

The physical functioning and mental health of informal carers: evidence of care-giving impacts from an Australian population-based cohort

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What is known about this topic

- A substantial proportion of the population in many countries provides informal care.
- Many studies have found carers to have worse health relative to non-carers, but few studies account for pre-existing health deficits.
- The negative effect of care-giving on employment has been well documented, but there is little evidence about health effects when carers continue to work.

What this paper adds

- A population-based cohort allowed examination of health changes from prior to care-giving and relative to that of matched non-carers.
- Not all informal carers will have adverse health changes, and for some, the changes will be positive.
- Informal carers who are working and providing high levels of care are at risk of substantial negative health impacts.

Abstract

Informal carers represent a substantial proportion of the population in many countries and health is an important factor in their capacity to continue care-giving. This study investigated the impact of care-giving on the mental and physical health of informal carers, taking account of contextual factors, including family and work. We examined health changes from before care-giving commenced to 2 and 4 years after, using longitudinal data from the Household Income and Labour Dynamics in Australia survey. The sample comprised 424 carers and 424 propensity score-matched non-carers. Health was self-assessed, measured with the SF-36 Health Survey Mental Health (MH) and Physical Functioning (PF) scales. Care-giving was classified as non-carer, low (<5 hours/week), moderate (5–19 hours/week) and high (20 or more hours/week). PF and MH change scores were regressed on baseline scores, care-giving, covariates (including work, family and socio-demographic characteristics) and interactions to identify impacts for subgroups. The physical and mental health impacts differed by gender, and care-giving hours and carer work hours were important contextual factors. Deterioration in both PF and MH was worse for females after 2 years and deterioration in MH was worse for males after 4 years. Among carers aged 40–64 years, there was a 17-point decline in PF ($P = 0.009$) and a 14-point decline in MH ($P < 0.0001$) after 2 years for female high caregivers working full-time and 9.3 point improvement ($P = 0.02$) for non-working male high caregivers. Change was not significant for non-carers. The study found that not all carers suffer adverse health impacts; however, the combination of high levels of care-giving with workforce participation can increase the risk of negative physical and mental health effects (particularly in female carers). Working carers providing high levels of care represent a vulnerable subgroup where supportive and preventive services might be focused.

Keywords: carer health, cohort study, informal care, SF-36 Health Survey, working carers

Introduction

Health and aged care services generally aim to help people with chronic illness or disability to continue living at home for as long as possible. This relies on the availability and capacity of family and friends to provide care (informal carers). Health is an important factor in the capacity of informal carers to continue providing care (McCann *et al.* 2004). Furthermore, if informal carers suffer health impairment as a consequence of

care-giving, this has implications for healthcare provision, as carers themselves become users of services beyond those designed to support the care recipient and the carer in his/her care-giving role. In Australia, 2.6 million carers (12% of the population) assist the aged or people with disability (Australian Bureau of Statistics 2012) and similar or higher proportions have been reported in the UK and Europe (NHS Health and Social Care Information Centre 2010, Vilaplana Prieto 2011). It is therefore important to understand the extent to which there are health impacts of care-giving in the population and if there are subgroups of carers at increased risk. This would facilitate the better design of supportive care and health services for carers to prevent new health problems or the exacerbation of existing conditions as a consequence of care-giving.

The provision of informal care is voluntary and based on social and family relationships; consequently, research into the health impacts of care-giving relies primarily on observational rather than experimental methods. Much of the research to date has used one of three approaches: (i) comparison of health measures between a sample of current carers and a sample of non-carers often using convenience samples; or (ii) analysis of associations between health measures and care-giving contextual factors likely to increase the objective or subjective care burden in a sample of current carers; or (iii) comparison of current carers with the general population using data from population surveys. All of these methods are limited in their capacity to identify care-related health impacts because they lack information about the health status of carers prior to the commencement of care-giving and because of difficulties in identifying an unbiased comparison group.

Meta-analyses of studies using the first approach have focused mainly on carers of people with dementia and found evidence of negative physical and mental health impacts of care-giving (Pinquart & Sorensen 2003, Vitaliano *et al.* 2003). However, the studies did not account for pre-care-giving health status and, although accounting for some carer socio-demographic characteristics, they may not have adequately accounted for the range of pre-existing factors, which predispose a person to become a carer. Studies using the second approach have also been the subject of meta-analysis (2007); focusing on factors associated with physical health impairment, the largest effect was found for psychological distress (measured as depressive symptoms and burden). Other associated factors included socio-demographic characteristics (carer age, being co-resident and relationship with recipient), care-giving stressors (time in

the care-giving role, care recipient cognitive impairment and behaviour problems) and resources (income and informal support) (Pinquart & Sorensen 2007). Interpreting the causal direction of cross-sectional associations can be difficult for such studies, particularly when subjective measures are used (the case for many, but not all, associations identified in the meta-analysis).

The third approach has shown varying results. Carers have been found to have lower mortality than the general population of the same age (O'Reilly *et al.* 2008), while subgroups of carers have been found to have worse health than the general population; worse health was found for carers aged less than 65 (Edwards *et al.* 2008), having dependent children (Cummins *et al.* 2007) or higher burden (based on self-reported strain or care hours) (Schulz & Beach 1999, Schulz *et al.* 2001, O'Reilly *et al.* 2008). Such comparisons are potentially confounded by the characteristics of the people who become carers; although most studies match or adjust for demographic characteristics such as age and sex, there is evidence of pre-existing health disparities (beyond those accounted for by age and sex), which varies for different samples. In an older sample (aged 65 or more) from the USA, carers had better pre-care-giving health relative to non-carers (McCann *et al.* 2004), but this has not been found among middle-aged samples. Initial health status was not predictive of care-giving in another US study of people aged 50–64 (Coe & van Houtven 2009); by contrast, an Australian study of women aged 47–52 found that, prior to care-giving, carers had worse health than non-carers (Lee & Gramotnev 2007) (not explained by workforce participation; Berecki-Gisolf *et al.* 2008).

