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Caring for the Caregiver: Investigating the Relationship Between Caregiving, Gender, and Diabetes Risk in MIDUS II

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Abstract

This study examines whether caregiving presents an equal risk for diabetes among gender. This study uses data from the second wave of the Midlife in the United States Survey, which included biological markers. We tested the relationship between caregiving and risk of diabetes across various models, controlling for demographics, confounders, and mechanisms that can explain the relationship. Cross-sectional analysis of the Homeostatic Model Assessment of Insulin Resistance (HOMO-IR) determined that (1)men had a higher risk of diabetes than women overall; (2)male caregivers demonstrated a lower risk of diabetes compared to non-caregiving men; (3)female caregivers exhibited a non-significant elevation in diabetes risk compared with non-caregiving females. Findings establish the basis for future studies which identify cardiometabolic disease risks between genders. Our study also provides foundation for future studies to expand and identify differences in psychosocial resources among male and female caregivers which may mitigate cardiometabolic disease risk.

Keywords

caregiving, diabetes, gender

What the paper adds

- Caregiving status may be associated with health outcomes and longevity in a gender-specific way, with higher HOMA-IR levels observed in men and women.
- Caregiving women demonstrated a higher risk of diabetes compared to non-caregiving women.
- Caregivers and men with higher depression showed associations with higher diabetes risk.

Applications of study findings

- Our healthcare system depends on unpaid healthcare providers, and the deteriorating health of these caregivers will directly impact patient outcomes.
- Identifying gender differences in specific cardiometabolic disease risk will be important for optimizing the recent strides that have been made in policies advocating for paid family medical leave.
- In wake of the US aging population, it is critical that we understand how caregiving stress accelerates the disease process among unpaid family caregivers.

Introduction

The Unpaid Caregiver

Family caregivers play a crucial role in providing unpaid caregiving responsibility and long-term services. According to the National Alliance for Caregiving and AARP, approximately 21% of Americans currently serve as family caregivers. These caregivers are vital in allowing patients to remain in their communities, reducing reliance on formal care services. The value of unpaid care provided by family members far exceeds that of paid care, significantly lowering the need for costly formal care services and enabling many older individuals to remain in their homes rather than transitioning to residential care facilities (Caldera et al., 2023; Wolff et al., 2016). Despite their invaluable contributions, caregiving can be stressful, and burnout may contribute to the decline in caregivers' health (Son et al., 2007; Tough et al., 2022). Unfortunately, policy discussions often overlook the importance of their role (Caldera et al., 2023). Numerous studies highlight the physical, emotional, and financial strains experienced by many family caregivers (Wolff et al., 2016).

Family caregiving encompasses both positive and negative impacts on caregivers' health and well-being (Andrén & Elmståhl, 2008). While caregivers often report poorer subjective health compared to non-caregivers, with physical health declining in association with greater caregiver burden and depressive symptoms (Aggarwal et al., 2009; Anderson et al., 2021; Andrén & Elmståhl, 2008), caregiving does not act in isolation. Rather, its effects are mediated through multiple factors. For example, lifestyle behaviors such as physical inactivity and poor diet, access to healthcare, psychosocial resilience, and the presence of social support or coping strategies can buffer or exacerbate the toll of caregiving. Longitudinal studies indicate that spousal caregivers, particularly those caring for individuals with dementia or cancer, face heightened risks of frailty and cardiovascular diseases (Lee & Li, 2022; Northouse et al., 2012). Caregiver strain is a significant predictor of negative health outcomes, including mortality (Baik et al., 2024). Biological indicators, such as stress hormones and immune function, further highlight the toll caregiving takes on the body, increasing risks of cardiometabolic changes, proinflammatory responses, and immune suppression (Lee & Li, 2022; Tough et al., 2022). Notably, caregiving, especially "sandwiched caregiving," represents a chronic stressor (Lei et al., 2023). The unique nature of unpaid caregiving—without the opportunity for unionizing or taking sick days—further exacerbates these challenges.

However, caregiving also offers potential for personal growth, enhanced self-esteem, and deeper relationships for many caregivers (Lei et al., 2023). Positive psychological effects, such as reduced feelings of burden and depression, can mitigate some of the negative health consequences of caregiving, leading to better overall mental health (Li et al., 2023). These positive effects, however, do not negate the physical demands of caregiving, which often result in injuries such as backaches, muscle strains, and contusions (Lee & Li, 2022). Thus, understanding the nuances of family caregiving—both its rewards and challenges—is essential for developing interventions and support systems that address caregivers' diverse needs and promote their well-being (Li et al., 2023; Ong et al., 2018).

