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International Psychogeriatrics xxx (xxxx) xxx

Contents lists available at ScienceDirect

International Psychogeriatrics

journal homepage: www.sciencedirect.com/journal/inpsyc

Original Research Article

Caregiving, all-cause mortality and cause specific mortality: Findings from the NIH-AARP diet and health study

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ARTICLE INFO

Keywords:
Caregiving
All-cause mortality
Cause-specific mortality
Cohort study

ABSTRACT

Introduction: There have been conflicting findings in studies exploring the relationship between caregiving and mortality, which may relate to differences in type and intensity of caregiving.
Methods: In the prospective National Institutes of Health American Association of Retired Persons (NIH-AARP) Diet and Health Study (n = 148,792, mean age 70.8 years), we evaluated the association of caregiving with all-cause mortality and cause-specific mortality, and explore whether the association differed by type of caregiving (adult or children) and by duration. Hazard ratios (HR) and 95 % confidence intervals (CI) for mortality associated with caregiving were estimated with the use of Cox proportional-hazards regression models, with non-caregivers as the reference category.
Results: During a mean follow-up of 12.9 years, 59,046 deaths were recorded. Overall caregiving for adults (HR 0.90; 95 %CI 0.88–0.93) and children (HR 0.90; 95 %CI 0.87–0.92) were associated with a lower risk of all cause-mortality, which was consistent for cardiovascular and non-cardiovascular deaths.
Conclusions: Among older adults, caregiving was associated with an overall reduced risk of mortality. Future research should examine how the duration and type of caregiving, including physical and psychological components, affect caregiver health outcomes.

Impact Statement

We certify that this work is novel clinical research. In this large prospective cohort study of older adults, we demonstrated that caregiving for both adults and children was associated with a lower risk of mortality.

Key Points

- Caregiving of adults and children overall reduces mortality risk compared to non-caregivers within a retired population.
- There was a lower risk of all cause mortality, mortality from cardiovascular disease and from non cardiovascular causes.

Why Does this paper matter?

This study leverages a large population to demonstrate that caregiving is associated with lower all-cause and cause-specific mortality among older adults. However, the health implications of caregiving are not uniform and within the caregiving cohort there may be individuals at higher risk which warrants further exploration, particularly those delivering high intensity care for protracted periods to other adults.

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https://doi.org/10.1016/j.inpsyc.2026.100195
Received 8 July 2025; Received in revised form 6 January 2026; Accepted 4 February 2026

Introduction

The relationship between caregiving and caregiver mortality appears complex [1], with some prospective cohort studies reporting an increased risk of mortality in caregivers (compared to non-caregivers), most notably when caregiving for persons with significant functional and behavioural issues [2,3], while others reporting no association [4], or a lower risk of mortality among people providing informal caregiving [5–7]. With changing demographics, families are often now reliant on older relatives for childcare which could pose a strain especially among frail multimorbid individuals. Lee et al. previously suggested that women caregiving for grandchildren and unwell spouses are at higher risk of cardiovascular disease (CVD) compared to non-caregivers [8,9] highlighting that caregiving for children may have negative health impacts for retired populations.

In considering the health effects of caregiving, two prominent models have been proposed, a) the *stress process model*, which describes a causal framework linking caregiving to adverse health outcomes; and b) the *healthy caregiver model*, which describes a selection bias related to individuals volunteering to be caregivers finding they are healthier than their peer population. The stress process model hypothesises that a mix of primary and secondary stressors can impact physical and mental health outcomes in caregivers [10]. Although the causal framework is incompletely understood, it is hypothesised that health outcomes in caregivers may be affected by several mechanisms including the inability to maintain healthy diet, adequate sleep and exercise due to the primary focus of care being on the care recipient [11–13]. Furthermore, chronic stress may impact several physiological mechanisms causing higher levels of stress hormones and inflammatory markers [14,15] leading to hypertension, hyperlipidaemia and metabolic abnormalities [16]. The healthy caregivers model proposes an alternate hypothesis, that those who become caregivers are generally healthier adults and there may be physical and cognitive benefits to caregiving [17,18], which may be mediated through positive changes in some lifestyle risk factors (e.g. physical activity) or psychological benefits related to enhanced sense of purpose and contribution. Therefore, when evaluating the association of caregiving with health outcomes, any association may be confounded by this source of selection or sampling bias.

In evolving our understanding of the association of caregiving and mortality, a key consideration is cause-specific mortality. Many studies have focused on the association of caregiving with all-cause mortality rather than cause-specific mortality [3,17]. One observational study from Northern Ireland explored cause-specific mortality and found the most common cause of mortality among caregivers was cancer followed by cardiovascular causes. In that study, caregiving was associated with a lower risk of death on follow-up, compared to non-caregivers, however, analysis focusing on young caregivers (aged 5–24 years) determined they were at higher risk of mortality than non-caregiving peers with risk increasing as caregiving intensity increased [19,20]. Two more recent studies have also demonstrated a consistent lower risk of mortality among caregivers when cause-specific mortality was explored, particularly for mortality from cardiovascular, cerebrovascular and cancer causes [21,22].

The NIH-AARP study provides an opportunity to determine the association of caregiving with all-cause mortality and cause-specific mortality, and to explore factors that may mediate an association.

Methods

Study sample

To evaluate the association of caregiving and mortality, we analysed data from U.S. National Institutes of Health American Association of Retired Persons (NIH-AARP) Diet and Health Study [23]. The NIH-AARP is a prospective cohort study, established primarily to understand the association between diet and cancer and included 567,169 US adults, aged 50–71 years who completed a baseline questionnaire (1995–1996) on demographics, diet and health behaviours, a risk factor questionnaire (1996–1997), and a final questionnaire (2004).