Few studies have examined the health impacts of care-giving by assessing change over time from before care-giving. Using the British Household Panel Survey, Hirst (2005) found that the prevalence of distress increased after the commencement of care-giving, was associated with hours of care provision at commencement, and the timing of changes in distress differed between men and women. Using the US Health & Retirement Survey, Coe and van Houtven (2009) focused on children (aged 50–64) caring for mothers and identified health impacts for all carers except for single women; depressive symptoms increased and self-rated health decreased with longer care-giving periods for married men and women, while the probability of a heart condition increased among single men (Coe & van Houtven 2009).

This paper reports a study of the health impacts of care-giving in an Australian population-based sample. The purpose was to investigate changes in health

status after the commencement of care-giving relative to the change for similar non-carers over the same period, examining the effects of quantity, duration and other aspects of the care-giving context, which may exacerbate or moderate care-giving impacts. The approach included comparisons with non-carers to account for change related to factors other than care-giving such as that due to the normal ageing process. The analysis endeavours to address limitations in existing literature, including comparability of carers and non-carers, analysis of change from before care-giving, as well as investigation of contextual factors including work and family.

Methods

Data

The study used the Household Income and Labour Dynamics in Australia (HILDA) Release 8 data set, which includes 8 years of longitudinal data on a large sample of Australian households. The survey commenced in 2001 and collects data from all household members aged 16 or over by annual face-to-face interviews and self-completed questionnaires. The questions cover many topics, including health, care-giving, socioeconomic, work, family, and lifestyle information (see <http://www.melbourneinstitute.com/hilda/> for more on HILDA). The study was part of a research programme approved by the University of Technology Sydney Research Ethics Committee.

Care-giving was measured with a question about the time spent caring for a disabled spouse, adult relative or elderly parent/parent-in-law in a typical week. This question was used to both identify carers and measure the care burden, defined as time care-giving in hours/week, which was classified as low (less than 5), moderate (5–19) and high (20 or more) care-giving. Health was measured as self-assessed health status using the SF-36 Health Survey (version 1) Physical Functioning (PF) and Mental Health (MH) dimension scores, scale range 0–100 (Ware *et al.* 1993, Ware & Gandek 1998). We used questions about long-term health conditions (limiting the ability to work) to identify a pre-existing chronic health condition, which might influence care-giving impacts. Other variables included demographic characteristics, resources and care-giving stressors in terms of time constraints related to work and other family responsibilities. Demographic variables included age, sex, born in Australia and English as the first language. Work and family variables included work hours (usually worked/week), married or has a partner and has young children (aged 14 years or less). Resources

included annual household income (after tax), education (tertiary qualification defined as a bachelor degree or higher) and perceived social support. Perceived social support was measured with 10 questions (Berry & Welsh 2009) combined into a single scale by calculating the mean of the 10 items (range 1–7), after reverse coding negatively worded items; the 10 items were intended to measure two subscales (Berry & Welsh 2009), but analysis of Wave 1 data revealed better internal consistency for the total scale (Cronbach's alpha 0.78) than for either of the subscales (sense of belonging 0.70 and tangible support 0.44).

Sample

The sample comprised participants in the HILDA8 self-completed surveys unless they had missing data for analysis variables at relevant time points or were excluded for the following reasons. Carers (defined above) were excluded: if care-giving at Wave 1, if they had less than two consecutive care-giving waves or if the only pre-care-giving data were more than 2 years before care-giving; as there was no information on the duration of care-giving between annual observations, we restricted the study to carers with two or more consecutive care-giving observations on the assumption that the second annual care-giving observation represented a minimum care-giving period of more than 1 year. Non-carers were defined as respondents who were not care-giving at all available waves and excluded if they had fewer than three consecutive data waves, were in receipt of a government carer benefit or payment at any wave or were residing in the same household as a carer (potentially a care recipient). One reason for 'non-carers' to be receiving carer financial support was that the question used to define carers applied to adult recipients, excluding the carers of children with disability. The survey asked about the care of children, but not about time caring for sick children or children with disability.

There were 18,529 individuals with data for the carer item, 3323 carers and 15,206 non-carers. Of these, 424 carers and 7063 non-carers had sufficient data for the study. Fifty-three per cent of non-carers and 87% of carers were excluded from the analysis for the reasons given in Table 1. Almost 75% of carers were not eligible and a further 12% were excluded due to non-response or missing data at one or more key time points. Among non-carers, 28% were not eligible and a further 25% were excluded due to non-response or missing data at one or more required time points. Relative to the 424 carers

Table 1 Reason for exclusion from the analysis

	Carers (<i>n</i> = 3322)	Non-carers (<i>n</i> = 14,985)
Not eligible for reasons other than missing data (%)		
Non-carer in carer household	–	3336 (22.3)
Non-carer, received carer financial support	–	187 (1.2)
Non-carer, <3 consecutive data waves (first observation 2007–2008*)	–	727 (4.9)
Carer at first observation	1526 (45.9)	–
Carer, <2 consecutive care-giving waves	960 (28.9)	–
First care-giving observation 2008*	203	–
Only care-giving for 1 observation	573	–
First 2 care-giving observations not consecutive years	184	–
Total not eligible for reasons other than missing data	2486 (74.8)	4250 (28.4)
Missing data (%)		
Non-carer, <3 consecutive data waves (due to non-response)	–	2406 (16)
Non-carer, care-giving status missing ≥ 1 required time point	–	829 (5.5)
Carer, <2 consecutive care-giving waves (due to non-response)	82 (2.5)	–
Carer, care-giving status missing after first care-giving	271 (8.2)	–
Carer, pre-care-giving data >2 years before care-giving	25 (0.8)	–
Missing SF-36 or propensity predictors	34 (1.0)	437 (2.9)
Total with missing data	412 (12.4)	3672 (24.5)

*Final data year available at the time of analysis.

included in the study, carers excluded due to missing data were providing similar care-giving hours at the first care-giving observation. Although similar to study carers for most characteristics, carers with missing data were slightly younger on average and had slightly worse mental health scores. They were also less likely to be married than carers included in the analysis and less likely to speak English as their first language (see Table 2).