Female Caregivers: Unique Health Risks

Unpaid caregiving is predominantly performed by middle-aged females (Lei et al., 2023; Stall et al., 2023). These caregivers, often "sandwiched," navigate the dual responsibilities of caring for both their children and aging parents (Gonyea et al., 2008; Lei et al., 2023). The constant juggling of caregiving duties with other life obligations can initiate a chronic stress cycle, contributing to feelings of isolation and burnout (Bonin-Guillaume et al., 2022). Female caregivers, in particular, may also experience grief, guilt, and other emotional burdens as they witness the decline of their care recipients' health. Caregiving, especially in the context of "sandwiched caregiving," can accelerate the progression of chronic diseases. Previous studies underscore the adverse effects of caregiving on mental health and physical well-being, including heightened risks of depression, pain, and cardiovascular disease (Andrén & Elmståhl, 2008; Tough et al., 2022). The combined physical and emotional demands often lead to a chronic stress cycle, which is linked to the development of chronic diseases, including cardiovascular disease (Aggarwal & Mosca, 2009; Baik et al., 2024).

When considering the impact of caregiving on heart disease risk, particularly among females, a variety of factors come into play. Research suggests that female caregivers face stronger correlations between caregiving and cardiovascular disease (Lambrias et al., 2023; Xiong et al., 2020). Women, especially those caring for spouses with chronic or terminal diseases, face unique challenges and stressors that heighten their cardiovascular risk (Baik et al., 2024; Lee & Li, 2022). Racial and cultural factors also influence cardiovascular risk, as Hispanic and non-Caucasian caregivers may experience disproportionate levels of caregiving stress due to socioeconomic and cultural factors (Baik et al., 2023). These caregivers may have limited access to healthcare resources and support, exacerbating the impact of caregiving stress on cardiovascular health (Baik et al., 2023).

Cardiovascular disease (CVD) is multifaceted and often co-occurs with comorbid metabolic diseases, such as diabetes mellitus. Diabetes, a metabolic disorder characterized by insulin resistance and elevated blood sugar levels, is a well-established risk factor for cardiovascular disease. It contributes to atherosclerosis, hypertension, dyslipidemia, and obesity, all of which further increase cardiovascular risk. Diabetes also damages blood vessels and nerves, leading to complications like peripheral artery disease and diabetic neuropathy, which heighten the likelihood of cardiovascular events. Interestingly, women exhibit fewer risk factors for

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heart disease compared to men; however, studies suggest that caregiving responsibilities may "tip the scales," making female caregivers more susceptible to cardiovascular disease and mortality despite these differences (Baik et al., 2024). Yet, gaps remain in the literature regarding how comorbidities like diabetes and poor glucose control contribute to cardiovascular risk in female caregivers.

Male Caregivers: Unique Health Benefits

Given that family caregiving has been predominantly shouldered by women (Sharma et al., 2016), few studies have focused on identifying differences in disease risk among male and female caregivers. However, the demand for family caregiving is increasing given the aging population. Many studies have focused on the differences in mental health between male and female caregivers (Xiong et al., 2020). Females demonstrate poorer mental health and perceived well-being among female caregivers, compared to male caregivers (Zwar et al., 2023).

One potential mechanism that may explain differences in health outcomes between men and women is the phenomenon of male self-selection into caregiving roles (Ramírez-Perdomo et al., 2024). Given that men are not normatively expected to take on caregiving roles, most male caregivers are already healthy. Conversely, female caregivers are often expected to assume caregiving responsibilities regardless of their health status (Swinkels et al., 2017). Therefore, men who take on caregiving roles may represent a select group who are healthier at baseline. This pattern differs from that of women, for whom caregiving responsibilities are more often culturally and socially obligatory, irrespective of health status. As a result, the female caregiving population is more heterogeneous in terms of health, which may obscure potential protective health effects of caregiving when compared to men. The expectation that women will fulfill caregiving roles, even when they have preexisting health conditions, may also explain why sex differences in the relationship between caregiving and metabolic health outcomes are observed. Additionally, men and women may perceive the caregiver burden differently, with women having higher self-expectations for care standards and perceived a greater care burden (De Graaff et al., 2025). However, few studies have identified specific differences in cardiometabolic disease risk among male and female caregivers.

Study Objectives

This study aims to address critical gaps in the literature regarding the intersection of caregiving, gender, and diabetes risk. We seek to explore (1) whether caregiving is associated with insulin resistance, as measured by HOMA-IR, and (2) whether this association differs by gender. Given that caregiving, especially among women, is linked to increased cardiovascular risk, clarifying these gender differences will be essential for optimizing recent policy efforts advocating for paid family medical leave. By identifying cardiometabolic disease risks in family caregivers, this study aims to emphasize the importance of targeted interventions and lifestyle modifications to prevent heart disease in caregivers.

Methods

Data and Sample

Data for the present study were drawn from the second wave of the National Survey of Midlife Development in the United States (MIDUS, 1995–2014). The second wave (MIDUS II) contains both survey responses and biomarker data for participants, and the data was collected between 2004 and 2009 (Ryff et al., 2021). For the survey, the University of Wisconsin Institute surveyed participants from the general population; from whom 75% were recontacted after the MIDUS-1 study in 1995. The project 4 about biomarker is a random subsample of the participants who completed the MIDUS II Survey. There were 4963 total participants in MIDUS II 25.06% of these participants agreed to provide biomarker data. The complete MIDUS II dataset contains data on 1244 participants, with a mean age of 54.5 years (SD = 11.7) and 56.7% being female. The study uses a cross-sectional design based on these participants.[1] The participants in the biomarker project were selected based on their willingness and ability to join one of the three hospitals running the project (UCLA, University of Wisconsin, and Georgetown University).[2] The sociodemographic variables are similar in the biomarker project than the whole MIDUS II sample.[3]

Measures

Insulin Resistance. We used Homeostatic Model Assessment of Insulin Resistance (HOMA-IR) as a measure of insulin resistance. Biomarker values were natural log-transformed to achieve normal distributions. Fasting blood samples were collected from each participant before breakfast on day 2 of their overnight hospital stay. To ensure consistency, all samples were collected and processed at the GCRC using standardized procedures. HOMA-IR is a quantitative variable between 0 and 100%.

