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ORIGINAL RESEARCH ARTICLE

Economic Spillover Effects of Intensive Unpaid Caregiving

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Abstract

Background Growing evidence has documented economic spillover effects experienced by intensive caregivers across the lifecycle. These spillover effects are rarely incorporated in economic analyses of health interventions. When these costs are captured, it is shown that commonly applied methods for valuing caregiver time may be underestimating the true opportunity costs of informal care. We explore how intensive caregiving is associated with economic outcomes for caregivers aged 18 years and older.

Methods We used the cross-sectional 2013 RAND Survey of Military and Veteran Caregivers, a survey of 3876 caregivers and non-caregivers aged 18 years and older to conduct multivariable analyses and calculate average marginal effects, focusing on the association between intensive caregiving (i.e., providing ≥ 20 h of weekly care) and six economic outcomes: schooling, labor force participation, taking unpaid time off of work, cutting back work hours, quitting a job, and early retirement.

Results Intensive caregivers are 13 percentage points (95% confidence interval [CI] 8–18) less likely to be employed than non-caregivers. Intensive caregivers are 3 percentage points (95% CI 0.5–5) more likely to cut back schooling, 6 percentage points (95% CI 2–10) more likely to take unpaid time off of work, 4 percentage points (95% CI 0.1–9) more likely to cut back work hours, 12 percentage points (95% CI 8–15) more likely to quit a job, and 5 percentage points (95% CI 2–7) more likely to retire early due to caregiving responsibilities relative to non-intensive caregivers.

Conclusions Despite the difficulty of quantifying the true opportunity costs of informal care, policy makers and researchers need to understand these costs. The higher the opportunity costs of unpaid care provision, the less likely it is that caregivers will provide this care and the less economically attractive this 'free' source of care is from a societal perspective.

Key Points for Decision Makers

Intensive informal caregivers across a wide age range experience economic penalties, from decreased schooling to early retirement.

Commonly applied costing methods for valuing informal caregiver time are likely underestimating the true opportunity costs of informal care provision.

To understand the net benefit of caregiving from a societal standpoint, we need a better understanding of these lifecycle costs of caregiving.

1 Introduction

As health systems increasingly move healthcare into home and community settings, there has been a growing recognition of the role that informal caregivers play in supporting

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this care. While home care provided with the aid of informal caregivers is generally viewed as cost saving from a health system perspective, there are important issues surrounding the redistribution of costs that are often overlooked in the existing cost-effectiveness literature [1]. In recognition of this, the most recent recommendations from the Panel on Cost-Effectiveness in Health and Medicine state that informal caregiver benefits and costs should be included in the societal reference case perspective when conducting economic evaluations of healthcare interventions [2]. However, there has not been consensus regarding the most appropriate method to assign costs to time spent caregiving or to the types of costs that should be included in these evaluations.

Most of the existing literature that attempts to value informal caregiving measures the time spent providing care and assigns a monetary valuation to this time using one of two methods: the replacement cost (or proxy good) method or the opportunity cost method [1, 3–5]. The replacement cost method values time spent providing informal care using the market price of paid formal care substitutes, which is often the wage rate of a home health aide [1]. The opportunity cost method, meanwhile, values time spent providing informal care as the economic value of opportunities foregone as a result of care provision [5]. In practice, this time is often valued as employed individual's current wage rate and either a reservation wage or imputed wage rate for individuals who are not employed [1, 5].

In policy settings, replacement cost methods are often favored over opportunity cost methods. The US Department of Veterans Affairs (VA), for instance, provides stipends for caregivers of veterans who qualify for comprehensive support, which are calculated using the geographically adjusted home health aide rate. There are many arguments in favor of applying a replacement cost methodology in policy environments, including the ease with which it can be standardized nationally and the potential for stipends based on this method to be cost minimizing from a government perspective. However, it is possible that replacement cost methods do not reflect important opportunity costs of care provision for the informal caregivers. Similarly, using a current wage rate to capture the opportunity costs of care may be underestimating the true opportunity costs of informal care provision.