Eligible participants were those who completed information on caregiving of adults and/or children in the final questionnaire. The study was approved by the National Cancer Institute Special Studies Institutional Review Board. We submitted a formal request for data to the NIH-AARP publications committee, with a detailed statistical analysis plan, which was approved in April 2020.

Assessment of exposure

Caregiving of adults was self-reported, and based on a question included in the final questionnaire asking *"During the past 12 months, approximately how much time per week did you participate in caring for another adult (for example, lifting, pushing a wheelchair, etc.)".*Caregiving of children was determined using a question in the same questionnaire asking "*During the past 12 months, approximately how much time per week did you participate in caring for children (for example, pushing a stroller, playing, lifting, etc.).*" Each participant selected the average total time per week spent caregiving adults and children separately. Participants could select from the following categories: 5 min, 15 min, 30 min, 1 h, 90 mins, 2–3 h, 4–6 h, 7–10 h or greater than 10 h. Respondents to these questions were categorised into non-caregivers, caregivers of adults and caregivers of children.

Prospective follow-up

Mortality was recorded by annually linking the cohort to the Social Security Administration Death Master File. To verify the participant was deceased, the National Death Index Plus (NDI) was searched and was used to obtain the cause of death. A previous study reported that 95 % of deaths can be identified using this method [24]. Follow-up time for all-cause mortality was from Aug 1, 2004 (time of questionnaire administration) to December 31, 2019. Annual linkage to the U.S. Postal Service's National Change of Address database was used to follow-up on participants, through processing undeliverable mail, using address change services, as well as participant notifications.

Causes of death

Causes of death were categorised using the National Centre for Health Statistics for vital status reporting [25] based on the causes of death provided by the NDI. Causes of death were categorised using the Surveillance, Epidemiology and End Results (SEER) database [26] which uses the International Classification of Diseases (ICD) classification. We investigated deaths from all causes, deaths due to CVD and non-cardiovascular causes of death (inclusive of cancer, respiratory Disease, Alzheimer's disease, accident, suicide, or homicide, diabetes, infectious causes, nephritis, nephrotic syndrome and nephrosis, chronic liver disease, congenital/perinatal and other/unknown cause of death).

Covariates

Several covariates were self-reported in questionnaires. These were categorised into demographic factors (age, race, sex, marital status, educational status), perception of health and well-being (depression, quality of life since retirement, self-reported general health status and trouble with activities of daily living), lifestyle cardiovascular risk factors (smoking, alcohol, body mass index, sleep duration, diet and physical activity) and co-morbidities (previous history of CVD, diabetes, hypertension, stroke, transient ischaemic attack (TIA), chronic obstructive pulmonary disease (COPD) and end stage kidney disease (ESKD)). Educational status was estimated from the highest level of education reported by participants.

A summary diet score was estimated using the HEI (Healthy Eating Index). The HEI score is a measure of adherence to federal diet recommendations (range from 0 to 100), aligned with the 2010 Dietary guidelines for Americans [27]. A maximum HEI score of 100 reflects the 'healthiest diet', in that the set of food items aligns with key dietary recommendations with a higher score reflecting a better diet. Physical activity was measured in final questionnaire and self-reported using the variable vigorous physical activity. Vigorous physical activity comprises the sum of the following individual activities; jogging, tennis, swimming, cycling and aerobic exercise measured in hours per week. Alcohol use was reported during baseline questionnaire of data collection and was categorised as current use of alcohol in the past year, with respondents answering yes or no. The smoking variable considered all questions asked about smoking during the final stage of data collection and categorised participants as never smoked, former smoker and current smoker. Sleep was reported as time spent per day over past 12 months sleeping at night or napping during the day. Participants could select from the following categories: None, less than 3 h, 3–4 h, 5–6 h, 7–8 h, 9–10 h, 11–12 h and more than 12 h.

Statistical analyses

Descriptive statistics were used to report the covariates included in the adjusted models. Continuous variables were reported as mean (SD) and compared using linear model Analysis of variance (ANOVA). Categorical variables were reported in proportions and compared using Pearson's Chi-squared test. All-cause mortality was the primary outcome measure. Cause-specific mortality were secondary outcome measures. Hazard ratios (HR) and 95 % confidence intervals (CI) for mortality associated with caregiving of adults and of children were estimated with the use of Cox proportional-hazards regression models. Non-caregivers were the reference category. We tested the proportional-hazards assumption by modelling the interaction of caregiving by time to follow-up. The underlying time variable was calculated from the scan date on the follow-up questionnaire which measured caregiving, until death from any cause, or the end of the follow-up on December 31, 2019.

We conducted a univariate and multivariable analysis of the association of caregiving with mortality. The multivariable model adjusted for age (at time of follow-up questionnaire); sex (male, female), race (Non-Hispanic White, Black, Hispanic, and Asian), marital status (married, widowed, separated, divorced, never married) and highest level of schooling completed (< 8 years of age, 8–11 years of age, 12 years or completed high school, post high-school or some college, college and post-graduate), self-reported history of depression; trouble with activities of daily living (none/slight trouble, significant trouble); quality of life since retirement (better/same, worse); self-reported general health (good/excellent, fair/poor),previous history of CVD, diabetes, hypertension, stroke, TIA, COPD, ESKD and behavioural risk factors; smoking (never/former or current smoker); alcohol (reported alcohol use in the past 12 months versus none); body mass index (continuous variable); sleep (≤6 hrs, 7–8 hrs or ≥9 h); vigorous physical activity (continuous variable) and diet (continuous variable).