Caregiving. Participants were asked whether they had "personally cared for a period of one month or more to a family member or friend because of a physical or mental condition, illness, or disability." Caregiving status was coded with a 1 = yes and 0 = no. Most of our sample identifies as non-caregivers (n = 974), while caregivers (n = 158) were more likely to be women (n = 92 vs. men n = 66).

Depression. Depression was measured with two different questionnaires. The first one is the aggregation of negative affects using the PANAS (Positive and Negative Affect Schedule, Watson et al., 1998), with 10 questions "indicate to what extent you have felt this way during the past week" from not at all to extremely." The second is the CES-D (Center for Epidemiologic Studies-Depression, Radloff, 1977), a 20-item questionnaire targeting thoughts and behaviors related to depression in a scale from 1, rarely or none of the time, to 4, most or all of the time. In the dataset, a composite measure of the NAS was already existing. The CESD had a high reliability (Cronbach's $\alpha = 0.89$), and we averaged the scale to a measure of depression.

Covariates. The following factors known to affect cardiovascular health with a potential confounding effect were included as covariates: age, gender, education, race, and exercising (Gruenewald et al., 2023). We also measured BMI, Well-Being, Loneliness, support availability, the use of antidepressant, antilipemic, antihypertensives, non-steroidal anti-inflammatory drugs, statins, and antidiabetics, all dichotomic 1, yes, and 2, no. Finally, we measured if the participant smoke, consume alcohol, have a chronic pain, an experience of stroke, cancer, heart failure, take treatment for heart trouble, consume regularly supplements, and have a chronic condition, all dichotomic 1, yes, and 2, no. Gender was measured using dichotomous indicators for *male* and *female*. Racial background was measured using 6 different backgrounds: white, black, native American, Asian, Hawaiian, and other. Exercise was measured with the item "Do you engage in regular exercise, or activity, of any type for 20 minutes or more at least 3 times/week?." Loneliness was measured with a single self-reported item "During the past week - I felt lonely" from 1 = rarely to 4 = most of the time. Support availability was created by averaging 4 items "I enjoy personal and mutual conversations with family members and friends," "I know that I can trust my friends, and they know they can trust me," (reversed) "Maintaining close relationships has been difficult and frustrating for me," and (reverse) "I have not experienced many warm and trusting relationships with others," with a Likert scale from 1 = I agree strongly to 7 = I disagree strongly. Finally, well-being was measured by an averaging of three constructs: personal growth, positive relations with others, and life purpose, all composed of 3 items (for a discussion around these items, see Ahrens & Ryff, 2006). Education level was measured from 1, no education, to 12, PhD

Analysis. We used linear regression of independent variables on HOMA-IR, our dependent variable. Gender, caregiving status, depression measured with CES-D, and their interaction were included to test the main hypothesis that gender moderates the association between caregiving and diabetes and cardiometabolic diseases. We conducted five different regressions. The first model included all covariates except smoking status, alcohol consumption, history of heart attack, and heart trouble because these variables had a lot of missing information. We conducted a second analysis that included these variables. Then, we conducted a third analysis that included the history of heart attack and excluded BMI. We conducted this analysis as we found that BMI was a strong predictor of HOMA-IR, and we wanted to understand how the effect is explained by other variables. The fourth model is a model where the control is only made for confounders—variables that can have differential effects on HOMA-IR. The fifth model is a model where the control is only made for mechanisms, variables that can explain the relationships between caregiving, gender, and HOMA-IR. The dataset was coded and analyzed with R (version 4.4.1). The threshold for significance was set at $p = .05$.

Results

Descriptive statistics of all variables are reported in Table 1. In total, 1132 individuals aged 34–84 years (M = 54.51, SD = 11.71) were included in the analysis for caregiving. Table 2 describes the five models used in the analysis. Most participants included in the analysis were female ($n = 656$, 58%) and 14% were caregivers.

To test our hypothesis that gender moderates the relationship between caregiving and risk for cardiometabolic disease, we conducted a series of analyses presented in Table 2. We first evaluated the effect of gender on log-transformed HOMA-IR (Matthews, 2003) given all the confounding and mechanisms tested. For the first model, we excluded four variables with low number of available data. We found that BMI was the main predictor of HOMA-IR ($b = 0.21$, $p < .001$). Gender ($b = -3.27$, $p = .04$), caregiving ($b = -3.01$, $p = .03$), depression ($b = -2.74$, $p = .01$), the use of antidiabetic ($b = -2.71$, $p < .001$), and the interaction between caregiving and depression ($b = 2.72$, $p = .02$) were also predictors of HOMA-IR. The second model included all variables available, reducing the number of observations from 910 to 54. Because of the lack of participants, we could not detect any effect. The third model is a reduced model without missing variables and BMI. This time, the use of antidiabetics is significant, as well as age.