This underestimation may be due to two factors. First, there is the potential impact of caregiving on labor market outcomes. International evidence indicates that intensive caregiving (i.e., providing 10–20 h of weekly care) negatively affects caregivers' labor market participation, hours of work, and wages [6–13]. Recent US literature, which best reflects the institutional setting of the current study, supports these findings. Using the Health and Retirement Study (HRS), Van Houtven et al. [9] found that male personal care caregivers were 2.4 percentage points less likely to be in the labor force while female caregivers who helped with chores were more likely to be retired than non-caregivers. Female caregivers who were employed decreased their work hours and faced a 3% lower wage relative to non-caregivers. Also using the HRS, along with Social Security data, Fahle and McGarry [14] found that, contrary to past thinking that individuals who select into caregiving are less attached to the labor force, eventual caregivers were more attached at age 18–44 years and, conditional on having earnings, earned more than non-caregivers. Therefore, the opportunity cost of caregiver time may be *higher* than that of non-caregivers. Further, the authors found a 2.9 percentage point reduction in the probability of caregivers working and a reduction of 1.3 work hours per week relative to non-caregivers [14]. Finally, using the National Longitudinal Survey of Mature Women, Jacobs et al. [12] found that caregivers providing 20 h of weekly care were 1–3 percentage points more likely to retire relative to non-caregivers. Combined, this literature implies that valuing time spent caregiving using the current wage rate could underestimate the opportunity costs of care by not taking into account that caregiving in itself may contribute to the lower earning potential of caregivers.

A second reason why the current wage rate may underestimate the true opportunity costs of informal care is that labor market effects can have longer-term consequences, impacting an individual's earning trajectory across his or her lifecycle. Using the HRS, Skira [15] found long-term trade-offs of caregiving related to the persistent nature of providing elder care. Women who left the labor market to provide care were much less likely to return to work, and, if they did, it was often for lower wages or on a part-time basis. Taking these longer-term opportunity costs into account, the median cost of care provision for women in their mid-50 s who provided care over a 2-year period was US$164,726. This can be compared to US$21,220 using commonly applied opportunity cost methods (i.e., current forgone wages) [15]. This finding highlights the importance of incorporating a longer time horizon when calculating the societal costs of informal care provision. It is also important to note that all the aforementioned US literature has focused on caregivers aged 50 years plus. There is limited evidence estimating the longer-term opportunity costs of informal care for younger caregivers.

To better understand the opportunity costs of caregiving, we consider six potential economic effects of caregiving for a broad age range of caregivers: labor force participation, taking unpaid time off work, cutting back work hours, quitting work, early retirement, and cutting back schooling. Previous analyses have found that 40% of post-9/11 caregivers are between the ages of 18 and 30 years [16]. We draw on a data source that over-samples these caregivers, so we can better understand the economic consequences of becoming an intensive caregiver early in one's career trajectory. Using

the RAND Survey of Military and Veteran Caregivers, we assess the extent to which intensive caregivers experience economic spillover effects related to their labor market and schooling outcomes due to informal care provision.[1] This analysis allows us to capture opportunity costs that are rarely explored in the literature, but that may have important downstream consequences. In considering these outcomes, we highlight the complexity of accurately capturing opportunity costs of care provision and the importance of understanding these often unmeasured costs of care.