In secondary analyses, we determined risk estimates for categories of caregiving within the caregiving cohort by increment of time spent caregiving each week. Categories included 1) caregiving of adults for less than 30 min, 30 min-1.5 h, 2–6 h, and 7 h or more; 2) caregiving of children for less than 30 min, caregiving of children 30 min-1.5 h, 2–6 h, and 7 h or more. Caregiving of children for less than 30 min was the reference category for these analyses. For cause-specific mortality, we collapsed duration of caregiving into increments of weekly time of < 2 h per week, 2–6 h per week and 7 h or more per week, with non-caregivers as the reference category. Analyses based on these categories was explored for the association between caregiving and all-cause mortality, CVD-mortality, cancer-related mortality, mortality due to Alzheimer's disease and mortality due to accident, suicide, or homicide.

All statistical analysis was performed using R version 3.6.3 and statistical significance was set at $p < 0.05$. As the analysis was confirmatory in nature, we did not adjust p-value for significance for multiple testing.

Results

Our analytic cohort consisted of 148,792 eligible participants. Among this cohort, 59,046 deaths were recorded between 1st of August 2004 and 31st of December 2019. Of the total sample included, 12.16 % (n = 18,101) reported being an adult caregiver at the time of survey, 17.41 % (n = 25,907) reported being a caregiver of children and the remaining 70.42 % (n = 104,784) were non-caregivers. The mean age was 70.5 (SD 5.1) years in those reporting being a caregiver for adults, 69.4 (SD 4.8) years in those reporting caregiving for children and 71.1 (SD 4.9) years in non-caregivers. Male respondents accounted for 60.2 % (n = 10,893) of caregivers of adults, 56.4 % of caregivers of children (n = 14,611) and 61.7 % of non-caregivers (n = 64,636). The majority of the analytic cohort were non-Hispanic white (94 %, n = 139,796). Most participants reported having good or excellent overall health status (90.2 %, n = 134,251), with 9.1 % (n = 1648) of caregivers of adults, 8.6 % of caregivers of children (n = 2231) and 10.2 % (n = 10,662) of non-caregivers reporting their health as being fair or poor. Characteristics of the analytic sample are outlined in Table 1.

Cardiovascular disease was the most common cause of death, attributed to 32.3 % (n = 19,101) of deaths in the cohort, followed by cancer (28.1 %, n = 16,608) respiratory disease (8.5 %, n = 5005) and Alzheimer's disease (3.8 %, n = 2249). Accident, suicide, or homicide was the underlying cause of death in 3.2 % (n = 1871) of the cohort. In 16.9 % (n = 9956) of participants who died, the cause of death was unknown.

Association of caregiving with all-cause mortality

During follow-up, mortality was 36.5 % (n = 6614) among adult caregivers, 32.5 % (n = 8420) among child caregivers and 42.0 % (n = 44,012) among non-caregivers. On multivariable analysis, self-reported caregiving for adults (HR 0.90; 95 % CI 0.88–0.93) and children (HR 0.90; 95 % CI 0.87–0.92) was associated with a reduced risk of all-cause mortality, compared to non-caregivers (Table 2, Fig. 1).

Association of caregiving with cause-specific mortality

During follow-up, 12.1 % (n = 2186) of adult caregivers, 10.2 % (n = 2637) of child caregivers and 13.6 % (n = 14,278) of non-caregivers had died from a reported cardiovascular cause. On multivariable analysis, caregiving for adults (HR 0.90; 95 % CI 0.86–0.95) and children (HR 0.88; 95 % CI 0.84–0.92) was associated with a reduced risk of cardiovascular mortality, compared to non-caregivers (Table 2, Fig. 1).

Mortality from non-cardiovascular causes was 24.5 % (n = 4428) in adult caregivers, 22.3 % (n = 5783) in child caregivers, and 28.4 % (n = 29,734) in non-caregivers. On multivariable analysis, caregiving for adults (HR 0.89; 95 % CI 0.86–0.92) and children (HR 0.88; 95 % CI 0.86–0.91) was associated with a reduced risk of mortality from non-cardiovascular causes, compared to non-caregivers (Table 2, Fig. 1).

On multivariable analysis, compared to non-caregivers, any form of caregiving was associated with lower mortality from cancer (HR 0.90; 95 % CI 0.87–0.93), Alzheimer's Disease (HR 0.84; 95 % CI 0.77–0.92) and accidents, suicide, or homicide (HR 0.77; 95 % CI 0.71–0.86). (Table 3).

Milestone analysis

The Cox-proportional Hazards assumption was tested for all-cause mortality and was statistically significant (p-value = < 0.05), and on

Table 1
Baseline participant characteristics.