The fourth model is a minimal model including only confounders. The results minor the ones from the first model but this time not exercising ($b = 0.62$, $p = .03$) and a lower level of education ($b = -0.12$, $p = .03$), as well as the interaction between gender and caregiving ($b = 3.94$, $p = .04$) and between gender and depression ($b = 2.15$, $p = .03$) predicted the increase in HOMA-IR.

The fifth and final model included all mechanisms and excluded confounders. The main predictor was the use of antidiabetics ($b = -3.18$, $p < .001$), and not other life experience or drug taken had an effect on HOMA-IR. Not exercising and our focal predictors and their interactions were again all significant. Using the fourth model, we found that male caregivers ($M = 3.74$, $SE = 0.63$) did not differ in their level of HOMA-IR as female caregivers ($M = 2.89$, $SE = 0.60$, $b = 0.85$, $p = .13$). However, for non-caregivers, men were more at risk than women (respectively, $M_{men} = 4.04$, $SE_{men} =$

Table 1. Descriptive Table of Quantitative Variables.

	Caregivers		Non-caregivers		Overall	
	Men	Women	Men	Women	Men	Women
	(N = 65)	(N = 92)	(N = 408)	(N = 556)	(N = 473)	(N = 648)
HOMA-IR	5.03 (12.5)	4.88 (14.1)	4.93 (10.2)	5.34 (13.8)	4.94 (10.6)	5.28 (13.8)
Age	55.2 (11.4)	56.7 (10.8)	56.5 (11.9)	54.4 (11.4)	56.3 (11.8)	54.7 (11.4)
Loneliness	1.35 (0.774)	1.36 (0.656)	1.38 (0.704)	1.44 (0.798)	1.38 (0.713)	1.43 (0.780)
Support availability	1.80 (1.09)	1.46 (1.02)	1.71 (1.12)	1.50 (1.10)	1.72 (1.12)	1.49 (1.08)
CES-depression	1.17 (0.410)	1.18 (0.420)	1.20 (0.397)	1.23 (0.428)	1.19 (0.399)	1.22 (0.426)
Negative affects (NAS)	1.48 (0.435)	1.49 (0.422)	1.52 (0.479)	1.59 (0.569)	1.51 (0.472)	1.57 (0.549)
BMI	29.8 (4.23)	29.5 (6.44)	29.8 (5.59)	30.1 (7.58)	29.8 (5.42)	30.0 (7.43)
Smoking status, yes	28 (42.4%)	33 (35.9%)	152 (37.1%)	167 (29.6%)	180 (37.8%)	200 (30.5%)
Origin	92% white, 1.5% native American, and 3% other	84.8% white 2.2% black 2.2% native American and 2.2% other	82.2% white 2.2% black 1% native American 0.5% Asian 2.4% other	75.2% white 2.5% black 0.9% native American, 0.2% Asian, and 2.3% other	83.7% white 1.9% black 1.1% native American, 0.4% Asian 2.5% other	76.5% white 2.4% black 1.1% native American 0.2% Asian 2.3% other
Antidepressant—Yes	13 (19.7%)	19 (20.7%)	46 (11.2%)	104 (18.4%)	59 (12.4%)	123 (18.8%)
Antilipemic—Yes	39 (59.1%)	45 (48.9%)	219 (53.4%)	254 (45.0%)	258 (54.2%)	299 (45.6%)
Antihypertensive—Yes	25 (37.9%)	37 (40.2%)	169 (41.2%)	236 (41.8%)	194 (40.8%)	273 (41.6%)
NSAID—Yes	7 (10.6%)	12 (13.0%)	37 (9.0%)	76 (13.5%)	44 (9.2%)	88 (13.4%)
Statins—Yes	28 (42.4%)	32 (34.8%)	151 (36.8%)	117 (20.7%)	179 (37.6%)	149 (22.7%)
Antidiabetics—Yes	3 (4.5%)	5 (5.4%)	61 (14.9%)	61 (10.8%)	64 (13.4%)	66 (10.1%)
Exercise regularly—Yes	57 (86.4%)	78 (84.8%)	313 (76.3%)	417 (73.9%)	370 (77.7%)	495 (75.5%)
Alcohol consumption per week	3.27 (1.38)	4.02 (1.28)	3.42 (1.53)	4.08 (1.26)	3.40 (1.51)	4.07 (1.26)
Education level	7.88 (2.24)	7.73 (2.49)	8.04 (2.45)	7.55 (2.47)	8.02 (2.41)	7.58 (2.47)
Chronic pain—Yes	23 (34.8%)	28 (30.4%)	118 (28.8%)	185 (32.8%)	141 (29.6%)	213 (32.5%)
History of heart attack	4 (6.1%)	0 (0%)	11 (2.7%)	5 (0.9%)	15 (3.2%)	5 (0.8%)
Treatment for heart trouble	14 (21.2%)	8 (8.7%)	42 (10.2%)	37 (6.6%)	56 (11.8%)	45 (6.9%)
History of cancer	2 (3.0%)	11 (12.0%)	46 (11.2%)	67 (11.9%)	48 (10.1%)	78 (11.9%)
Supplement taking	58 (87.9%)	79 (85.9%)	248 (60.5%)	348 (61.7%)	306 (64.3%)	427 (65.1%)
History of stroke	3 (4.5%)	3 (3.3%)	12 (2.9%)	17 (3.0%)	15 (3.2%)	20 (3.0%)
Chronic condition	46 (69.7%)	74 (80.4%)	278 (67.8%)	382 (67.7%)	324 (68.1%)	456 (69.5%)
Well-being	16.6 (2.56)	17.3 (2.37)	16.9 (2.66)	17.4 (2.63)	16.8 (2.65)	17.4 (2.59)