The foremost determinant of becoming a carer is having a relative or friend with supportive care needs, but potential carers may have a choice to provide care or have it provided by a service or another informal carer. Thus, the decision to become a carer will also be related to carer factors, some of which may be related to health (such as age or workforce participation). To address confounding related to selection into care-giving, we used propensity score matching (Kurth *et al.* 2005, Caliendo & Kopeinig 2008) to select a sample of non-carers, comparable to the carers for characteristics potentially associated with becoming a

Table 2 Characteristics at first care-giving observation for carers included in analysis and carers excluded due to missing data

	Included in analysis % (<i>n</i> = 424)	Missing data % (<i>n</i> = 412)
Age – mean (SD)	50.0 (14.8)	47.3 (17.0)*
Female	59.9	56.1
Tertiary education	21.5	18.0
Household income		
<\$30,000	23.8	26.0
\$30,000–49,999	25.0	23.1
\$50,000–69,999	19.8	17.7
$\geq 70,000$	31.4	33.3
First language English	91.0	84.2**
Australian born	78.8	73.3
Married or partner	79.7	68.0***
Children ≤ 14	25.7	28.4
Employed	57.3	55.3
Hours worked/week – mean (SD)	20.4 (21.6)	20.7 (22.3)
Chronic health condition limiting work	23.1	23.1
SF-36 items – mean (SD)		
Physical Functioning	78.8 (24.5)	81.3 (23.2)
Mental Health	72.5 (18.1)	69.5 (20.0)*
Care-giving hours/week		
<5	49.1	50.0
5–19	33.5	27.7
20 or more	17.4	22.3

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$ (chi-squared test for categorical variables and *t*-test for continuous variables).

carer and the subsequent health outcomes. Propensity scores are predicted probabilities given a set of characteristics; we used logistic regression to model the probability of becoming a carer, using baseline (before care-giving) characteristics as predictors. Carers were then matched to non-carers with the same (closest) probability of becoming a carer. Nearest neighbour matching was done with the PSMatching SAS macro (Coca-Perrillon 2007), using 1:1 matching without replacement and a calliper of 0.05.

The baseline data wave for each carer was defined as the year before the first care-giving wave unless this observation was missing, when the observation 2 years before was used (51 cases, 12% of carers). As the baseline year for carers could have been any year from 2001 to 2006, the baseline year for non-carers was randomly selected from among the first to third last observation so that each non-carer had at least two consecutive data waves after the baseline wave. The baseline year was included as a predictor in the propensity score model, along with age, sex, marriage/partner, children, work hours, income, education, country of birth, chronic health condition limiting work, partner with a chronic health condition,

another household member with a chronic health condition and having at least one living parent.

The propensity score model is presented in Table 3. As predictors of care-giving varied with age, the model included a number of interactions between

Table 3 Propensity score model: logistic regression model for the probability of becoming a carer using baseline (pre-care-giving) levels for covariates ($n = 7487$)

Independent variable	Adjusted odds ratio	95% CI
Baseline year		
2001	3.42	2.31–5.05
2002	2.82	1.85–4.29
2003	2.17	1.41–3.34
2004	1.74	1.12–2.69
2005	2.19	1.44–3.34
2006	1.00	1.00–1.00
Female versus male		
Age 15–39	0.69	0.44–1.05
Age 40–64	1.71	1.28–2.29
Age 65+	1.20	0.70–2.04
Age* (additional 1 year)	1.06	1.04–1.09
Age categories		
15–39	0.39	0.16–0.92
40–64	1.35	0.71–2.59
65+	1.00	1.00–1.00
Australian born	1.32	1.01–1.73
Tertiary education	1.28	0.98–1.67
Household income* (additional \$10,000 annually)		
Age 15–39	0.94	0.87–1.01
Age 40–64	1.01	0.98–1.05
Age 65+	1.01	0.90–1.13
Hours worked/week* (additional 8 hours/week)	0.93	0.89–0.98
Chronic condition		
Age 15–39	1.94	1.09–3.44
Age 40–64	0.89	0.62–1.29
Age 65+	1.12	0.64–1.97
Married/has partner	1.91	1.41–2.61
Children aged ≤ 14 years	0.81	0.61–1.08
Partner has chronic condition	2.04	1.57–2.65
Other household member has chronic condition	3.17	2.36–4.28
Parent alive		
No	4.90	3.27–7.34
Yes	1.66	1.23–2.23
Missing	0.34	0.22–0.52

Age (continuous) was interacted with 'Australian born', 'Married/has partner' and 'Parent alive'. Age categories were interacted with 'Household income' and 'Chronic condition'. Mean age of carers = 49 years was used to estimate odds ratio (OR) for variables interacted with age in years. OR estimation for age (in years and in categories) used the most prevalent categories of interaction variables and sample mean income = \$55,755. Pseudo F^2 : 0.144. Chronic condition = chronic health condition limiting work.

*OR for continuous variables should be interpreted as the odds associated with the variable units in parenthesis.

age and other predictors. Age was included as a continuous variable and as a categorical variable (15–39, 40–64, 65 or more). These age categories represent different life stages with differing likelihood for becoming a carer and some predictors (e.g. sex) did not have a linear relationship with age, but differed by age category (see Table 3). The parent-alive variable was included in the model despite having missing data for 16% of the sample (missing treated as a separate category) as this variable was significantly associated with care-giving and improved the model R^2 .

Analysis

MH and PF were analysed separately; as they were highly skewed, with substantial ceiling effects for PF (baseline PF = 100 for 26.5%), the analysis used change from baseline as the dependent variable and adjusted for the baseline level. Because the duration of care-giving may be related to the carer's health, the impact of shorter and longer term care-giving was examined by analysing change from baseline separately at two time points (2 years and 4 years after baseline), while including only the carers continuing to provide care and their matched non-carers in each analysis. Thus, four regression models were estimated as follows:

$$\Delta y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \dots + \beta_p x_p + \varepsilon$$

where Δy = change from baseline (the outcome, PF or MH, at the relevant time point, 2 or 4 years, minus the baseline level); x_1 – x_3 = indicator variables for low, moderate and high care-giving (non-carers omitted); x_4 = baseline level of the outcome; x_5 – x_p = covariates and interaction terms described below.