2 Methods

We used the 2013 RAND Survey of Military and Veteran Caregivers, a cross-sectional survey of military and veteran caregivers, civilian caregivers, and a comparison group of non-caregivers. In the RAND survey, military and veteran caregivers are individuals who provided care to ill, injured, and wounded service members and veterans, while civilian caregivers are those who provide care to non-military personnel or veterans. Caregivers are respondents who provided unpaid care and assistance for, or managed the care of, someone at least 18 years of age with an illness, injury, or condition for which they require outside support. The survey was administered to a probability-based panel of 41,163 households designed to represent the US general population of non-institutionalized adults. Due to a relatively small sample ($n = 72$) of post-9/11 caregivers in the probability-based sample, an additional 281 post-9/11 caregivers were recruited from a convenience sample derived from a database provided by the Wounded Warrior Project. A statistical raking algorithm, iterative proportional fitting, was used to create blended weights to account for the mixed sampling strategy so that the military and civilian caregivers were nationally representative samples of each caregiver group [16, 17]. The survey is unique due to its focus on a broad age range of caregivers (18 years and older) and its assessment of economic penalties experienced across various stages of respondents' career trajectories. The focus on military and veteran caregivers helps to fill an important gap in understanding the experiences of caregivers of US veterans from recent conflicts in the Middle East, in which more military members than any prior conflict survived significant blast injuries due to advances in battlefield medicine. This is the first survey to describe the effects of these recent conflicts on informal caregivers. Our analysis includes 3876 individuals (1163 non-caregivers, 885 military caregivers, and 1828 civilian caregivers) aged 18 years and older. The inclusion of both military and civilian caregivers allows for comparison across the two groups.

We conducted descriptive and multivariable regression analyses. In our descriptive analyses, we calculated the means and proportions of demographic, socioeconomic, household, and care recipient characteristics. We used *t* tests and Pearson's Chi-squared statistics to determine whether there were significant differences between non-caregivers, intensive caregivers, and other caregivers. The caregiving groups included military and veteran caregivers as well as civilian caregivers. In our multivariable analyses, we used logistic regression models[2] to determine how the probability of employment and five self-assessed economic outcomes were associated with our key independent variable, intensive informal care provision. Intensive caregiving was defined as the provision of 20 or more hours of care per week, which according to previous research is the upper threshold above which care provision is likely to impact labor supply and outcomes [12]. We also focused on this subset of caregivers because caregiving decisions are less likely to be endogenous for intensive caregivers. Previous research has found that intensive caregivers are much less likely to perceive their care provision as a choice [19], which decreases the likelihood that caregivers who are less attached to the labor market self-select into the caregiving role. We are unable, however, to model the simultaneity of work and care decisions with the current data, so it is possible that the caregiving coefficients would be biased. Evidence surrounding the expected direction of this bias is mixed [9, 10]. To test the hypothesis that self-selection into a caregiving role is less of a choice for higher-intensity caregivers, we conducted sensitivity analyses where we lowered the threshold for intensive caregiving to 1 and 5 h of weekly care. At these levels, it is possible that care provision is more likely to be a choice, so we might expect a null or weaker association.

Our analysis focused on economic outcomes that are relevant across the lifecycle: probability of employment, taking unpaid time off work, cutting back work hours, quitting a job, cutting back schooling, and early retirement. We first conducted multivariable analyses that included both non-caregivers and caregivers to determine the probability of employment for intensive caregivers relative to other caregivers and non-caregivers. Next, we focused on the subset of respondents who identified as caregivers and looked at the self-assessed economic impacts of their informal care provision. For these analyses, we compared intensive caregivers

[1] In the present context, 'spillover' effects refer to the effects on a caregiver's quality of life due to having a family member with a chronic illness.

[2] Logistic regression models were chosen over linear probability models because there was a wide range of probabilities in the outcomes of interest (i.e., from 0.10 to 0.49). Logistic models provide better model fit under these circumstances [18]. Sensitivity analyses using linear probability models yielded similar results.

to non-intensive caregivers. Caregivers were asked the following questions: (1) "As a result of caregiving did you ever take unpaid time off work or stop working temporarily?"; (2) "As a result of caregiving did you ever cut back the number of hours in your regular weekly job schedule?"; (3) "As a result of caregiving, did you ever quit working entirely?"; (4) "As a result of caregiving, did you ever take retirement earlier than you would have otherwise?"; and (5) As a result of caregiving, did you ever take time off from school or cut back on classes?" Non-response rates to these questions were low (ranging from 2.2% to 3.1%). *t*-Tests and Pearson's Chi squared tests did not indicate any significant differences in socioeconomic characteristics between respondents and non-respondents. We used logistic regression models and calculated average marginal effects for each outcome.