Note. For quantitative variables, values are means and standard deviation into brackets. For categorical variables, values are numbers and percentages into brackets.

0.49, $M_{women} = 3.16$, $SE_{women} = 0.49$, $b = 0.88$, $p < .001$). Results are displayed in Figure 1. This result corroborates prior findings on elevated risk for diabetes and cardiometabolic disease in males.

We found interactions between caregiving, gender, and depression. They are plotted in Figures 1 and 2. Using the deviation from the mean as an indicator of high and low relative depression level, we found that non-caregivers had the same HOMA-IR level for all degrees of depression, while for caregiving, the higher the level of depression, the lower the HOMA-IR. Depression did not affect the level of HOMA-IR for women but did for men where the higher degree of depression had a tendency to increase the level of HOMA-IR.

Taken together, our results indicate that caregiving status may predict health and longevity in a gender-dependent fashion, with a higher level of HOMA-IR for men who are not caregivers. This result holds when considering confounders and mechanisms for the effect, even when controlling for BMI and the use of antidiabetics which were found to be the strongest predictors of HOMA-IR.

Discussion

The Future: Preventing Cardiometabolic Disease in Caregivers

Diabetes and heart disease are leading causes of death in the US. Among the general population, middle-aged men are at a greater risk than women (Kautzky-Willer et al., 2023). Our results corroborate this, and we find that, overall, men demonstrate increased diabetes risk compared with women. Our findings collectively indicate that caregiving status may

Table 2. Log-Transformed HOMA-IR Analysis.