	Non-caregiver (N = 104784)	Caregiver of Adults (N = 18101)	Caregiver of children (N = 25907)	Total (N = 148792)	P value
Age					< 0.001
Mean (SD)	71.1 (4.9)	70.5(5.1)	69.4 (4.8)	70.8 (4.9)	
Sex					< 0.001
Female	40148 (38.3 %)	7208 (39.8 %)	11296 (43.6 %)	58652 (39.4 %)	
Race					< 0.001
Non-Hispanic White	98745 (94.2 %)	16949 (93.6 %)	24102 (93.0 %)	139796 (94.0 %)	
Black	3059 (2.9 %)	662 (3.7 %)	875 (3.4 %)	4596 (3.1 %)	
Hispanic	1581 (1.5 %)	263 (1.5 %)	458 (1.8 %)	2302 (1.5 %)	
Asian	1399 (1.3 %)	227 (1.3 %)	472 (1.8 %)	2098 (1.4 %)	
History of depression					< 0.001
Yes	13895 (13.3 %)	2767 (15.3 %)	3456 (13.3 %)	20118 (13.5 %)	
Quality of retired life (compared to working life)					< 0.001
Better/Same	92646 (88.4 %)	15741 (87.0 %)	23303 (89.9 %)	131690 (88.5 %)	
Worse	12138 (11.6 %)	2360 (13.0 %)	2604 (10.1 %)	17102 (11.5 %)	
Trouble with ADLs					< 0.001
None/Slight trouble	76359 (72.9 %)	13313 (73.5 %)	19853 (76.6 %)	109525 (73.6 %)	
Significant trouble	28425 (27.1 %)	4788 (26.5 %)	6054 (23.4 %)	39267 (26.4 %)	
Self-Reported General Health					< 0.001
Good/Excellent	94122 (89.8 %)	16453 (90.9 %)	23676 (91.4 %)	134251 (90.2 %)	
Fair/Poor	10662 (10.2 %)	1648 (9.1 %)	2231 (8.6 %)	14541 (9.8 %)	
BMI					< 0.001
Mean (SD)	27.1 (5.1)	27.3 (4.9)	27.2 (5.0)	27.1 (5.1)	
Sleep (hours/day)*					< 0.001
7–8hrs	60814 (59.3 %)	10396 (58.6 %)	15450 (60.9 %)	86660 (59.5 %)	
< 6hrs	26393 (25.7 %)	5023 (28.3 %)	6576 (25.9 %)	37992 (26.1 %)	
≥ 9hrs	15415 (15.0 %)	2326 (13.1 %)	3324 (13.1 %)	21065 (14.5 %)	
Physical Activity**					< 0.001
< 75 mins per week	59869 (57.1 %)	9145 (50.5 %)	13393 (51.7 %)	82407 (55.4 %)	
≥ 75 mins per week	44912 (42.9 %)	8952 (49.5 %)	12513 (48.3 %)	66377 (44.6 %)	
Smoking Status					< 0.001
Never/Former	98073 (93.6 %)	17084 (94.4 %)	24426 (94.3 %)	139583 (93.8 %)	
Current	6711 (6.4 %)	1017 (5.6 %)	1481 (5.7 %)	9209 (6.2 %)	
Use of alcohol in last year					
Yes	82488 (79.1 %)	13919 (77.2 %)	20219 (78.4 %)	116626 (78.7 %)	< 0.001
Total HEI-2015 Score					0.001
HEI < 50	4126 (3.9 %)	642 (3.5 %)	1024 (4.0 %)	5792 (3.9 %)	
HEI 50–65	34964 (33.4 %)	6084 (33.6 %)	8824 (34.1 %)	49872 (33.5 %)	
HEI 66–80	55689 (53.1 %)	9699 (53.6 %)	13770 (53.2 %)	79158 (53.2 %)	
HEI ≥ 80	10005 (9.5 %)	1676 (9.3 %)	2289 (8.8 %)	13970 (9.4 %)	
History of CVD					
Yes	21269 (20.3 %)	3374 (18.6 %)	4678 (18.1 %)	29321 (19.7 %)	< 0.001
History of Diabetes					
Yes	18108 (17.3 %)	2863 (15.8 %)	4084 (15.8 %)	25055 (16.8 %)	< 0.001
History of Hypertension					
Yes	59222 (56.5 %)	10016 (55.3 %)	14040 (54.2 %)	83278 (56.0 %)	< 0.001
History of COPD					
Yes	4400 (4.2 %)	616 (3.4 %)	796 (3.1 %)	5812 (3.9 %)	< 0.001
History of ESKD					
Yes	492 (0.5 %)	70 (0.4 %)	127 (0.5 %)	689 (0.5 %)	0.247
History of Stroke					
Yes	4400 (4.2 %)	616 (3.4 %)	796 (3.1 %)	5812 (3.9 %)	< 0.001
History of TIA					
Yes	4703 (4.5 %)	773 (4.3 %)	965 (3.7 %)	6441 (4.3 %)	< 0.001

Table 1: Data are n (%) or mean (SD).
BMI = Body Mass Index; ADL = Activities of Daily Living; HEI = Healthy Eating Index; CVD = Cardiovascular Disease; COPD = Chronic Obstructive Pulmonary Disease; ESKD = End Stage Kidney Disease; TIA = Transient Ischaemic Attack
Data were missing in 7863 for BMI; 3075 for sleep; 8 for vigorous physical activity and 646 for alcohol use.
* Sleeping at night or napping during the day
** Sum duration (minutes/week) of vigorous intensity

exploring the Kaplan-Meier curves, we elected to conduct a milestone analysis by duration of follow-up. We performed an analysis of all-cause mortality for participants whose follow-up period terminated within the first two years of follow-up and those that were followed up from two years to end of follow-up. Overall, the association of caregiving and mortality among adult caregivers (HR 0.97; 95 % CI 0.86–1.09) and child caregivers was not significant within short-term follow-up (HR 1.02; 95 % CI 0.92–1.14) but was statistically significant after two years follow-up for both caregivers of adults (HR 0.90; 95 % CI 0.88–0.93) and caregivers of children (HR 0.89; 95 % CI 0.87–0.91) (Supplementary Material, Table S1).

Subgroup analysis of caregiving sample alone

In our analysis confined to caregivers (reference category was child caregiving < 30 min per week), we observed a graded reduction in all-cause mortality for increased duration of child caregiving but a graded increase in all-cause mortality with increased duration of adult

Table 2
Association between caregiving and all-cause, cardiovascular and non-cardiovascular mortality, among participants in the NIH-AARP diet and health study.