All regressions controlled for caregiver demographic (age, marital status, sex, race/ethnicity, and urban/rural residence), socioeconomic (home ownership and education), household (number of household members and children in the household), and care recipient (relationship to caregiver, military or civilian care recipient, activities of daily living [ADL]/instrumental activities of daily living [IADL] limitations, and service-connected disability rating for military care recipients) characteristics. We also accounted for the era of military service, and in alternate models we interacted a post-9/11 indicator variable with intensive caregiving to see if there was an incremental effect of intensive caregiving for this subgroup. We included survey weights in all regressions to account for non-random survey sampling methods [17].

With our reduced form approach, in which we do not control for the endogeneity of caregiving, the marginal effects can be interpreted as a measure of the associated relationship of caregiving and outcomes. As noted earlier, the RAND survey allows us to control for often unobserved caregiver and care recipient factors that may contribute to omitted variable bias. For instance, we control for the level of care needed, which may differ across subgroups and, if unobserved, could bias our estimates. Including a rich set of control variables in the model helps to ameliorate, but not eliminate, concerns about this type of bias.

3 Results

3.1 Descriptive Overview

In Table 1, we summarize the sample characteristics. The significance columns show the results of Pearson's Chi square tests and *t*-tests comparing each characteristic for intensive caregivers and non-intensive caregivers relative to non-caregivers. We found that relative to non-caregivers, intensive caregivers had significantly lower rates of employment (38% vs. 52%), higher rates of unemployment (10% vs. 5%), and higher rates of labor force non-participation (52% vs. 42%). Intensive caregivers were less likely to own their homes (70% vs. 75%) and reported lower overall health (general health score of 50.1 vs. 62.1). Intensive caregivers were more likely to be 55 years and younger (55% vs. 48%) and less likely to have a college degree (35% vs. 48%). Intensive caregivers were more often women (74% vs. 62%) and living in households with more members and a greater number of children.

Non-intensive caregivers were also more likely to be unemployed relative to non-caregivers (7% vs. 5%), but were less likely to be labor force non-participants (i.e., not currently seeking employment) (39% vs. 44%). They had lower overall health (general health score) (57.6) relative to non-caregivers (62.1).

In Table 2, we provide an overview of the proportion of caregivers who indicated that they experienced labor market penalties due to caregiving. Intensive caregivers experienced these costs at much higher rates than non-intensive caregivers, with 39% indicating that they took unpaid time off work, 35% indicating that they cut back work hours, and 34% indicating that they had quit a job due to caregiving obligations. These opportunity costs appear early and late in intensive caregivers' labor market trajectories, with 15% of intensive caregivers indicating that they had retired early due to caregiving duties and 16% indicating that they had cut back schooling due to caregiving duties.

3.2 Multivariable Results

Results of the multivariable regression predicting the probability of employment (Table 3) indicate that intensive caregivers are 13 percentage points (95% confidence interval [CI] 8–18) less likely to be employed than non-caregivers. We did not find a significant association for non-intensive caregivers. Other variables in the model are in the expected directions—younger individuals, those with higher educational attainment, and men are significantly more likely to be employed.

In Table 4, we present the results of a series of multivariable models among our caregiving subsample. These models indicate that net of other factors, intensive caregivers are 6 percentage points (95% CI 2–10) more likely to take unpaid time off work, 4 percentage points (95% CI 0.1–9) to cut back work hours, 12 percentage points (95% CI 8–15) more like to have quit a job, 5 percentage points (95% CI 2–7) more likely to have retired early, and 3 percentage points (95% CI 0.5–5) more likely to have cut back schooling due to caregiving relative to less intensive caregivers. Alternate models indicate that there were no incremental effects of being an intensive military or post-9/11 caregiver on the probability of experiencing economic consequences due to caregiving. In analyses where we lowered the intensity