	Model 1	Model 2	Model 3	Model 4	Model 5
(Intercept)	4.16 [−0.16, 8.48]	−4.93 [−30.80, 20.94]	15.74* [2.25, 29.22]	7.43*** [4.52, 10.33]	10.97*** [7.07, 14.87]
Gender	−3.27* [−6.38, −0.16]	−12.18 [−40.42, 16.06]	−0.80 [−13.13, 11.52]	−4.45** [−7.80, −1.10]	−4.33* [−7.67, −0.99]
Caregiving	−3.01* [−5.66, −0.36]	−6.92 [−19.36, 5.51]	−0.33 [−7.65, 6.99]	−2.82* [−5.63, −0.01]	−3.56* [−6.41, −0.71]
Depression	−2.74* [−4.87, −0.61]	−3.31 [−12.86, 6.24]	−1.55 [−7.91, 4.81]	−2.13* [−4.22, −0.05]	−2.86* [−5.14, −0.58]
Negative affects	0.27 [−0.21, 0.75]	1.50 [−1.26, 4.26]	−0.57 [−2.42, 1.27]		
Age	−0.01 [−0.03, 0.01]	−0.04 [−0.17, 0.10]	−0.10* [−0.18, −0.02]	−0.01 [−0.03, 0.01]	
Loneliness	0.36 [−0.04, 0.75]	−0.65 [−3.56, 2.27]	−0.45 [−2.13, 1.23]		0.42 [−0.00, 0.84]
Support availability	−0.09 [−0.37, 0.20]	1.02 [−0.50, 2.55]	0.43 [−0.70, 1.56]		−0.08 [−0.38, 0.22]
BMI	0.21*** [0.17, 0.24]				
Black origin	−1.18 [−2.40, 0.03]	−0.92 [−10.26, 8.42]	−3.45 [−8.01, 1.12]	−0.32 [−1.65, 1.02]	
Native American	0.12 [−1.75, 2.00]	0.53 [−7.59, 8.65]	0.96 [−7.95, 9.88]	1.02 [−0.98, 3.02]	
Asian	0.82 [−3.31, 4.96]			−0.42 [−4.21, 3.37]	
Other origin	0.88 [−0.36, 2.12]		1.08 [−7.78, 9.94]	0.85 [−0.49, 2.18]	
Antidepressant	−0.45 [−0.98, 0.09]	0.91 [−2.62, 4.44]	0.39 [−1.72, 2.49]		−0.55 [−1.12, 0.02]
Antilipemic	−0.29 [−0.70, 0.12]	−0.26 [−3.53, 3.00]	0.84 [−0.95, 2.62]		−0.31 [−0.74, 0.13]
Antihypertensives	−0.07 [−0.53, 0.39]	−1.28 [−4.52, 1.96]	−0.82 [−2.69, 1.05]		−0.34 [−0.81, 0.14]
NSAID oral	−0.35 [−0.93, 0.22]	0.60 [−3.02, 4.21]	−0.19 [−2.32, 1.94]		−0.42 [−1.04, 0.20]
Statins	−0.06 [−0.54, 0.41]	2.39 [−1.00, 5.77]	0.83 [−1.00, 2.66]		−0.20 [−0.69, 0.30]
Antidiabetic	−2.71*** [−3.43, −1.98]	−4.61* [−8.03, −1.19]	−3.86** [−6.33, −1.39]		−3.18*** [−3.95, −2.41]
Exercise	0.05 [−0.44, 0.53]	1.77 [−0.62, 4.15]	0.45 [−1.29, 2.19]		0.52* [0.01, 1.03]
Education	−0.07 [−0.15, 0.01]	0.18 [−0.26, 0.62]	−0.08 [−0.41, 0.26]	−0.11* [−0.20, −0.02]	
Chronic pain	0.07 [−0.36, 0.49]	0.06 [−2.89, 3.00]	−0.66 [−2.37, 1.05]		−0.09 [−0.55, 0.36]
Chronic condition	−0.30 [−0.82, 0.23]	2.01 [−3.91, 7.93]	−0.67 [−3.02, 1.69]		−0.01 [−0.57, 0.55]
Nutrition supplement	−0.08 [−0.56, 0.39]	1.71 [−1.58, 4.99]	0.09 [−1.74, 1.93]		0.11 [−0.40, 0.61]
Well-being	0.00 [−0.11, 0.12]	0.43 [−0.22, 1.08]	0.17 [−0.24, 0.57]		−0.03 [−0.15, 0.10]
Experience of cancer	0.15 [−0.44, 0.74]	−1.14 [−4.65, 2.38]	−1.15 [−3.25, 0.95]		0.23 [−0.39, 0.85]
Gender × caregiving	3.06 [−0.34, 6.46]	11.26 [−17.82, 40.34]	−0.78 [−14.14, 12.58]	3.62 [−0.05, 7.29]	4.14* [0.50, 7.79]
Gender × depression	2.15 [−0.40, 4.70]	6.11 [−15.37, 27.59]	0.41 [−9.68, 10.50]	3.06* [0.36, 5.76]	2.95* [0.21, 5.69]
Caregiving × depression	2.72* [0.51, 4.94]	4.12 [−5.48, 13.73]	1.19 [−5.13, 7.52]	2.65* [0.36, 4.94]	3.09* [0.70, 5.47]
Gender × caregiving × depression	−2.44 [−5.22, 0.35]	−6.04 [−28.02, 15.94]	0.27 [−10.50, 11.04]	−3.10* [−6.06, −0.14]	−3.33* [−6.33, −0.34]
Heart attack		2.20 [−1.57, 5.97]	−0.67 [−2.95, 1.62]		
Heart trouble		−0.06 [−2.43, 2.31]			
Smoking		3.44 [−1.60, 8.47]			
Alcohol		0.20 [−0.54, 0.95]			
Num.Obs	912	54	139	942	921
R2 Adj	0.262	0.688	0.221	0.035	0.129
AIC	4597.9	280.6	809.2	4956.6	4775.1
F	10.823	1.687	1.115	2.592	6.366
RMSE	2.91	1.80	3.58	3.31	3.15

Note. *$p < .05$, **$p < .01$, and ***$p < .001$.

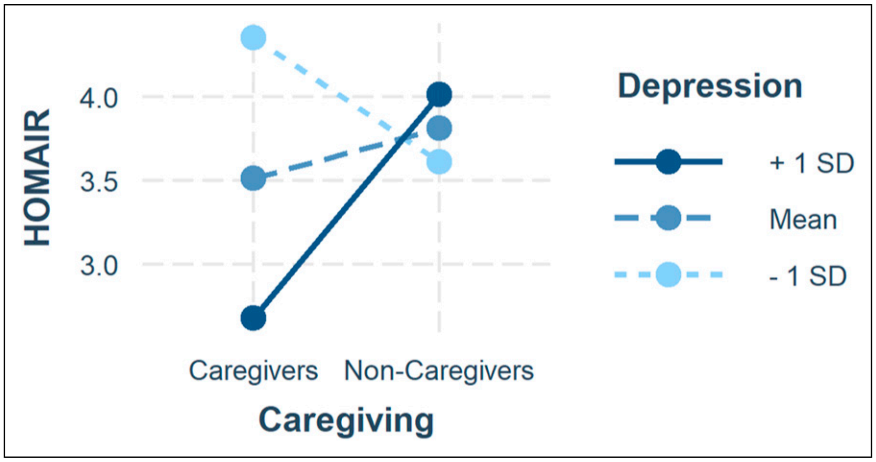

Figure 1. Interaction between caregiving and depression.

