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Impact of long-hours family caregiving on non-fatal coronary heart disease risk in middle-aged people: Results from a longitudinal nationwide survey in Japan

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Aim: The effects of family caregiving, especially long-hours caregiving, on coronary heart disease (CHD) are debatable. We examined the impact of family caregiving on incident non-fatal CHD.

Methods: We used data from the Longitudinal Survey of Middle-Aged and Elderly Persons from 2005 to 2010, a nationwide panel survey for Japanese people aged 50–59 years in 2005 (baseline). After we excluded non-respondents and people with missing key variables at baseline, 25 121 individuals without CHD, stroke or cancer were followed up for a mean of 4.6 years. The exposure was assessed at baseline by three indicators: (i) family caregiving; (ii) hours spent caregiving; and (iii) kinship type of care recipient. The non-fatal CHD incidence was identified according to questionnaire responses from 2006 to 2010.

Results: Cox's proportional hazards analysis did not show a statistically significant association between family caregiving and incident non-fatal CHD (hazard ratio [HR] 1.13, 95% confidence interval [CI] 0.92–1.40). Caregivers who spent 20–69 h per week on care showed a statistically significant increased risk for non-fatal CHD (HR 1.78, 95% CI 1.23–2.58) compared with non-caregivers; whereas this increased risk was statistically significant only among women (HR 1.98, 95% CI 1.27–3.08), but not among men (HR 1.35, 95% CI 0.67–2.71). Kinship type of care recipient did not make a significant difference to the effects of family caregiving on incident non-fatal CHD.

Conclusions: Long-hours family caregiving could be an independent risk factor for incident non-fatal CHD among middle-aged women in Japan. **Geriatr Gerontol Int 2017; 17: 2109–2115.**

Keywords: caregivers, coronary heart disease, epidemiology, family care, Japan.

Introduction

The need for care for disabled and elderly people is growing in aging societies. As a result, informal care – provided mainly by non-professional family members, other relatives or friends – is playing an increasingly important role.[1] In Japan, for example, whose population is aging faster than those of any other countries,[2] family members accounted for approximately 70% of main caregivers for persons requiring long-term care, amounting to 5 million people in 2010.[3] Such family care is physically and psychologically demanding for caregivers.[4] It has thus been suggested that caregiving could be a significant risk factor for caregivers' health.[5] Determining the effects of family caregiving on caregivers' health is particularly important, because their own health problems can cause them not only to suffer from a heavier caregiving burden, but also to discontinue employment or family care.

Previous studies have identified an association between family caregiving and increasing psychological problems.[6,7] The effects of family caregiving on mortality are inconclusive. One study carried out in the 1990s showed that caregiving could be associated with higher mortality.[8] Conversely, recent large-population studies have suggested that caregiving might decrease mortality, and that family care could exert positive effects.[9,10]

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The effect of family caregiving is likewise debatable with respect to coronary heart disease (CHD). In a study using the Nurses' Health Study cohort in the USA, family caregiving for a spouse for ≥9 h/week was associated with increased incident CHD.[11] Overexertion, physical effects of psychological stress, decreased self-care and unhealthy lifestyles presumably explain this association.[5] After controlling for the health status at baseline, another study, using the Whitehall II cohort, found that caregiving per se was not associated with a higher risk of CHD.[12] However, those studies did not focus on long-hours care. Long-hours caregiving, such as ≥20 h/week devoted to caregiving, is very common in developed countries.[13] However, no firm conclusions have been drawn about the effects of long-hours caregiving on CHD. By contrast, the effects of long-hours working on CHD have been rigorously examined – and indeed, almost confirmed.[14]

Using a Japanese nationwide panel study for the middle-aged population, in the present study we investigated the effect of family caregiving on CHD incidence in terms of the number of care hours. A previous study showed that the kinship type of care recipient could impact the effect of caregiving on CHD;[11] thus, we also examined caregiving effects with respect to the category of recipients.