Table 1 Descriptive overview of non-caregivers, intensive caregivers, and non-intensive caregivers

Characteristic	Full sample		Non-caregiver		Intensive caregiver			Non-intensive caregiver		
	Mean/%	SE	Mean/%	SE	Mean/%	SE	Sig.[a]	Mean/%	SE	Sig.[a]
n	3876		1163		988			1705		
Employment status										
Employed	49%	0.01	52%	0.01	38%	0.02	***	54%	0.01	
Unemployed	7%	0.00	5%	0.01	10%	0.01	***	7%	0.01	*
Not in labor force	44%	0.01	44%	0.02	52%	0.02	***	39%	0.01	*
Married/cohabiting	64%	0.01	62%	0.02	0.67	0.02	*	0.63	0.01	
Home ownership	73%	0.01	75%	0.01	0.7	0.02	**	0.74	0.01	
General health score	57.03	0.40	62.10	0.68	50.10	0.78	***	57.60	0.6	***
Age (years)										
18–30	13%	0.01	15%	0.01	13%	0.01		12%	0.01	
31–55	38%	0.01	33%	0.01	42%	0.02	***	38%	0.01	**
56–65	27%	0.01	24%	0.01	25%	0.01		30%	0.01	**
≥ 66	22%	0.01	28%	0.01	20%	0.01	***	20%	0.01	***
Race/ethnicity										
Non-Hispanic White	78%	0.01	82%	0.01	73%	0.02	***	77%	0.01	**
Non-Hispanic Black	7%	0.00	6%	0.01	9%	0.01	**	8%	0.01	
Other	3%	0.00	2%	0.01	2%	0		3%	0	
Hispanic	8%	0.00	8%	0.01	10%	0.01		9%	0.01	
≥ 2 races	4%	0.00	2%	0	5%	0.01	***	4%	0	*
Education										
High school	18%	0.01	17%	0.01	22%	0.01	**	17%	0.01	
Some college	39%	0.01	35%	0.01	44%	0.02	***	39%	0.01	*
College	25%	0.01	29%	0.02	22%	0.01	***	25%	0.01	*
Post-college	18%	0.01	19%	0.01	13%	0.01	***	20%	0.01	
Sex (1 = male)	32%	0.01	38%	0.02	26%	0.01	***	32%	0.01	**
No. of household members	2.58	0.02	2.33	0.04	2.91	0.05	***	2.57	0.03	***
No. of children in household	65%	0.02	0.56	0.03	0.81	0.04	***	0.62	0.03	
Urban residence	86%	0.01	87%	0.01	84%	0.01	*	86%	0.01	

SE standard error, *Sig*. significance

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$

[a]Significant tests indicate results from Pearson's Chi squared tests and *t*-tests assessing differences between each caregiver subgroup and non-caregivers

Table 2 Proportion of intensive and non-intensive caregivers experiencing labor market costs due to caregiving

Labor market cost	Intensive caregivers		Non-intensive caregivers	
	Proportion (%)	SE	Proportion (%)	SE
Unpaid time off work	39	0.02	23	0.01
Cut back work hours	35	0.02	21	0.01
Quit work	34	0.02	9	0.01
Early retirement	15	0.01	6	0.01
Cut back schooling	16	0.01	6	0.01

SE standard error

threshold to 1 h per week, there were no significant associations between intensive caregiving and any of the dependent variables except for cutting back hours of work. For analyses where the intensity threshold was 5 h per week, we found significant associations, but with smaller magnitudes for all outcomes except for cutting back work hours (full model results available upon request).