Models were estimated in Stata11 (StataCorp 2009) using robust standard errors to account for clustering between matched pairs, as the propensity score-matched pairs cannot be assumed to be independent (Austin 2011). All models included age and sex because self-reported health differs by these variables (Hawthorne *et al.* 2007) as do patterns of care-giving (Australian Bureau of Statistics 2012). Age was included as a categorical variable (15–39, 40–64, 65 or more) to identify care-giving impacts at different life stages: young (student or early career/children young), middle-aged (mid-late career/children older) and older (post-retirement). Further potential covariates and interactions with care-giving were tested and included if statistically significant. The F statistic was used to test the joint significance of interaction terms. Potential covariates included pre-existing chronic health condition, work hours, marital status,

children, household income, education and perceived social support. As mental and physical health status are frequently correlated, current MH was tested as a potential covariate in PF change models and current PF was tested in the MH change models. Continuous covariates were centered at the sample mean except for work hours where zero has a natural interpretation of not employed. The interaction between caregiving and work resulted in small cell sizes for working high caregivers. Of 72 high caregivers, 21 were working at baseline and 13 at 2 years. Baseline work hours were used in the PF model at 2 years, rather than current work hours where the model was affected by the extreme influence of a few observations. This was not an issue for the MH model at 2 years where current work hours were used.

Mean change as predicted by each model was calculated for each subgroup identified by significant interaction terms, at the sample mean for continuous covariates and the most prevalent sample categories (e.g. aged 40–64).

Results

Baseline characteristics

Prior to matching, there were a number of statistically significant differences between carers and non-carers for baseline characteristics (see Table 4). Carers were significantly older on average than non-carers; carers were predominantly middle-aged (65%), while half of the non-carers were in the young age group. Carers had lower workforce participation relative to non-carers and included a higher proportion of females. A higher proportion of carers were also married or had a partner. Among the young age group, a higher proportion of carers (18%) had a pre-existing chronic health condition relative to non-carers (7%). After matching, there were no statistically significant differences (see Table 4). The mean propensity score was the same for carers and matched non-carers [0.137, standard deviation (SD) 0.114], while the mean absolute difference in score between matches was 0.0004 (SD 0.002). In addition to comparable characteristics, the matched carers and non-carers had similar baseline PF scores (Table 5); however, carers had slightly lower MH scores (median MH = 76 for carers and 80 for non-carers, see Table 5).

Care-giving

Two years from baseline, just over half of the carers were low caregivers (less than 5 hours/week, see Table 5), which was similar to that observed at 1 year

Table 4 Baseline characteristics for carers and non-carers before and after propensity score matching

	Carers <i>n</i> = 424 (%)	Non-carers	
		Unmatched <i>n</i> = 7063 (%)	Matched <i>n</i> = 424 (%)
Age – mean (SD)	48.9 (14.8)	41.8 (17.9)***	49.7 (15.2)
15–39	21.9	50.4	20.3
40–64	63.0	35.4	60.6
65+	15.1	14.2	19.1
Female	59.9	53.5*	59.7
15–39	48.4	54.4	52.3
40–64	65.2	51.0***	62.7
65+	54.7	56.7	58.0
Tertiary education	21.2	20.6	18.9
Household income			
<\$30,000	26.2	26.0	26.9
\$30,000–49,999	25.2	23.6	20.1
\$50,000–69,999	19.1	22.3	24.5
≥\$70,000	29.5	28.1	28.5
First language	91.0	91.0	90.6
English			
Australian born	78.8	78.6	77.6
Married or partner	78.8	60.2***	78.5
Children ≤14	26.4	27.8	25.0
Employed	59.0	64.3*	58.7
Hours worked/ week – mean (SD)	20.9 (21.5)	23.8 (21.9)**	20.6 (21.1)
Chronic health condition	19.3	14.4**	19.6
limiting work			
15–39	18.3	7.0***	17.4
40–64	16.5	17.4	14.4
65+	32.8	33.4	38.3
Partner has chronic health condition	29.3	11.3***	32.6
Other household member has chronic health condition	18.4	8.2***	17.2
Parent alive			
No	34.2	25.5***	33.0
Yes	56.4	57.7	58.3
Missing	9.4	16.9	8.7

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$ (chi-squared test for categorical variables and two-sample *t*-test for continuous variables).

from baseline (reported in Table 2). Of the 424 carers included in the analysis at 2 years, 151 continued care-giving at 4 years from baseline. A slightly higher proportion were moderate (5–19 hours/week) or high (20+ hours/week) caregivers at 4 years (56% versus 49% at 2 years, see Table 5).

Descriptive statistics for PF and MH change

On average, there was a small negative change in PF for both carers and non-carers at 2 and 4 years from

Table 5 Descriptive statistics for care-giving and health measures at baseline, 2 years and 4 years

	2 years		4 years	
	Carers (<i>n</i> = 424)	Non-carers (<i>n</i> = 424)	Carers (<i>n</i> = 151)	Non-carers (<i>n</i> = 151)
Care-giving hours/week (%)				
<5	51.2		43.7	
5–19	31.8		37.1	
20+	17.0		19.2	
Physical Functioning				
Baseline				
Mean (SD)	80.0 (24.1)	82.8 (21.4)	80.7 (22.1)	83.2 (19.5)
Median	90.0	90.0	90.0	90.0
Change				
Mean (SD)	–0.9 (23.5)	–2.2 (16.6)	–3.5 (18.0)	–1.3 (17.1)
Better (%)	31.1	29.5	30.5	35.8
No change (%)	31.6	33.0	23.8	27.1
Worse (%)	37.3	37.5	45.7	37.1
Mental Health				
Baseline				
Mean (SD)	73.1 (17.5)	76.3 (16.3)	73.6 (18.2)	76.5 (16.3)
Median	76.0	80.0	80.0	80.0
Change				
Mean (SD)	–0.8 (15.4)	–0.6 (14.3)	–1.6 (14.9)	0.5 (15.4)
Better (%)	41.8	43.4	37.7	45.7
No change (%)	12.7	14.9	10.6	11.9
Worse (%)	45.5	41.7	51.7	42.4

baseline. For many carers and non-carers, PF remained unchanged or improved at both time points, but, while similar numbers of carers and non-carers reported worse PF at 2 years, a higher proportion of carers reported worse PF at 4 years (46% versus 37% for non-carers, see Table 5). The pattern for MH was similar, with minimal change on average and many carers and non-carers reporting better MH at both time points. While similar numbers of carers and non-carers reported worse MH at 2 years, a higher proportion of carers reported worse MH at 4 years (52% versus 42% for non-carers, see Table 5).