	All-Cause Mortality	Cardiovascular Deaths	Non-Cardiovascular Deaths
Univariate	**HR (95 % CI)**	**HR (95 % CI)**	**HR (95 % CI)**
Non-Caregivers	Ref	Ref	Ref
Caregiver of Adults	0.83 (0.81–0.85)	0.82 (0.78–0.86)	0.81 (0.79–0.84)
Caregiver of children	0.71 (0.70–0.73)	0.66 (0.64–0.69)	0.71 (0.69–0.73)
Multivariate			
Non-Caregivers	Ref	Ref	Ref
Caregiver of Adults	0.90 (0.88–0.93)	0.90 (0.86–0.95)	0.89 (0.86–0.92)
Caregiver of children	0.90 (0.87–0.92)	0.88 (0.84–0.92)	0.88 (0.86–0.91)

Multivariate: Adjusted for age, race, sex, marital status, education, vigorous physical activity, smoking, alcohol use, diet, body mass index, sleep, depression, Quality of life since retirement compared to working life, personal trouble with activities of daily living, self-reported overall health history of hypertension, diabetes, cardiovascular disease, end stage kidney disease, stroke, transient ischaemic attack and chronic obstructive pulmonary disease
HR = Hazard Ratio; CI = Confidence Interval

caregiving, on univariate analysis. However, following multivariable adjustment, there was no significant association, suggesting that the association observed on univariate analysis was explained by mediating and/or confounding variables (Fig. 2)

Discussion

In this large prospective cohort study, we found that caregiving for adults and children was associated with a lower overall risk of all-cause mortality, as well as mortality from cardiovascular and non-cardiovascular causes. Although statistically significant, the magnitude of these associations was modest, suggesting that while caregiving may confer some protective benefit, its practical impact on mortality risk is likely small. This pattern supports the healthy caregiver hypothesis, whereby caregivers may experience an increased sense of purpose and remain more physically and cognitively engaged through providing care [18]. Healthier individuals may also be more likely to assume caregiving roles, which could partly account for the observed associations.

Across the literature the definition of caregiving for adults varies with most definitions encompassing that care delivered is unpaid, that there is a pre-existing relationship with the person requiring care [28]. Studies have also defined caregiving by living arrangements, relationship type and illness type [29].Some studies have provided breakdown of caregiving by quantity of time [30,31], which may act as a surrogate for strain. The definition of caregiving within this study was based on

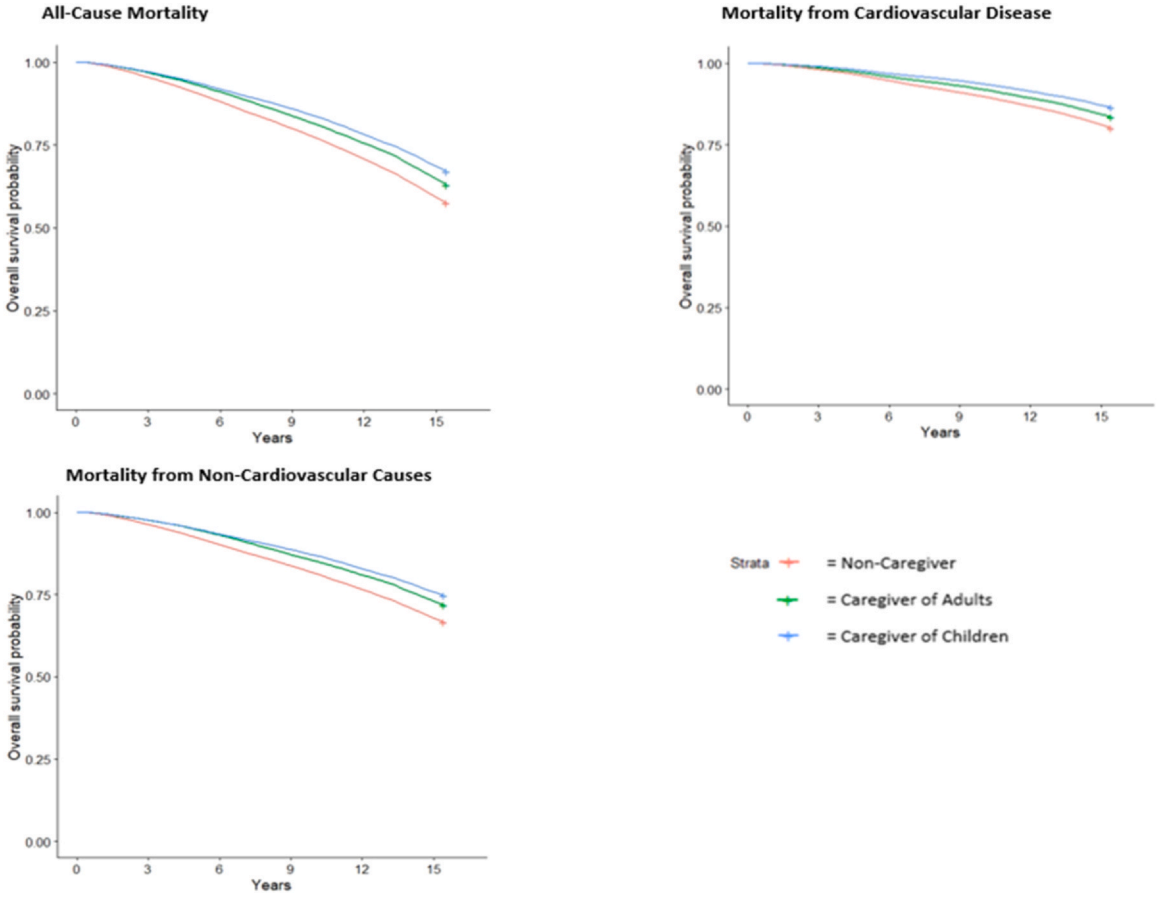
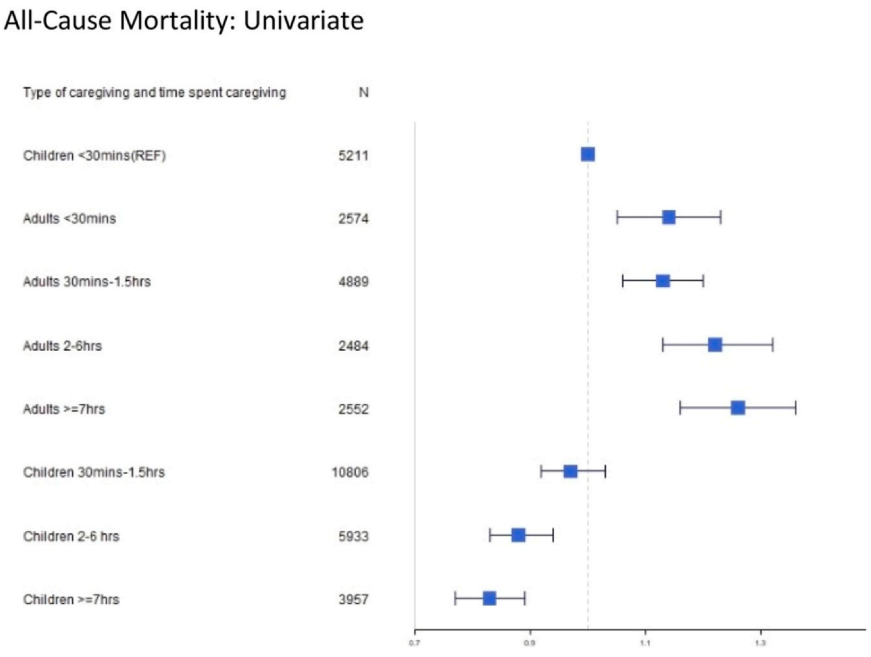


