (25.0)	1,728 (24.5)	251 (29.1)	.003
Obesity (BMI $\geq 30$ kg/m <sup>2</sup> ), $n$ (%)	740 (9.3)	645 (9.1)	95 (11.0)	.17
Diabetes, <sup>¶</sup> $n$ (%)	220 (2.8)	200 (2.8)	20 (2.3)	.39
Hypertension, <sup>‡‡</sup> $n$ (%)	1,629 (20.6)	1,456 (20.6)	173 (20.1)	.71
Dyslipidemia, <sup>***</sup> $n$ (%)	2,614 (34.8)	2,337 (34.9)	277 (34.5)	.84

Notes: BMI = body mass index;  $M$  = mean;  $SD$  = standard deviation.

\*More than 21 units of alcohol per week for men and more than 14 for women.

<sup>†</sup>Less than 1 h/wk of moderate physical activity or vigorous physical activity.

<sup>‡</sup>Self-rated health: very poor, poor, or average.

<sup>§</sup>Score  $\geq 5$  on the 30-item General Health Questionnaire.

<sup>||</sup>Lowest quartile of the distribution of the SF-36 physical component summary score.

<sup>¶</sup>Fasting glycemia  $\geq 6.1$  mmol/L, or 2-hour postloadglucose glycemia  $\geq 10$  mmol/L, or diabetes medication.

<sup>‡‡</sup>Systolic (diastolic) blood pressure  $\geq 140$  ( $\geq 90$ ) mm Hg or antihypertensive medication.

<sup>\*\*\*</sup>HDL cholesterol <1.04 mmol/L for men or <1.29 mmol/L for women, or triglycerides  $\geq 1.7$  mmol/L or intake of lipid-lowering medications.

adjustment for health behaviors and cardiovascular risk factors did not alter the results. The interaction terms between caregiving and self-rated ( $p = .60$ ), mental ( $p = .42$ ), and physical ( $p = .90$ ) health did not suggest that the combined effect of caregiving and health was greater than their independent effects.

## DISCUSSION

In a large sample of nearly 8,000 middle-aged men and women followed up for almost two decades, we found no clear evidence of greater risk for CHD among caregivers. However, caregivers in poor health at the start of the study were at increased risk of CHD compared with noncaregivers in good health. There was no evidence of an increased incidence of CHD among caregivers who were in good health. These associations were independent of a range of characteristics including age, sex, ethnicity, marital status, socioeconomic position, health behaviors, and chronic diseases and risk factors. Given consistent evidence of poorer health status of caregivers (28–30), it is important to highlight the increased risk of CHD among middle-aged caregivers reporting poor health.

Two reports from the Nurse's Health Study showed that women, aged on average 60 years, providing care to an ill spouse (6) or to ill children and/or grandchildren (31), were at increased risk of CHD. The main limitations of these studies were the inability to generalize the results to male

caregivers as the data were derived from a cohort of women, the relatively short follow-up (4 years on average), and the fact that the health of the caregivers was not taken into consideration. Hence, no firm conclusions could be drawn about the long-term impact of caregiving on a disease that can take years or decades to become clinically manifest. There is considerable evidence of the adverse effects of chronic stressful situations on cardiovascular health (32). Chronic stress induced by caregiving is seen to trigger psychological distress, which when accompanied by low personal and social resources and vulnerabilities results in poor health behaviors, cardiometabolic abnormalities, and finally CHD (33).

A recent cross-sectional study based on a small sample of individuals, mean age 70 years, showed the Framingham CHD risk score to be higher in caregivers of Alzheimer's disease patients than in noncaregivers (8.0 [ $SD = 2.9$ ] vs 6.3 [ $SD = 3.0$ ], respectively;  $p = .01$  [7]). Our study is in line with these findings; baseline characteristics showed caregivers to be more likely to report psychological distress and have poorer self-rated and physical health even though the prevalence of hypertension, diabetes, or dyslipidemia was similar to that of noncaregivers. Previous research has emphasized the role of perceived health for the risk for future cardiovascular disease (18). Our study indicates that this appears to be particularly relevant in the caregivers' population. Further analysis of our data showed that compared with caregivers in good and/or very good

Table 2. Association Between Informal Caregiving, Health Status, and Incident Coronary Heart Disease (CHD; Follow-Up to 2007–2009; the Whitehall II Study,  $N = 7,925$ )