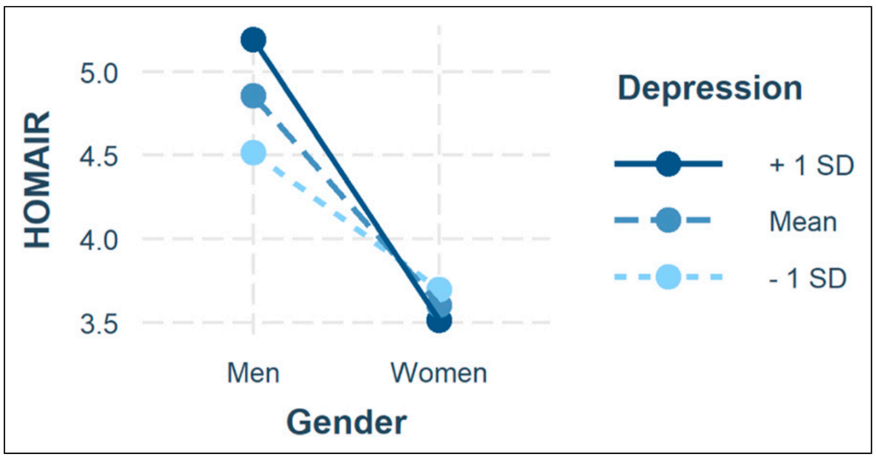

Figure 2. Interaction between gender and depression.

be associated with health outcomes and longevity in a gender-specific way, with higher HOMA-IR levels observed in men and women. This relationship persists even after adjusting for potential confounders and mediating factors, particularly BMI and the use of antidiabetic medications, which were identified as the most influential predictors of HOMA-IR.

Our results show a gender-specific effect of caregiving status on diabetes risk. Specifically, in mid-life, female caregivers are at a higher risk of diabetes compared to non-caregiving in women. In contrast, male caregivers are at a lower risk of diabetes than non-caregiving men. One potential mechanism that may explain the observed differences in insulin resistance (HOMA-IR) between caregiving and non-caregiving men is the phenomenon of male self-selection into caregiving roles. Unlike women, who are often expected to assume caregiving responsibilities regardless of their health status, men who take on caregiving roles may represent a select group who are healthier at baseline (Sharma et al., 2016). This selection bias could contribute to the lower levels of insulin resistance observed among caregiving men (Swinkels et al., 2017) compared to their non-caregiving counterparts, as those in better overall health may be more capable of handling the physical and emotional demands of caregiving (Friedemann & Buckwalter, 2014). Conversely, men who are in poorer health or at a greater risk for metabolic disorders may be less likely to take on caregiving roles, thereby disproportionately concentrating higher HOMA-IR values within the non-caregiving male population.

This pattern differs from that of women, for whom caregiving responsibilities are more often culturally and socially obligatory, irrespective of health status. As a result, the female caregiving population is more heterogeneous in terms of health, which may obscure potential protective health effects of caregiving when compared to men. The expectation that women will fulfill caregiving roles, even when they have preexisting health conditions, may also explain why sex differences in the relationship between caregiving and metabolic health outcomes are observed.

Our findings that female caregivers are at a greater risk of diabetes compared with non-female caregivers suggest that women, regardless of health status, are expected to shoulder the burden of family caregiving. Indeed, many women are practiced multi-taskers and excellent caregivers which aligns with our sample size being skewed towards women. Not surprisingly, aging parents often prefer that their daughters will fulfill the family caregiving responsibilities (Gonyea et al., 2008). It is therefore crucial that the gendered nature of caregiving be clearly recognized and that we clearly understand the unique health risks and support needs of caregivers.

Caregiving can contribute to a lack of social connections due to its demanding nature, increasing the risk of depression (Liang et al., 2024). Social support has been identified as a modifiable lifestyle factor which can reduce the risk of cardiovascular disease in unpaid caregivers. Perhaps, social support is one potential modifiable lifestyle factor which the non-caregiving public may help curb the cardiometabolic health risk among caregivers. Indeed, robust social support networks play a pivotal role in mitigating the adverse health effects of caregiving. Studies have consistently demonstrated that caregivers with strong social support systems experience better mental health outcomes and higher levels of resilience in coping with caregiving stressors (Tough et al., 2022). Positive relationships with family, friends, and community members provide caregivers with emotional validation, practical assistance, and opportunities for respite, buffering the negative impact of caregiver burden on mental well-being.

Indeed, social support may have a protective role in attenuating the detrimental effects of caregiver burden on mental health. Recent studies have shown that the quality of the caregiver–care recipient relationship also influences caregivers' mental well-being, with positive relationship dynamics correlating with better mental health outcomes (Andrén & Elmståhl, 2008; Ong et al., 2018). Therefore, interventions aimed at enhancing social support networks and fostering positive caregiver–care recipient relationships are essential for promoting the mental well-being of caregivers and reducing the risk of caregiver burnout. Providing caregivers with access to support groups, counseling services, and respite care can help alleviate caregiver burden and strengthen their ability to cope with the challenges of caregiving. Additionally, raising awareness among family members and healthcare professionals about the importance of providing emotional support and practical assistance to caregivers can facilitate the creation of a supportive caregiving environment that promotes caregivers' health and well-being.