4 Discussion

We used the RAND Survey of Military and Veteran Caregivers to assess the types of opportunity costs experienced by a wide age range of caregivers and the extent to which these costs are encountered by intensive versus non-intensive

Table 3 Employment probability of intensive caregivers versus non-caregivers

Characteristic	Marginal effects	SE	95% CI	Sig.
Caregiver status				
Non-caregiver (Ref)				
Non-intensive caregiver	0.01	0.02	−0.03 to 0.05	
Intensive caregiver	−0.13	0.03	−0.18 to −0.08	***
Home owner	0.04	0.02	−0.01 to 0.08	
Married/cohabiting	0.04	0.02	0.00 to 0.08	
Age (years)				
18–34 (Ref)				
35–54	0.00	0.03	−0.06 to 0.06	
55–65	−0.23	0.03	−0.28 to −0.17	***
≥65	−0.52	0.02	−0.56 to −0.49	***
Race/ethnicity				
Non-Hispanic White				
Non-Hispanic Black	−0.07	0.03	−0.14 to −0.01	*
Other	0.01	0.06	−0.10 to 0.11	
Hispanic	−0.04	0.03	−0.10 to 0.03	
≥2 races	−0.03	0.05	−0.12 to 0.06	
Education				
High school (Ref)				
Some college	0.12	0.03	0.07 to 0.17	***
College	0.19	0.03	0.14 to 0.24	***
Post-college	0.30	0.03	0.25 to 0.35	***
Sex (male = 1)	0.05	0.02	0.02 to 0.09	**
No. of household members	−0.01	0.01	−0.03 to 0.01	
No. of children in household	0.01	0.01	−0.02 to 0.03	
Urban residence	−0.01	0.03	−0.06 to 0.05	
Service connected disability	−0.13	0.04	−0.21 to −0.05	**
n	3817			

CI confidence interval, *Ref* reference category, *SE* standard error, *Sig*. significance

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$

caregivers. We found that intensive caregivers, both military and civilian, experience economic penalties related to their labor market participation, work hours, job stability, and time off work. These findings support the growing literature that has documented participation, hours of work, and wage penalties experienced by informal caregivers [8, 9, 15, 20]. In line with existing literature, we also found that intensive informal caregivers have experienced retirement consequences due to caregiving [7, 9, 12]. The short-term implications of these career disruptions may be captured using a current wage rate. Given the wide age range of our sample, we were also able to capture important consequences of informal care unique to younger caregivers. Sixteen percent of informal caregivers have cut back schooling or taken time off school to provide informal care. Of the caregivers who identified schooling penalties, 68% were under the age of 45 years. These types of disruptions to the accumulation of human capital earlier in an individual's labor market trajectory can have important long-term ripple effects that are not captured using a current wage rate. We are not aware of any studies in the caregiving literature that have addressed this topic, though our findings indicate that this could be an important consequence of intensive informal caregiving, which should be examined in longitudinal analyses.

Economic spillover effects for caregivers, particularly those that affect labor market outcomes, are rarely incorporated into economic evaluations of health interventions, even when the societal viewpoint is adopted [1]. When these costs are incorporated, there can be uncertainty surrounding which economic outcomes to include and how to measure them. We have demonstrated that being an intensive caregiver is associated with economic penalties for a wide age range of caregivers. Using commonly applied replacement cost methods, such as those used to calculate VA caregiver stipend rates, are efficient from the perspective of the government—replacement cost methods may be the only feasible solution when there are budget limitations for a stipend program. They also provide an administratively facile way

Table 4 Probability of experiencing negative labor market and school outcomes, all caregivers