Methods

Data collection

In the present observational longitudinal study, we extracted the data from the Longitudinal Survey of Middle-Aged and Elderly Persons, which is a Japanese nationwide population-based panel survey. The Japanese Ministry of Health, Labor and Welfare has carried out this survey every year since 2005. From the data obtained in this survey, we used six waves of panel data. The individuals in the first wave were aged 50–59 years, and the data were collected nationwide in November 2005 through a two-stage random sampling procedure. Questionnaires were distributed to the participants' homes by investigators or mail in late October; the questionnaires were to be completed by 2 November, and returned to the investigators directly or by mail several days later. The questionnaires were distributed to 40 807 individuals, and 34 505 responded (response rate 84.6%). The second to sixth waves of the survey, which targeted the participants who responded at least once in the past 2 years, were carried out in early November every year from 2006 to 2010. The numbers of respondents in the panel surveys from 2006 to 2010 were 32 285, 30 730, 29 605, 28 736 and 26 220, respectively. Of 34 505 respondents in the first wave, we excluded 7970 owing to missing key variables with respect to health behavior, disease information and socioeconomic factors at baseline (the first wave in 2005). There were no remarkable differences in age and sex between individuals with and without missing key variables (the mean ages were, respectively, 54.9 and 54.6 years; women accounted for 51.6% and 51.4%). Among the remaining 26 535 participants, we excluded 1414 because they had CHD, stroke or cancer at baseline. Accordingly, 25 121 participants were analyzed. Based on the second to sixth waves of the survey, we identified either incident CHD or the dropout. The institutional review board of The University of Tokyo approved this study protocol after ethical consideration (approval no. 11033).

Measures

Caregiving status

The explanatory variable in the present study was caregiving status at the baseline. We assessed caregiving status by the following three indicators: (i) family caregiving; (ii) hours spent on caregiving; and (iii) relationship of the care recipient to the participant. Family caregiving was represented as a dichotomous variable according to the answer (yes, 1; no, 0) to the question of "Are you currently caring for any relatives regardless of whether they are within or out of the household?" The hours spent on caregiving were measured by the average hours spent on caregiving per week in the previous month. Then, we categorized the average hours into three levels: ≤9 h/week; 10–19 h/week; and 20–69 h/week. In one official Japanese survey, sleeping and work (paid work or housework) were found to occupy approximately 14 h a day on average among caregivers.[15] Therefore, we excluded caregivers who responded that they had spent 70 h/week or more on care. Such caregivers accounted for approximately 4% of the total. The relationship of the care recipient to the participant was categorized as parent, spouse's parent or other. We did so because among Japanese aged in their 50s, most care recipients are parents or spouse's parents (see Discussion). Participants categorized as both "caring for parents" and "caring for parents-in-law" were excluded from the analysis.

Incident CHD

In the questionnaire, participants were asked every year if they had been diagnosed as having heart disease (myocardial infarction or angina pectoris) in the previous year. If the response was yes, the individuals were identified as having CHD. We regarded the onset year of CHD as the year when individuals first reported CHD diagnosis. As we could not identify death in our data, we only observed non-fatal CHD, which is often regarded as a clinically important indicator for mortality.[16]

Covariates

The covariates included age; sex; marital status; academic background; employment status; heavy alcohol consumption; smoking status (current or past smoking);

exercise habits; current status of diabetes, dyslipidemia and hypertension; and depressive states. These variables were derived from the first-wave data; only academic background was derived from second-wave data, because it was first included at that time. Marital status was represented as whether the individual cohabited with their spouse. We classified academic background as whether the participant had attended university or graduate school. We defined heavy alcohol consumption as ethanol intake of more than 300 g/week,[17] and exercise habits in terms of doing moderate to high-level exercise twice or more a week. We identified the current status of diabetes, dyslipidemia and hypertension through self-reporting to the questions that asked if they were diagnosed with such diseases or under medical treatment at the time. We determined depressive states using the Kessler Psychological Distress Scale at baseline, and we considered the Kessler Psychological Distress Scale scores >12 as a proxy for depressive states.[18]

Statistical analysis

We compared the characteristics at baseline between non-caregivers and caregivers. The incidence rate of CHD was estimated for three family caregiving indicators. We applied Cox's proportional hazards model to assess the associations of three indicators with risk of CHD. Individuals' health status, health behaviors, and employment status would be potential confounders in the relationship between caregiving and incident CHD,[12] whereas caregiving might lead to the CHD incidence through deterioration in health status or health behaviors and unemployment.[5] For each indicator, hence, we used two types of models; in model 1, we adjusted for age; sex; marital status; academic background at baseline, and in Model 2, we additionally adjusted for the following variables that could be mediators: job status; heavy alcohol consumption; smoking status; exercise habits; current status of diabetes, dyslipidemia and hypertension; and depressive states at baseline. We regarded participants as dropouts when they did not respond to the questionnaires for the first time from the first wave. We carried out two robustness checks. First, we applied more segmentalized criteria (0–4 h/week, 5–9 h/week, 10–19 h/week, 20–49 h/week, 50–69 h/week) in line with previous research.[19] Second, we repeated the analysis by changing the upper limit of the inclusion threshold of the hours spent on family care from 70 h/week (main analysis), to 100 h/week, 140 h/week and no upper threshold, respectively. We carried out all analyses using Stata version 14 (StataCorp, College Station, TX, USA).