PF change at 2 years

Age, baseline PF, pre-existing chronic health condition and marital status were significantly associated with negative change in PF at 2 years, while current MH and household income were associated with positive change (Table 6), but these effects did not differ between carers and non-carers. The model for change in PF at 2 years included statistically significant interactions between care-giving and both sex ($P = 0.03$) and work hours at baseline ($P = 0.04$). On average, males who were not working and were high caregivers reported an improvement of 9.96 points relative to non-carers who were not working, while for non-working females, this was 12.86 points less than for males (Table 6). Longer work hours at base-

line were associated with a small positive change in PF at 2 years (0.07 points per hour per week worked) for non-carers. However, this was not the case for carers, particularly high caregivers, where the effect of baseline working hours/week was 0.42 points per hour less than for working non-carers (see Table 6). Although the effect for female high caregivers or for working high caregivers separately is relatively small, in combination, it is substantial. Thus, high care-giving females who were working 35 hours/week at baseline had a decline in PF at 2 years of between 11 and over 20 points (depending on age and other covariates). This is illustrated in Figure 1A for the 40- to 64-year age group where two of the effects for high caregivers were significantly different from zero: the 9.3 point improvement for non-working males ($t = 2.29$, $P = 0.02$) and the 17.4 point decline for females who were working 35 hours/week at baseline ($t = -2.62$, $P = 0.009$).

MH change at 2 years

Higher baseline MH, pre-existing chronic health condition and being born in Australia were significantly associated with negative change in MH at 2 years, while having English as the first language was associated with positive change (Table 7), but these effects did not differ between carers and non-carers. The MH model for change at 2 years also included statis-

Table 6 Physical Functioning (PF) regression models: change from baseline to 2 years and from baseline to 4 years

	Model 1			Model 2		
	PF change at 2 years			PF change at 4 years		
	<i>n</i> = 848			<i>n</i> = 302		
	Coefficient	95% CI	<i>P</i> -value	Coefficient	95% CI	<i>P</i> -value
Care-giving						
<5 hours/week	1.98	−2.59 to 6.56	0.395	−10.31	−17.89 to −2.73	0.008
5–19 hours/week	2.51	−4.84 to 9.86	0.503	−7.68	−16.40 to 1.04	0.084
20+ hours/week	9.96	1.52–18.40	0.021	3.12	−6.68 to 12.91	0.530
Age						
40–64	−3.04	−5.69 to −0.39	0.025	−0.80	−6.15 to 4.54	0.767
65+	−9.06	−12.82 to −5.30	0.000	−3.23	−11.28 to 4.82	0.429
Female	−1.59	−4.55 to 1.37	0.292	2.12	−1.45 to 5.70	0.242
Baseline PF (−81)	−0.44	−0.53 to −0.36	0.000	−0.46	−0.60 to −0.32	<0.001
Baseline health condition	−8.89	−12.61 to −5.16	0.000	−9.45	−15.78 to −3.13	0.004
Current MH (−74)	0.18	0.10–0.25	0.000	0.16	0.04–0.28	0.008
Baseline work hours/week	0.07	0.00–0.14	0.051			
Current work hours/week				0.13	−0.004 to 0.26	0.057
Employed at baseline				1.85	−7.01 to 10.70	0.681
Care-giving × sex						
<5 hours/week Female	−2.12	−6.79 to 2.54	0.372			
5–19 hours/week Female	3.91	−2.99 to 10.82	0.266			
20+ hours/week Female	−12.86	−22.84 to −2.89	0.012			
Care-giving × baseline work						
<5 hours/week	−0.05	−0.16 to 0.06	0.405			
5–19 hours/week	−0.11	−0.24 to 0.01	0.073			
20+ hours/week	−0.42	−0.77 to −0.07	0.019			
Care-giving × employed						
<5 hours/week Employed				11.02	2.56–19.48	0.011
5–19 hours/week Employed				6.06	−4.84 to 16.95	0.274
20+ hours/week Employed				−12.39	−26.51 to 1.74	0.085
HH income \$,000 (−57)	0.03	0.005–0.05	0.020			
Married/partner	−2.67	−5.30 to −0.04	0.047			
Constant	5.01	0.75–9.27	0.021	−3.02	−12.99 to 6.95	0.551
<i>R</i> ²	0.28			0.29		

CI, confidence interval; MH, Mental Health; HH, household. Omitted level for care-giving is non-carer and for age is <40. Model 1: Care-giving $F(3, 423) = 2.19, P = 0.088$; Care-giving × sex $F(3, 423) = 3.20, P = 0.023$; Care-giving × work hours $F(3, 423) = 3.30, P = 0.020$. Model 2: Care-giving $F(3, 150) = 3.44, P = 0.018$; Care-giving × baseline employment $F(3, 150) = 4.19, P = 0.007$. Robust standard errors used for both models.

tically significant interactions between care-giving and both sex ($P = 0.02$) and current work hours ($P = 0.02$). Female moderate caregivers reported positive change (5.40 points) in MH relative to males, while female high caregivers reported negative change (7.52 points). Change for male carers was not significantly different from that for non-carers (Table 7). Longer weekly work hours were associated with a positive change of 0.09 points/hour for non-carers, whereas for high caregivers, this was 0.33 points/hour less than non-carers (see Table 7). The mean change in MH resulting from these interactions is illustrated in Figure 2A for the 40- to 64-year age group where two of the effects for high caregivers were significantly different from zero: the 5.6 point

decline for non-working females ($t = -2.39, P = 0.02$) and the 14.2 point decline for females working 35 hours/week ($t = -14.22, P < 0.0001$). The 6.6 point decline for working males was not significant ($t = -1.73, P = 0.09$).