Fig. 1. Kaplan Meier curve all-cause mortality, CVD mortality, mortality from non-CVD causes. Fig. 1 Univariate Survival curves for caregivers of adults (green line, n = 18,501), caregivers of children (blue line, n = 26,422) and non-caregivers (red line, n = 107,061), from the NIH-AARP Diet and Health Study over the 15 years of follow-up after enrolment, 2004–2019 for all causes of death, death from cardiovascular causes and death from non-cardiovascular causes.

Table 3
Association between caregiving and all-cause mortality, CVD-mortality, cancer related mortality, mortality due to Alzheimer's disease and mortality due to accident, suicide, or homicide.

	All-Cause Mortality HR (95 % CI)		Mortality due to Cardiovascular Disease HR (95 % CI)		Cancer Mortality HR (95 % CI)		Alzheimer's disease Mortality HR (95 % CI)		Mortality due to Accident, Suicide, Homicide HR (95 % CI)	
	Univariate	**Multivariate**	**Univariate**	**Multivariate**	**Univariate**	**Multivariate**	**Univariate**	**Multivariate**	**Univariate**	**Multivariate**
Any Caregiving	0.76 (0.75–0.78)	0.90 (0.88–0.92)	0.72 (0.70–0.75)	0.89 (0.86–0.92)	0.78 (0.75–0.80)	0.90 (0.87–0.93)	0.68 (0.63–0.72)	0.84 (0.77–0.92)	0.66 (0.60–0.72)	0.77 (0.71–0.86)
Any Adult	0.83 (0.81–0.85)	0.90 (0.88–0.93)	0.82 (0.78–0.86)	0.90 (0.86–0.95)	0.82 (0.78–0.86)	0.90 (0.86–0.95)	0.75 (0.67–0.84)	0.82 (0.73–0.93)	0.70 (0.62–0.80)	0.74 (0.65–0.85)
Any Child	0.71 (0.70–0.73)	0.90 (0.87–0.92)	0.66 (0.64–0.69)	0.88 (0.84–0.92)	0.75 (0.72–0.78)	0.91 (0.87–0.95)	0.64 (0.57–0.71)	0.86 (0.77–0.96)	0.63 (0.56–0.70)	0.80 (0.71–0.90)
Any Caregiving										
< 2 hrs week	0.77 (0.75–0.79)	0.90 (0.88–0.92)	0.73 (0.70–0.76)	0.88 (0.84–0.92)	0.78 (0.75–0.81)	0.89 (0.86–0.93)	0.71 (0.64–0.78)	0.86 (0.78–0.96)	0.68 (0.61–0.76)	0.77 (0.62–0.86)
2–6 hrs week	0.73 (0.71–0.76)	0.90 (0.87–0.93)	0.72 (0.67–0.76)	0.92 (0.86–0.98)	0.78 (0.73–0.83)	0.92 (0.86–0.98)	0.68 (0.58–0.80)	0.86 (0.72–1.01)	0.63 (0.52–0.75)	0.77 (0.64–0.93)
≥ 7 hrs week	0.63 (0.52–0.78)	0.93 (0.76–1.15)	0.52 (0.36–0.76)	0.77 (0.52–1.15)	0.64 (0.45–0.92)	0.90 (0.61–1.33)	0.61 (0.25–1.46)	1.12 (0.46–2.70)	*Not sig (v large CI)*	*Not sig (v large CI*
Adult Caregiving										
< 2 hrs week	0.80 (0.77–0.83)	0.88 (0.85–0.91)	0.79 (0.75–0.84)	0.89 (0.84–0.94)	0.78 (0.73–0.83)	0.86 (0.81–0.92)	0.74 (0.64–0.86)	0.85 (0.73–0.99)	0.68 (0.58–0.80)	0.74 (0.62–0.87)
2–6 hrs week	0.88 (0.83–0.93)	0.94 (0.88–0.99)	0.90 (0.81–0.99)	0.97 (0.87–1.07)	0.89 (0.80–0.99)	0.96 (0.86–1.07)	0.82 (0.63–1.07)	0.81 (0.61–1.08)	0.76 (0.57–1.02)	0.77 (0.56–1.05)
≥ 7 hrs week	0.92 (0.87–0.98)	0.95 (0.89–1.01)	0.92 (0.83–1.01)	0.91 (0.81–1.01)	0.94 (0.84–1.05)	0.96 (0.86–1.07)	0.68 (0.50–0.91)	0.65 (0.47–0.89)	0.77 (0.57–1.04)	0.73 (0.52–1.00)
Children Caregiving										
< 2 hrs week	0.75 (0.73–0.77)	0.90 (0.88–0.93)	0.69 (0.66–0.73)	0.88 (0.83–0.92)	0.78 (0.74–0.82)	0.91 (0.87–0.96)	0.69 (0.61–0.78)	0.88 (0.77–0.99)	0.68 (0.60–0.78)	0.81 (0.71–0.94)
2–6 hrs week	0.67 (0.64–0.70)	0.87 (0.83–0.92)	0.63 (0.59–0.69)	0.88 (0.81–0.96)	0.73 (0.67–0.79)	0.90 (0.83–0.98)	0.62 (0.51–0.76)	0.88 (0.71–1.08)	0.57 (0.46–0.72)	0.77 (0.61–0.98)
≥ 7 hrs week	0.63 (0.60–0.67)	0.89 (0.84–0.94)	0.57 (0.51–0.63)	0.87 (0.78–0.97)	0.66 (0.59–0.73)	0.90 (0.80–0.99)	0.52 (0.39–0.68)	0.80 (0.60–1.06)	0.50 (0.37–0.67)	0.77 (0.56–1.05)