Results

Table 1 reports the characteristics of participants stratified by caregiving status at baseline. Compared with non-caregivers, caregivers tended to be women, unemployed, unmarried and somewhat older. Smoking habits and some alcohol consumption were more frequent among non-caregivers than among caregivers. Table 2 shows non-fatal CHD incidence by family caregiving status. Over 5-year follow up, we recorded 1083 cases of non-fatal CHD (98 among caregivers, 985 among non-caregivers). We observed 4598 dropouts (331 among caregivers, 4267 among non-caregivers). The average follow-up period was 4.6 years. Caregivers had a little higher incidence rate of non-fatal CHD than non-caregivers; caregivers spending 20–69 h on care had a much higher incidence rate than non-caregivers (16.1 *vs* 9.6 /1000 person-years).

Table 3 shows the association between caregiving status and incident non-fatal CHD. Cox's proportional hazards analysis adjusted for age, sex, marital status, and academic background did not show a statistically significant association between family caregiving and incident non-fatal CHD (model 1: hazard ratio [HR] 1.15, 95% confident interval [CI] 0.93–1.42). When further adjusted for other confounders, it remained insignificant (model 2: HR 1.13, 95% CI 0.92–1.40). Regarding care hours, both in model 1 and model 2, caregivers spending 20–69 h/week on family care showed a greater risk for incident non-fatal CHD (model 1: HR 1.88, 95% CI 1.30–2.73; model 2: HR 1.78, 95% CI 1.23–2.58), though caregivers spending ≤9 h or 10–19 h/week did not have a significantly increased risk. The relationship to the care recipient was unlikely to be associated with incident non-fatal CHD both in model 1 and model 2.

In the analyses stratified by sex (Table 4), family care for ≤9 h or 10–19 h/week did not have a significant effect on CHD both in model 1 and model 2. Caregiving for 20–69 h/week was likely to increase the incidence of non-fatal CHD compared with non-caregivers for women (model 1: HR 2.10, 95% CI 1.35–3.26; model 2: HR 1.98, 95% CI 1.27–3.08); however, there was no statistically significant association for men (model 1: HR 1.43, 95% CI 0.71–2.88; model 2: HR 1.35, 95% CI 0.67–2.71). There was no evidence of a statistically significant interaction between sex and care hours. For both sexes, the relationship to the care recipients did not affect the incidence of non-fatal CHD.

In the first robustness check, the effects of family caregiving were unremarkable in the categories under 20 h/week; but there was a notable increase for 20–49 h/week and 50–69 h/week. In the second robustness check, when we considered the participants who reported unrealistically long hours of family care, whichever upper threshold we applied, the results did not change greatly.

Discussion

Using Japanese nationwide panel data for the middle-aged population, in the present we investigated the association

Table 1 Baseline characteristics and comparison between caregivers and non-caregivers

	Non-caregivers (*n* = 23 021)		Caregivers (*n* = 2100)	
	n	%	*n*	%
Age (years)				
50–54	10 976	47.7	913	43.5
55–59	12 045	52.3	1187	56.5
Sex				
Men	11 351	49.3	729	34.7
Women	11 670	50.7	1371	65.3
Lifestyle-related diseases				
Diabetes	1515	6.6	115	5.5
Dyslipidemia	2030	8.8	241	11.5
Hypertension	3839	16.7	354	16.9
Kessler 6 score				
–4	17 362	75.4	1 332	63.4
5–12	5 072	22.0	677	32.2
≥13	587	2.5	91	4.3
Smoking status				
Never smoking	11 021	47.9	1265	60.2
Past smoking	5001	21.7	365	17.4
Current smoking	6999	30.4	470	22.4
Alcohol consumption				
Non-drinker	11 045	48.0	1158	55.1
Ethanol intake of <300 g/week	11 053	48.0	874	41.6
Ethanol intake of ≥300 g/week	923	4.0	68	3.2
Moderate-to-hard exercise				
No	15 643	68.0	1 359	64.7
1/month–1/week	2814	12.2	261	12.4
≥2/week	4564	19.8	480	22.9
Academic background				
Junior high school	3914	17.0	244	11.6
High school	11 413	49.6	1037	49.4
College	3637	15.8	441	21.0
University/graduate school	3916	17.0	372	17.7
Others	141	0.6	6	0.3
Marital status				
Married	19 554	84.9	1756	83.6
Separated/divorced/widowed	2338	10.2	196	9.3
Never married	1129	4.9	148	7.0
Employment				
Employed	18 979	82.4	1511	72.0
Not employed	4042	17.6	589	28.0