PF change at 4 years

Higher baseline PF and a pre-existing chronic health condition were significantly associated with negative change in PF at 4 years, while current MH and current work hours were associated with positive change (Table 6), but these effects did not differ between carers and non-carers. The PF model at 4 years (Table 6) included a statistically significant

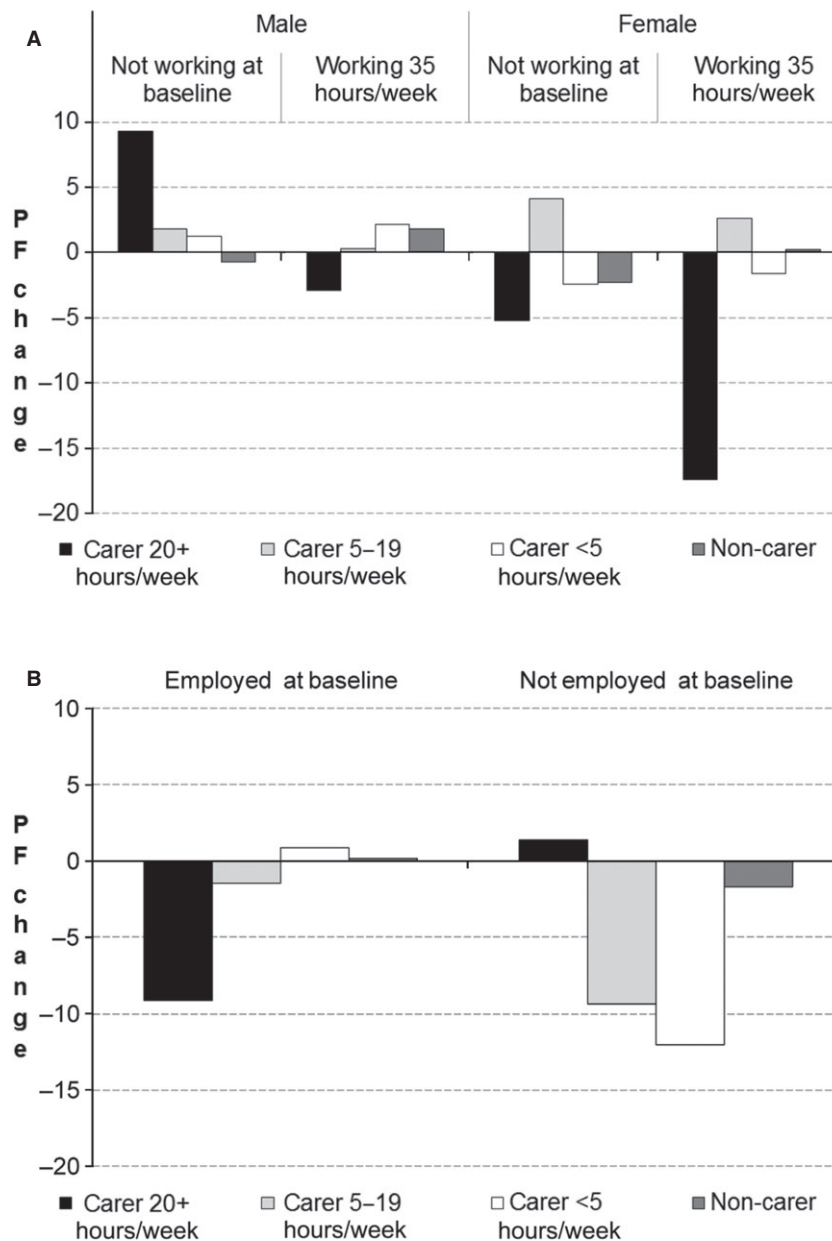


Figure 1 Physical Functioning (PF): predicted^a mean change by care-giving. (A) Change at 2 years by gender and baseline working hours.^b (B) Change at 4 years by baseline employment status. ^aEstimated from the models in Table 6 using the most prevalent age category (40–64 years) and the sample mean for all other covariates unless otherwise stated. ^bThe predictions for carers working at baseline are for working 35 hours/week, the baseline average working hours for workers in the sample.

interaction between care-giving and baseline employment status ($P = 0.007$). There was a significant 11.02 point improvement for low caregivers employed at baseline relative to those not employed and a 12.39 point decline for high caregivers. Among those not employed at baseline, there was negative change for low and moderate caregivers relative to non-carers. The resulting mean change is illustrated in Figure 1B for the 40- to 64-year age group where high caregivers employed at baseline showed a 9.1 point decline

($t = -2.17, P = 0.03$) and, among those not employed at baseline, moderate caregivers showed a 9.4 point decline ($t = -2.40, P = 0.02$) and low caregivers showed a 12.0 point decline ($t = -3.38, P = 0.001$).

MH change at 4 years

Higher perceived social support was significantly associated with positive change in MH at 4 years and having young children was associated with negative

Table 7 Mental health (MH) regression models: change from baseline to 2 years and from baseline to 4 years

	Model 1			Model 2		
	MH change at 2 years			MH change at 4 years		
	<i>n</i> = 848			<i>n</i> = 302		
	Coefficient	95% CI	<i>P</i> -value	Coefficient	95% CI	<i>P</i> -value
Care-giving						
<5 hours/week	0.76	−3.87 to 5.40	0.746	−1.47	−7.00 to 4.05	0.599
5–19 hours/week	−2.44	−7.35 to 2.47	0.330	−9.24	−17.02 to −1.46	0.020
20+ hours/week	3.21	−3.48 to 9.90	0.346	−8.71	−18.13 to 0.70	0.069
Age						
40–64	0.37	−2.12 to 2.85	0.772	1.29	−2.55 to 5.13	0.509
65+	1.98	−1.40 to 5.36	0.250	1.45	−3.45 to 6.35	0.560
Female	−0.08	−2.72 to 2.56	0.950	−2.84	−6.88 to 1.20	0.167
Baseline MH (−74)	−0.41	−0.47 to −0.35	<0.001	−0.58	−0.68 to −0.47	<0.001
Baseline health condition	−4.50	−7.10 to −1.90	0.001			
Current PF (−81)				0.05	−0.04 to 0.15	0.277
Female × PF (−81)				0.15	0.02–0.29	0.023
Current work hours/week	0.09	0.01–0.16	0.023			
Care-giving × sex						
<5 hours/week Female	−1.76	−6.31 to 2.79	0.447	0.42	−6.51 to 7.35	0.905
5–19 hours/week Female	5.40	0.11–10.68	0.046	8.59	−0.18 to 17.35	0.055
20+ hours/week Female	−7.52	−15.12 to 0.12	0.054	8.28	−2.84 to 19.39	0.143
Care-giving × current work						
<5 hours/week	−0.08	−0.18 to 0.03	0.160			
5–19 hours/week	0.00	−0.11 to 0.11	0.994			
20+ hours/week	−0.33	−0.55 to −0.11	0.004			
Australian born	−2.50	−4.92 to −0.09	0.042			
English first language	3.61	−0.14 to 7.37	0.059			
Children aged 14 or less				−3.74	−7.63 to 0.16	0.060
Perceived social support (−5)				4.60	2.73–6.46	<0.001
Constant	−2.70	−7.70 to 2.31	0.290	0.80	−4.17 to 5.77	0.752
<i>R</i> ²	0.23			0.39		