Exposure	CHD Events	Person-Years	Model 1	Model 2
			HR (95% CI)	HR (95% CI)
Total population				
Noncaregivers	725	106,877	ref	ref
Caregivers	107	13,066	1.18 (0.96, 1.45)	1.20 (0.98, 1.47)
Age ( $p$ for interaction = .16)				
Age $\leq 50$ y				
Noncaregivers	298	66,055	ref	ref
Caregivers	27	6,557	0.94 (0.63, 1.40)	0.88 (0.59, 1.31)
Age > 50 years				
Noncaregivers	427	40,821	ref	ref
Caregivers	80	6,509	1.30 (1.02, 1.65)	1.28 (1.01, 1.63)
Sex ( $p$ for interaction = .48)				
Men				
Noncaregivers	575	75,072	ref	ref
Caregivers	74	7,864	1.12 (0.88, 1.44)	1.15 (0.90, 1.47)
Women				
Noncaregivers	150	31,804	ref	ref
Caregivers	33	5,202	1.34 (0.92, 1.96)	1.36 (0.93, 1.99)
Marital status ( $p$ for interaction = .12)				
Married/Cohabiting				
Noncaregivers	584	82,713	ref	ref
Caregivers	88	9,160	1.29 (1.03, 1.62)	1.30 (1.04, 1.63)
Other				
Noncaregivers	141	24,053	ref	ref
Caregivers	19	3,889	0.85 (0.52, 1.37)	0.87 (0.54, 1.42)
Ethnicity ( $p$ for interaction = .21)				
White				
Noncaregivers	617	97,638	ref	ref
Caregivers	97	12,504	1.14 (0.92, 1.41)	1.16 (0.93, 1.44)
Other				
Noncaregivers	108	9,239	ref	ref
Caregivers	10	562	1.69 (0.88, 3.24)	1.58 (0.81, 3.05)
Socioeconomic position ( $p$ for interaction = .07)				
High				
Noncaregivers	301	43,104	ref	ref
Caregivers	33	4,597	0.92 (0.64, 1.33)	0.93 (0.65, 1.34)
Low				
Noncaregivers	424	63,772	ref	ref
Caregivers	74	8,470	1.35 (1.05, 1.73)	1.38 (1.07, 1.77)

Notes: HR = hazard ratio; CI = confidence interval; ref = reference.

Model 1 = adjustment for age, sex, ethnicity, socioeconomic position, and marital status.

Model 2 = Model 1 + adjustment for smoking status, alcohol consumption, fruit/vegetables consumption, and physical activity.

self-rated health, caregivers who rated their health as poor were 1.8 times ( $p = .004$ ) more likely to develop CHD (results not shown).

There is increasing evidence that caregivers suffer from poor health and this contributes to feelings of stress (29,30). Perceived stress could be a function of the intensity of caregiving, women in poor health who spend 8 or more hours everyday caring have been shown to be at higher risk for caregiver stress (29). The rather simplistic measures of caregiving duration and burden used in our analysis do not show them to be important determinants of future CHD risk. It is possible that reports of poor health in our study are proxy markers of perceived stress. Thus, a simple question such as “How would you rate your health?” may be a useful

strategy when screening caregivers who would benefit from cardiovascular monitoring.

An important contribution of our study relates to the finding that healthy caregivers, defined using measures of mental and physical health, did not experience increased risk of CHD over the follow-up compared with noncaregivers. There is some evidence of similar results in older populations. One study reported caregivers with chronic pain to have more psychological distress, poorer self-rated health, and greater decline in physical function; these findings did not extend to caregivers not reporting chronic pain (34). Our results are also similar to that reported by a study on older women where caregiving itself was not associated with greater decline in motor function but caregivers with

Table 3. Association Between Informal Caregiving, Health Status, and Incident Coronary Heart Disease (CHD; Follow-Up to 2007–2009; the Whitehall II Study,  $N = 7,925$ )