Kessler 6 score: Kessler Psychological Distress Scale score. Moderate-to-hard exercise was identified as panting exercise (e.g. walking, jogging, swimming, aerobics). Ethanol intake of 300 g/week was identified as "3 days/week and 100 g/drinking" or "5 days/week and 60 g/drinking." College included junior/vocational/technical colleges.

between family caregiving and incident CHD. After adjusting for potential confounders, we did not find a clear association between family caregiving and incident CHD. However, regarding caregiving burden, longer hours of family care (20–69 h/week) were an independent risk factor for incident non-fatal CHD. An investigation by Lee *et al.* using the Nurses' Health Study showed that family caregiving of more than 9 h/week for a spouse resulted in a higher risk of CHD; however, that finding has limited external validity, because the participants were

Table 2 Non-fatal coronary heart disease incidence stratified by family caregiving status

Exposure	Number in category	Person-years at risk	Case with non-fatal CHD	Incidence rate (/1000 person-years)
Family caregiving (no)	23 021	103 117	985	9.6
Family caregiving (yes)	2100	9507	98	10.3
Care hours of family caregivers				
≤9 h/week	1048	4802	42	8.7
10–19 h/week	340	1541	14	9.1
20–69 h/week	401	1805	29	16.1
Care recipients of family caregivers				
Caring for the parent	1199	5367	61	11.4
Caring for the parent-in-law	666	3089	29	9.4
Caring others	176	770	7	9.1

In the category of care hours, we excluded 221 caregivers who did not respond about the number of care hours; 90 caregivers who replied that they had spent ≥70 h on care were excluded. In the category of care recipients, 59 individuals who cared for both parents and parents-in-law were excluded.

Table 3 Association between family caregiving status and incident non-fatal coronary heart disease

Exposure	Hazard ratio (95% CI)	
	Model 1	Model 2
Family caregiving status		
Family caregiving (yes)†	1.15 (0.93–1.42)	1.13 (0.92–1.40)
Care hours		
≤9 h/week†	0.96 (0.70–1.30)	0.97 (0.71–1.32)
10–19 h/week†	1.04 (0.62–1.77)	1.04 (0.61–1.77)
20–69 h/week†	1.88 (1.30–2.73)	1.78 (1.23–2.58)
Care recipients		
Caring the parent†	1.17 (0.90–1.52)	1.16 (0.90–1.51)
Caring the parent-in-law†	1.22 (0.84–1.77)	1.22 (0.84–1.77)
Caring others†	1.00 (0.48–2.11)	0.91 (0.43–1.93)

In the model using the categorization by care hours as an exposure, we excluded 221 caregivers who did not respond about the number of care hours; 90 caregivers who replied that they had spent ≥70 h on care were excluded. In the model using the categorization by care recipients as an exposure, 59 individuals who cared for both parents and parents-in-law were excluded from analysis. †Reference category for each exposure was no family caregiving. In model 1, we adjusted for age; sex; marital status; and academic background at baseline. In model 2, we additionally adjusted for job status; heavy alcohol consumption; smoking status; exercise habits; current status of diabetes, dyslipidemia and hypertension; and depressive states at baseline. CI, confidence interval.

female medical care professionals.[11] The results of the present study, therefore, reinforce those of Lee *et al.* The present finding suggests, therefore, the necessity of interventions to prevent the development of CHD associated with long hours of family caregiving.

Thus far, the biological association between family caregiving and CHD has not been sufficiently clarified. It has been shown that heavy physical activity and emotional stress are acute risk factors for incident CHD by triggering sympathetic nerve systems.[20] Family caregiving is generally considered to be involved with physical or psychological stress.[21] These findings suggest that family caregiving has immediate negative effects on the cardiovascular system. From this perspective, longer-hours caregiving, which leads to a greater caregiving burden, could lead to a higher frequency of CHD development.[21] In addition to this short-term mechanism, long-term mechanisms have been suggested. Consistent family care can lead directly to deterioration in the caregivers' lifestyle, as well as having indirect effects in terms of psychiatric stress.[4,22] From this perspective, model 2 (fully adjusted model) might suffer from overadjustment, though the results in model 1 (minimally-adjusted model) were quite similar to those in model 2. Even if health status at baseline, along with health behaviors and job status, was a mediator, our full-adjusted model showed that long hours of family caregiving per se could be an independent and direct risk

Table 4 Association between family caregiving status and incident non-fatal coronary heart disease stratified by sex