Multivariate = Adjusted for age, race, sex, marital status, education, vigorous physical activity, smoking, alcohol use, diet, body mass index, sleep, depression, Quality of life since retirement compared to working life, personal trouble with activities of daily living, self-reported overall health history of hypertension, diabetes, cardiovascular disease, end stage kidney disease, stroke, transient ischaemic attack and chronic obstructive pulmonary disease
Hrs = h; HR = Hazard Ratio; CI = Confidence Interval



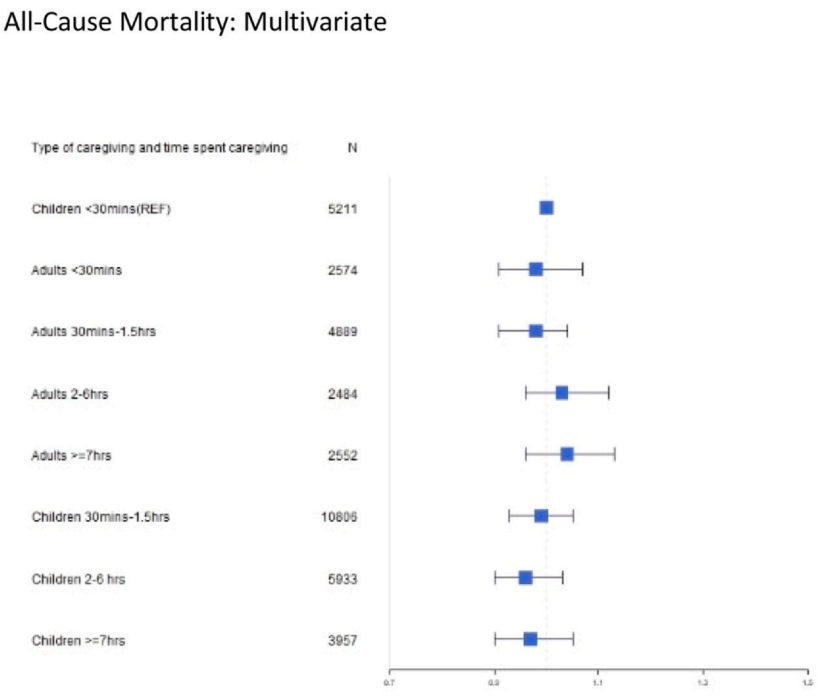


Fig. 2. Association Between Caregiving and All-Cause Mortality among caregivers in the NIH-AARP Diet and Health Study. Fig. 2: Hazard ratios for death from all causes and from specific causes are for the comparison of caregivers of children and of adults by time spent caregiving compared to caregivers of children for thirty minutes or less per week. Participants were classified by duration of caregiving; caregiving of adults for less than 30 mins, 30min-1.5 h, 2–6 h, and 7 h or more, caregiving of children for less than 30 mins, caregiving of children 30min-1.5 h, 2–6 h and 7 h or more. Multivariate model adjusted for age, race, sex, marital status, education, vigorous physical activity, smoking, alcohol use, diet, body mass index, sleep, depression, Quality of life since retirement compared to working life, personal trouble with activities of daily living, self-reported overall health history of hypertension, diabetes, cardiovascular disease, end stage kidney disease, stroke, transient ischaemic attack and chronic obstructive pulmonary disease.

time spent delivering physical care alone but did not explore the physical and psychological intensity associated with caregiving and may account for the strength and direction of our findings.

In our analysis of cause-specific mortality, low-to-moderate caregiving duration was associated with lower hazard of death from cardiovascular disease, cancer, and Alzheimer's disease, with the most pronounced reduction observed for deaths due to accidents, suicide, and homicide. These effects were generally small in magnitude, though consistent with previous observational findings [6,21,22]. Among caregivers providing ≥ 7 h of care weekly, most associations were attenuated and no longer significant, except for deaths due to Alzheimer's disease (HR 0.65; 95 % CI 0.47–0.89) (Table 3), which represents a moderate effect size. This finding aligns with Mikkola et al. [21] and may reflect both selection effects, since individuals with dementia are unlikely to serve as caregivers, and the cognitive engagement hypothesis, whereby caregiving activities help preserve cognitive function.