Exposure	CHD Events	Person-Years	Model 1	Model 2	Model 3*
			HR (95% CI)	HR (95% CI)	HR (95% CI)
<b>Caregiving and self-rated health</b>					
Noncaregivers, good self-rated health	501	82,494	1 (ref)	1 (ref)	1 (ref)
Noncaregivers, poor self-rated health	224	24,382	1.61 (1.37, 1.88)	1.54 (1.30, 1.81)	1.40 (1.18, 1.65)
Caregivers, good self-rated health	68	9,415	1.12 (0.87, 1.44)	1.13 (0.87, 1.45)	1.08 (0.83, 1.41)
Caregivers, poor self-rated health	39	3,651	2.00 (1.44, 2.78)	1.94 (1.40, 2.70)	1.80 (1.28, 2.53)
			$p < .001$	$p < .001$	$p < .001$
<b>Caregiving and mental health</b>					
Noncaregivers, good mental health	565	84,172	1 (ref)	1 (ref)	1 (ref)
Noncaregivers, poor mental health	160	22,705	1.24 (1.04, 1.48)	1.22 (1.02, 1.45)	1.25 (1.04, 1.50)
Caregivers, good mental health	72	9,400	1.10 (0.86, 1.40)	1.11 (0.87, 1.42)	1.09 (0.84, 1.40)
Caregivers, poor mental health	35	3,667	1.63 (1.16, 2.30)	1.63 (1.16, 2.30)	1.63 (1.13, 2.34)
			$p = .007$	$p = .01$	$P = .01$
<b>Caregiving and physical health</b>					
Noncaregivers, good physical health	486	81,963	1 (ref)	1 (ref)	1 (ref)
Noncaregivers, poor physical health	239	24,913	1.57 (1.34, 1.84)	1.52 (1.30, 1.78)	1.44 (1.22, 1.70)
Caregivers, good physical health	69	9,457	1.16 (0.90, 1.50)	1.17 (0.91, 1.51)	1.19 (0.92, 1.55)
Caregivers, poor physical health	38	3,610	1.87 (1.34, 2.62)	1.84 (1.32, 2.58)	1.57 (1.09, 2.26)
			$p < .001$	$p < .001$	$p < .001$

Notes: HR = hazard ratio; CI = confidence interval; ref = reference.

The  $p$  values indicate a test for heterogeneity in effects across the four groups.

Model 1 = adjustment for age, sex, ethnicity, socioeconomic position, and marital status.

Model 2 = Model 1 + adjustment for smoking status, alcohol consumption, fruit and vegetables consumption, and physical activity.

Model 3 = Model 2 + adjustment for hypertension, diabetes, and dyslipidemia at Phase 3 (1991–1993).

adverse health conditions experienced faster decline in motor function (9).

A recent survey of the National Health Service Information Centre estimated that among the 5 million adults who provide in-home care to a sick, a disabled, or an elderly person at the present time in England, 29% feel stressed because of the care they provide, but nearly half of them (48%) indicate that caring has no effect on their health (35). Not surprisingly, those not affected by caregiving were the ones more likely to report less time spent providing care (<20 h/wk). However, a substantial proportion (34%–38%) of caregivers potentially experiencing the most stressful situations, caring for someone in the same household and/or caring  $\geq 20$  h/wk, considered their health not to be affected by the care they provided. Perceived rewards from providing care (36,37), better health self-care (38), an increase in physical activity resulting from care tasks (39,40), or improved social networks (strengthened family ties, participation in caregivers or other association groups, and nonconflictual and complementary interactions with formal carers [36]) are some of the hypothesized explanations for healthy caregivers not experiencing adverse, stress-related morbidities such as CHD.

The main strengths of this study include its prospective design and standardized validation of CHD. The large sample size and comprehensive assessment of participants' mental and physical health at baseline using validated, widely used questionnaires, as well as assessment of sociodemographic and lifestyle characteristics, allowed us to statistically control for potential confounders of the

associations examined in this article. A particular contribution of the study lies in our evaluation of the hypothesized heterogeneity in the relation between caregiving and CHD using three measures of health status.

This study has some limitations. First, we had no data on characteristics of the care recipient and on specific tasks of caring, both in terms of type and frequency of care, provided by the participants. In particular, we had no data on whether the care recipient lived in the caregiver's household or had physical and/or mental disability, and if there was disability whether it was severe. These factors are known to be chronic stressors for the caregiver. However, even a comprehensive knowledge of objective stressors cannot fully capture the true psychological impact of caregiving, as there is interindividual variability in the perceived burden and emotional response to these factors (2). Thus, the lack of a measure of perceived stress is also a limitation of our study. Second, data from this study are drawn from an occupational cohort of white-collar workers with stable jobs, limiting the generalizability of our findings. However, our sample comprises a wide range of socioeconomic positions, with annual full-time salaries in 1995 ranging from £4,995 (U.S. \$10,006) to £150,000 (U.S. \$300,480.).

In conclusion, caregiving in midlife is not in itself associated with greater risk of CHD, it is associated with increased risk for CHD only among caregivers who report being in poor health. These results emphasize the need to consider caregivers as a heterogeneous population composed of people who will go on to experience adverse health consequences, but also healthy caregivers who are likely to cope

well with caring responsibilities in the long run (41). Given the recent gains in life expectancy fueled by increases at older ages, the 80 and older age group in particular (42), formal and informal carers may face a growing burden of disability and chronic diseases over the next decades. One of the challenges of future research on caregivers is hence to better disentangle the key determinants of a “healthy caregiving.”

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