Our results demonstrated that physical inactivity, diabetic medication intake, and BMI were important predictors of diabetes risk. These results are related to previous findings, in Reasons for Geographic and Racial Differences in Stroke (REGARDS) study, which found caregivers with high caregiving strain showed associations with low physical activity and low medical medication adherence (King et al., 2021). While we did not examine these mediators and confounders strictly in the caregiving sample, these are important modifiable risk factors that can be improved to mitigate diabetes risk in caregivers. Particularly, non-pharmacological interventions may be able to improve caregiver health, improve quality of life, and reduce depressive-like symptoms, while increasing caregiving quality (Richardson et al., 2013). Future research should further investigate the role of preexisting health differences in male caregivers, as well as the impact of social support networks, to better understand the mechanisms underlying these associations.

Limitations

This study retains notable limitations. First, each caregiver–recipient dyad is nuanced and can have a range of physical and psychosocial challenges (Lyons et al., 2002). Indeed many "sandwiched" female caregivers must provide care for recipients spanning toddler to older adults (Lei et al., 2023). Unfortunately, the MIDUS data do not provide the number of care recipients respondents have or their relationship with care recipients. Future research should incorporate qualitative surveys aimed at acquiring more detailed information concerning specific caregiving duties. Moreover, such qualitative research would contribute toward understanding caregivers' perception of purpose, mental, and physical well-being within their caregiving role. This information will be critical to understand how best to support our nation's unpaid caregivers in their critical service within the US health system. Second, while the MIDUS II sample is drawn from a nationally representative population sample, the majority are Caucasians. Given the diverse aging US population, future studies should prioritize racial and ethnic differences in caregiving trends. Additionally, our study only comprised a cross-sectional analysis of participants, which precludes causal inferences. Future work should investigate whether there is a gendered effect on the long-term health risks and comorbidities of insulin resistance among unpaid caregivers. Future work should also investigate the moderating effects of perceived social support and purpose in mitigating the stress of providing care. Moreover, the usage of binary caregiving as a variable limited our ability to capture caregiving intensity, duration, and role which may impact stress. Although, our study is conservative in that we only selected caregivers who reported caring for a loved one for three months or more which would indicate the effect we detected is real. Lastly, selection biases may have affected our results due to the biomarker project sample being used which is based on willingness and ability to participate. This may limit the generalizability that can be made due to a motivated or healthier sample. For example, our sample reflected the observation in the general population that female caregivers outnumber male caregivers. However, the smaller sample of male caregivers may limit our understanding of how caregiving affects diabetes risk in men.

Conclusion

Prior studies show that caregiving can have beneficial impact on well-being and sense of purpose. However, without adequate social support, caregiving burden remains a significant risk factor for poor psychological and physical well-being. While the literature on caregiver health has become more salient in last several decades, gaps remain in the literature. Our findings build on previous literature in two ways: (1) by inquiring how providing care in midlife is associated with cardiometabolic disease risk and (2) by examining the moderating effect of gender. In line with our hypothesis, we find that caregiving may have a protective effect on diabetes risk particularly in men.

Our results have implications for understanding how gender may have distinct impacts on caregiver physical and mental well-being. Caregiver well-being can have direct consequences on patient health. Therefore, understanding caregiver health is crucial not only for the well-being of the caregiver but also for ensuring optimal patient care and public health costs. Identifying gender differences in specific cardiometabolic disease risk will be important for optimizing the recent strides that have been made in policies advocating for paid family medical leave (Wittke & Spangler, 2018). Moreover, it is important to identify these health risks associated with caregiving to emphasize the need for family caregivers to make lifestyle changes to prevent heart disease. Future work should aim to examine the long-term gender-specific effects of caregiving on diabetes risk and determine whether individualized psychosocial support reduces disease risk in caregivers.

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Declaration of Conflicting Interests

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Ethical Statement

Informed Consent

Each MIDUS project has its own IRB from the University of Wisconsin-Madison, and researchers obtained informed consent from the participants.

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Data Availability Statement

The second wave of the National Survey of Midlife Development in the United States (MIDUS, 1995–2014) is an available dataset which can be utilized for research purposes. We used both survey and biomarker datasets in which data was collected from 2004 to 2009. The data is available at https://midus.wisc.edu/data/index.php.

Notes

1. We used MIDUS II as it is the most powerful sample available in the MIDUS study. Two other samples used biomarkers, the first one being the refresher (n = 863) and MIDUS 3 (n = 747).
2. More information, including the IRB, can be found at https://www.icpsr.umich.edu/web/NACDA/studies/29282.
3. In the MIDUS survey, there were 47.6% of men and 52.4% of women. There were 474 (45.4%) men and 570 (54.6%) women in our sample. The mean age is 55 (SD = 12.4) in MIDUS II and 55.2 (SD = 11.8) for the biomarker project. The mean BMI is 29.8 (SD = 6.62) in MIDUS II and 29.1 (SD = 6.01) for the biomarker project.

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