CI, confidence interval; PF, Physical Functioning; HH, household. Omitted level for care-giving is non-carer and for age is <40. Model 1: Care-giving $F(3, 423) = 0.81, P = 0.491$; Care-giving × sex $F(3, 423) = 3.49, P = 0.016$; Care-giving × work hours $F(3, 423) = 3.36, P = 0.019$. Model 2: Care-giving $F(3, 150) = 2.58, P = 0.056$; Care-giving × sex $F(3, 150) = 1.75, P = 0.159$. Robust standard errors used for both models.

change (Table 7), but these effects did not differ between carers and non-carers. This model also included a significant interaction between current PF and sex; higher current PF was associated with positive change in MH for females, but not for males. While not of direct interest to the research question, this interaction term was statistically significant and had a small impact on the model R^2 and other model coefficients. The MH model for change at 4 years included an interaction between sex and care-giving, which was retained in the model because its inclusion had a substantial impact on the care-giving estimates and precision. Male moderate and high caregivers reported negative change relative to non-carers of 9.24 and 8.71 points, respectively, but females did not. The resulting mean change is illustrated in Figure 2B for the 40- to 64-year age group where, among males, there was a 7.2 point decline for moderate caregivers

($t = -2.02, P = 0.045$) and a non-significant 6.6 point decline for high caregivers ($t = -1.49, P = 0.14$).

Importance of change

The overall sample SD at baseline was 17.0 for MH and 22.8 for PF; the negative changes at 2 years for working females are greater than half a standard deviation and considered an important change (Norman *et al.* 2003). The mean change in PF and MH for non-carers ranged from a worsening of 3 points to an improvement of 2 points and considered trivial (less than 20% of a standard deviation).

Discussion

We found considerable variation among carers in the physical and mental health impacts of care-giving.

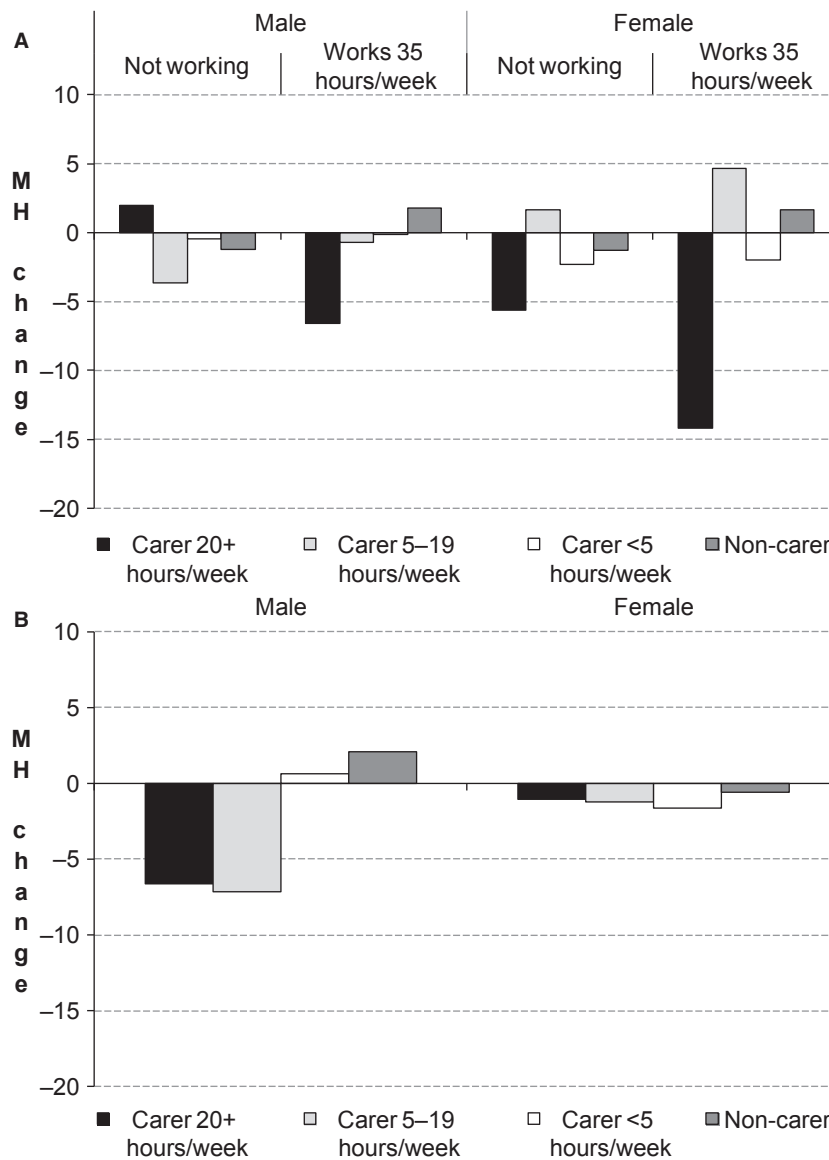


Figure 2 Mental Health (MH): predicted^a mean change by care-giving. (A) Change at 2 years by gender and current working hours.^b (B) Change at 4 years by gender. ^aEstimated from the models in Table 7 using the most prevalent age category (40–64 years) and the sample mean for all other covariates unless otherwise stated. ^bThe predictions for carers currently working are for working 35 hours/week, the baseline average working hours for workers in the sample.

Many reported health improvement after commencing care-giving, while others reported substantial deterioration. Care-giving hours and carer work commitments were important factors as health worsened substantially at high levels of both, and the effects differed between males and females. After 2 years, both PF and MH worsened substantially for high care-giving females who were working, while PF improved for high care-giving males who were not working. After 4 years, deterioration in MH was worse for moderate and high care-giving males, but not for females. There were no gender differences in PF effects at 4 years.