Exposure	Men Hazard ratio (95% CI)		Women Hazard ratio (95% CI)	
	Model 1	Model 2	Model 1	Model 2
Family caregiving status				
Family caregiving (yes)†	1.07 (0.78–1.46)	1.06 (0.78–1.45)	1.22 (0.92–1.62)	1.18 (0.89–1.57)
Care hours				
≤9 h/week†	1.04 (0.69–1.56)	1.06 (0.70–1.59)	0.88 (0.55–1.41)	0.87 (0.54–1.40)
10–19 h/week†	1.25 (0.59–2.65)	1.27 (0.60–2.68)	0.87 (0.41–1.83)	0.86 (0.41–1.82)
20–69 h/week†	1.43 (0.71–2.88)	1.35 (0.67–2.71)	2.10 (1.35–3.26)	1.98 (1.27–3.08)
Care recipients				
Caring for the parent†	1.09 (0.77–1.54)	1.08 (0.76–1.53)	1.30 (0.88–1.92)	1.29 (0.87–1.91)
Caring for the parent-in-law†	1.23 (0.55–2.75)	1.28 (0.57–2.87)	1.20 (0.78–1.83)	1.17 (0.77–1.79)
Caring for others†	0.87 (0.28–2.72)	0.82 (0.26–2.55)	1.12 (0.42–3.00)	1.04 (0.39–2.79)

In the model using the categorization by care hours as an exposure, we excluded 221 caregivers who did not respond about the number of care hours; 90 caregivers who replied that they had spent ≥70 h on care were excluded. In the model using the categorization by care recipients as an exposure, 59 individuals who cared for both parents and parents-in-law were excluded from analysis. †Reference category for each exposure was non-caregivers. CI, confidence interval.

factor for CHD. This finding was in contrast to the study carried out by Buyck *et al.*, which concluded that family caregiving itself did not have an impact on CHD after adjusted for health status at baseline.[12]

In contrast, some recent studies have shown that caregivers have lower mortality.[9,10] This phenomenon is considered to be a result of the positive effects of family caregiving: caregivers find their role satisfying and rewarding; alternatively, caregivers are generally more active than non-caregivers.[23,24] Even if there were such protective effects, the present results showed the longer-hours caregiving would counteract such effects.

Our stratified analyses show that the effects of long hours of family care on incident CHD were observed only among women, not among men. This finding could be partly due to the fact that some kinds of care work (e.g. transfer aid, excretion care and bathing assistance) can be physically demanding for women owing to low muscle strength. Combined with the finding that female caregivers tend to suffer more greatly with the care burden and become more depressive than males, female caregivers might be psychologically and physically negatively affected by family caregiving.[25,26] Nevertheless, because there was no significant interaction between sex and care hours, it was unclear if the effects of long hours of family care differed by sex. Further studies with more participants than the present study might reveal the impact of long-hours care among men and its sex difference.

Some limitations should be noted. First, the outcome in the present study was non-fatal CHD. We could not assess the relationship between family caregiving and fatal CHD. According to the Japanese vital statistics (2011), however, as the number of fatal CHD is much smaller than that of non-fatal CHD among this study's age group (<1 individual per 1000 person-years), the present results would closely represent the effects of family caregiving on all CHD incidence.[27] Second, we did not use clinical data or physicians' diagnoses; we used self-reporting to identify the incidence of CHD. We could not distinguish stable angina pectoris from acute coronary syndrome. In the present study, the incident rate of CHD was 9.4 individuals per 1000 person-years. This value is similar to the incident rate of CHD (acute coronary syndrome and stable angina pectoris) in a middle-aged population.[28,29] Third, family caregiving status at baseline and covariates were assessed in the same self-administered questionnaire. This might lead to dependent errors among exposure variables and covariates, and generate some distortion. Fourth, the relatively high rate of dropout (18%) might cause selection bias. Fifth, the present study did not consider either of formal care utilization or care recipients' states, such as clinical information, degree of need for care and details of care; however, these factors could potentially alter the family care burden, and accordingly, could potentially modify the effects of family care on the incident CHD. Further investigations of the health impacts of both informal and formal care in the context of care recipients' states are required.

The necessity of care for elderly or disabled people is increasing worldwide along with global aging, though the provision of formal care is restricted by financial constraints. Family care plays an important role in care systems;[30] accordingly, the effect of family caregiving on physical health is gaining attention. In the present population-based study among middle-aged Japanese, we showed that long hours of family caregiving increased the risk of incident CHD, especially among women. This increased risk existed after adjusting for lifestyle-related

diseases, health behavior, depressive states and socioeconomic factors. The need for public policies to relieve the caregiving burden for long-hours caregivers considering the sex-related difference is suggested.

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Disclosure statement

The authors declare no conflict of interest.

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