A limitation of our study is the inability to determine the association of high-intensity adult caregiving, especially in settings associated with caregiver strain. Collectively, findings from observational studies would appear to support the need to identify certain cohorts of caregivers of adults, likely those delivering care for higher durations and intensities that may benefit from health interventions (i.e., those for whom the stress process model may have relevance). For example, those looking after more dependent co-morbid adults for durations of high intensity

are often older, female, non-White, have lower income levels and more often live with their care recipient [32,33]. Key additional factors to consider outside of these demographic findings include relationship to the care recipient, duration of daily care, functional status of the care recipient, provision of overnight care and professional home supports and therapies. Given the suggested protective benefit identified in this study, caregivers should be supported adequately and empowered within their roles, with healthcare providers mindful of those exposed to caregiving environments which are high demand, stressful and result in physical burden.

There were several limitations associated with this study. First, the cohort analysed were mainly white, well educated, married older adults in overall good health, limiting the generalisability to other socio-economic populations. The design and sampling of the NIH-AARP study was intended to explore the relationship between diet and health which therefore may restrict the interpretation of our findings. Second, we did not have information on level of disability of care recipient, if they were living within the same household as the caregiver, their underlying diagnosis, the relationship between both parties and detail on caregiving duties provided. Third, as this study was questionnaire based, respondents self-reported key variables rather than objective measurements being obtained and therefore some covariates could be subject to self-reporting bias e.g., sleep and overall health status. Additionally, we did not adjust the p-value for multiple testing. Fourth, there was no clear measurement of caregiving strain in this study; in lieu of this we used history of depression and quality of life since retirement as surrogate markers. Finally, age was a significant confounder in this sample. On adjustment for age alone there was no association with caregiving for adults and all-cause mortality which was unsurprising given the mean age of the analytic cohort was 70.8 years. However, on further adjustment for sex and race, caregiving for adults for higher periods of time (two hours or more) re-emerged as a risk factor for all-cause mortality suggesting the need for specific population selection.

Despite these limitations there were several strengths to this study. First was the large analytic sample and follow-up period which allowed us to explore caregiving, lifestyle factors, all-cause and cause-specific mortality. In addition, this study uniquely captured time spent caregiving for adults and time spent caregiving for children allowing for a robust exploration of mortality across the spectrum of caregiving which older adults provide.

In conclusion, caregiving of adults and children was associated with a reduction in the odds of death (during follow-up) compared to non-caregivers. Limitations of our study preclude determining whether specific types of caregiving (e.g. severe dementia) may have differing directions of association.

CRediT authorship contribution statement

Clodagh McDermott: Writing – review & editing. **O'Donnell Martin:** Writing – review & editing, Supervision, Conceptualization. **Andrew Smyth:** Writing – review & editing. **Canavan Michelle:** Writing – review & editing, Supervision, Conceptualization. **Conor Judge:** Writing – review & editing, Formal analysis. **Costello Maria:** Writing – review & editing, Writing – original draft, Validation, Methodology, Formal analysis, Conceptualization. **Robert Murphy:** Writing – review & editing. **Catriona Reddin:** Writing – review & editing.

Funding

None.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Declaration of Generative AI and AI-assisted technologies in the writing process

There was no use of AI or AI assisted technologies in the writing process.

Acknowledgements

This research was supported by the Intramural Research Program of the NIH, National Cancer Institute. Cancer incidence data from the Atlanta metropolitan area were collected by the Georgia Center for Cancer Statistics, Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, Georgia. Cancer incidence data from California were collected by the California Cancer Registry, California Department of Public Health's Cancer Surveillance and Research Branch, Sacramento, California. Cancer incidence data from the Detroit metropolitan area were collected by the Michigan Cancer Surveillance Program, Community Health Administration, Lansing, Michigan. The Florida cancer incidence data used in this report were collected by the Florida Cancer Data System (Miami, Florida) under contract with the Florida Department of Health, Tallahassee, Florida. The views expressed herein are solely those of the authors and do not necessarily reflect those of the FCDC or FDOH. Cancer incidence data from Louisiana were collected by the Louisiana Tumor Registry, Louisiana State University Health Sciences Center School of Public Health, New Orleans, Louisiana. Cancer incidence data from New Jersey were collected by the New Jersey State Cancer Registry, The Rutgers Cancer Institute of New Jersey, New Brunswick, New Jersey. Cancer incidence data from North Carolina were collected by the North Carolina Central Cancer Registry, Raleigh, North Carolina. Cancer incidence data from Pennsylvania were supplied by the Division of Health Statistics and Research, Pennsylvania Department of Health, Harrisburg, Pennsylvania. The Pennsylvania Department of Health specifically disclaims responsibility for any analyses, interpretations, or conclusions. Cancer incidence data from Arizona were collected by the Arizona Cancer Registry, Division of Public Health Services, Arizona Department of Health Services, Phoenix, Arizona. Cancer incidence data from Texas were collected by the Texas Cancer Registry, Cancer Epidemiology and Surveillance Branch, Texas Department of State Health Services, Austin, Texas. Cancer incidence data from Nevada were collected by the Nevada Central Cancer Registry, Division of Public and Behavioral Health, State of Nevada Department of Health and Human Services, Carson City, Nevada. We are indebted to the participants in the NIH-AARP Diet and Health Study for their outstanding cooperation. We also thank Sigurd Hermansen and Kerry Grace Morrissey from Westat for study outcomes ascertainment and management and Leslie Carroll at Information Management Services for data support and analysis.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.inpsyc.2026.100195.

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