Before matching, carers were older and included more female, married and fewer employed people relative to non-carers. Among the youngest age group, the proportion of carers with a pre-existing chronic health condition was more than double that for non-carers, although, for middle and older age groups, these proportions were similar. This is in contrast to previous findings of better health before care-giving among older carers (McCann *et al.* 2004) and worse health among middle-aged carers (Lee & Gramotnev 2007, Berecki-Gisolf *et al.* 2008), although consistent with Coe and Van Houtven (2009) who

found that health did not predict care-giving among middle-aged people.

Longer care-giving was associated with worsening physical health for high caregivers who were working at baseline and for low and moderate caregivers who were not working at baseline. As those employed at baseline were on average younger and had better pre-care-giving health than those not employed, it is possible that care-giving impacts were likely to only occur at higher care-giving for the former (healthier) group, but not the latter, despite model adjustment for age and pre-existing health status.

Males and females differed in the timing of health impacts: females reported early negative physical and mental health impacts of high care-giving, while males reported early positive physical health impacts of high care-giving and negative mental health impacts after longer care-giving. Physical health effects of longer care-giving were similar for males and females. The timing of mental health impacts is consistent with Hirst (2005), where psychological distress among males (care-giving for 20+ hours/week) showed a smaller initial increase than for females, but, after 4 years, increased for males while declining for females.

A number of factors may contribute to the observed gender differences. Potential benefits from care-giving through improved quality of the relationship with the care recipient, role satisfaction and feelings of accomplishment (Carbonneau *et al.* 2010) may contribute to health improvement in non-working male high caregivers. Care-giving satisfaction has been associated with health and well-being cross-sectionally (Cohen *et al.* 2002), but the evidence for gender differences is limited (Del-Pino-Casado *et al.* 2012). There is more evidence to support differential negative impacts. Care-related stress has been associated with health outcomes (Schulz & Beach 1999, Schulz *et al.* 2001, Pinquart & Sorensen 2007) and research has found that, relative to female carers, males perceive care-giving as less stressful (Kim *et al.* 2007, Brazil *et al.* 2009). Brazil *et al.* (2009) also found differences by carer gender in the type of care provided, which may contribute to differential impacts. It is also possible that there are differences in the way male and female carers are perceived and assessed as needing support by informal networks and formal providers. Pinquart and Sorensen (2006) found that care-giving stressors and support explained most gender differences in carer health. The carer-recipient relationship could also be a factor as non-spousal carers have been found to have worse physical health and/or mental health than spousal

carers (Kim *et al.* 2007, Pinquart & Sorensen 2007) and in Australia, the proportion of male carers caring for a spouse is much higher than that for female carers (Australian Bureau of Statistics 2012); carer-recipient relationship was not available for the current study.

We expected that the care-giving context would be important for health impacts, with some factors contributing to negative impacts (burden and time conflicts due to work and family) and others being protective (education, income and social support). We found two important contextual factors, the time spent care-giving and work hours. Providing care for 20+ hours/week was associated with negative changes in both physical and mental health in both the shorter and longer terms. Higher working hours before care-giving were associated with substantial deterioration in physical health in the shorter term for female high caregivers, while higher current working hours were associated with deterioration in mental health. As only five high caregivers were still working after 4 years, there was no long-term effect found for work hours, but negative impacts persisted for high caregivers who were previously employed. Other contextual variables were associated with health, but were not associated with care-giving; these included marital status, children, income and perceived social support. Unlike Coe and van Houtven (2009), we did not find different care-giving effects for married and unmarried carers and although we expected care-giving health impacts to be modified by perceived social support, this was not the case (possibly due to the capacity of our measure to capture the relevant aspects).

The study has some limitations. A large number of carers were excluded because of missing or insufficient data; however, excluded carers were similar to the sample of carers used in the analysis on most characteristics. Some carer groups were excluded because of data limitations. The study was unable to examine care-giving of less than 1-year duration, which may have excluded some demanding and stressful care-giving episodes (such as end-of-life cancer care) of relatively short duration. The carers of children with disability were also excluded as the question about care-giving hours applied to adult care recipients only. We minimised the likelihood of misclassifying these carers as non-carers by excluding 'non-carers' in receipt of government financial support for care-giving. The time spent care-giving is self-reported and can be difficult for carers to estimate, but this is a commonly used question for this purpose. We identified a comparable group of non-carers using propensity score

matching, but are unable to determine the extent of sampling bias due to unmeasured factors. The inclusion of information about the care recipient's condition, relationship with the carer and the nature of the care provided would have enhanced the insights the study could provide, but this information was not available for the current analysis. Questions about care recipients were added in Wave 5 of HILDA, which will allow for this in future. Future research might also exploit health variables included in later waves of HILDA (such as body mass index) and examine health changes after care-giving ends.

This paper contributes to the available information regarding the impact of care-giving on health, which is a significant issue for many health systems. It draws on a large population-based cohort to address some limitations in the existing literature. Because the uptake and duration of care-giving may be related to carer factors (including health) as well as care recipient need, simple comparisons between carers and the general population of the same age may yield biased results. This study took the approach of comparing carers to non-carers who were similar on a large range of characteristics and focusing on change in health measures from before care-giving while accounting for pre-care-giving status. It was also able to investigate the impact of contextual factors less commonly addressed in the health literature, such as work and family, and identifies carer subgroups vulnerable to health impacts.

The health impacts of care-giving are not uniform; not all carers will have adverse mental or physical health changes and for some, the changes will be positive. However, those who are providing high levels of care and working are at risk of substantial negative health impacts. The differing impacts of care-giving suggest the need for a range of policy solutions, recognising the positive as well as the negative aspects of care-giving and encompassing employment and retirement policies, as well as health and social care. Informal carers comprise a substantial proportion of the population in many countries, which is likely to increase as these populations age and with increasing emphasis on maintaining the frail elderly at home. Increasing workforce participation among women and the extended age of workforce participation will result in increasing numbers combining work and informal care in the future. The challenges for policy include the tailoring of support services to the needs of individual carers, ensuring that employment conditions and health services provision can accommodate care-giving responsibilities and identify-

ing early interventions to maintain health where care-giving is long term.

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