Characteristic	Unpaid time off			Cut back hours			Quit work			Early retirement			Cut back school		
	dy/d*x*	95% CI	Sig.	dy/d*x*	95% CI	Sig.	dy/d*x*	95% CI	Sig.	dy/d*x*	95% CI	Sig.	dy/d*x*	95% CI	Sig.
CG status															
Non-intensive CG (Ref)															
Intensive CG	0.06	0.02 to 0.10	**	0.04	0.001 to 0.09	*	0.12	0.08 to 0.15	***	0.05	0.02 to 0.07	***	0.03	0.005 to 0.05	*
Post-9/11 CG	0.13	0.02 to 0.24	*	0.10	−0.01 to 0.20		0.08	−0.01 to 0.17		0.06	−0.02 to 0.15		0.08	0.01 to 0.15	*
Relationship to care recipient															
Spouse	0.11	0.05 to 0.18	***	0.11	0.04 to 0.17	***	0.23	0.16 to 0.30	***	0.08	0.03 to 0.13	***	0.03	−0.004 to 0.06	
Parent	0.14	0.06 to 0.22	***	0.12	0.04 to 0.20	**	0.16	0.07 to 0.25	***	0.06	0.01 to 0.11	*	0.02	−0.02 to 0.06	
Child	0.05	−0.003 to 0.10		0.05	−0.001 to 0.10	*	0.10	0.05 to 0.14	***	0.01	−0.01 to 0.04		0.01	−0.01 to 0.03	
Other (Ref)															
No. of ADL tasks performed by CG	0.01	0.002 to 0.02	*	0.01	0.001 to 0.02	*	0.01	0.004 to 0.02	**	0.00	−0.001 to 0.01		0.00	−0.01 to 0.003	
No. of IADL tasks performed by CG	0.02	0.01 to 0.02	***	0.02	0.01 to 0.03	***	0.01	0.001 to 0.01	*	0.00	0.000 to 0.01	*	0.01	0.003 to 0.01	***
No. of CGs in network	0.00	−0.01 to 0.01		0.01	−0.003 to 0.02		−0.01	−0.02 to −0.003	*	0.00	−0.01 to 0.01		0.00	−0.002 to 0.01	
Home owner	−0.03	−0.07 to 0.01		−0.01	−0.05 to 0.03		−0.03	−0.07 to 0.003		0.00	−0.02 to 0.02		−0.02	−0.04 to −0.002	*
Married/cohabiting	−0.04	−0.08 to 0.01		−0.03	−0.08 to 0.01		−0.07	−0.10 to −0.03	***	−0.04	−0.07 to −0.02	***	−0.03	−0.05 to −0.005	*
Age (years)															
18–34 (Ref)															
35–54	−0.04	−0.09 to 0.02		−0.01	−0.07 to 0.04		−0.01	−0.05 to 0.04		0.03	−0.02 to 0.07		−0.04	−0.05 to −0.02	***
55–65	−0.07	−0.13 to −0.01	*	−0.08	−0.14 to −0.03	**	0.02	−0.03 to 0.07		0.19	0.10 to 0.29	***	−0.06	−0.08 to −0.04	***
≥65	−0.18	−0.23 to −0.13	***	−0.19	−0.24 to −0.15	***	−0.02	−0.07 to 0.03		0.17	0.06 to 0.28	***	−0.07	−0.09 to −0.06	***
Race/ethnicity															
Non-Hispanic White (Ref)															
Non-Hispanic Black	−0.08	−0.14 to −0.02	**	−0.06	−0.11 to 0.00	*	0.00	−0.05 to 0.06		0.02	−0.02 to 0.05		0.03	−0.01 to 0.06	
Other	0.10	−0.01 to 0.22		0.04	−0.07 to 0.14		0.10	−0.001 to 0.21	*	0.01	−0.05 to 0.06		0.01	−0.03 to 0.05	
Hispanic	0.01	−0.06 to 0.07		0.01	−0.06 to 0.07		0.03	−0.02 to 0.08		0.01	−0.02 to 0.05		0.02	−0.01 to 0.05	
≥2 races	0.00	−0.09 to 0.08		0.01	−0.07 to 0.09		0.03	−0.04 to 0.09		0.01	−0.03 to 0.05		0.01	−0.03 to 0.05	
Education															
High school (Ref)															
Some college	0.07	0.02 to 0.12	*	0.10	0.05 to 0.15	***	−0.01	−0.05 to 0.02		0.01	−0.01 to 0.04		0.08	0.05 to 0.12	***
College	0.08	0.02 to 0.14	*	0.09	0.03 to 0.16	**	−0.01	−0.05 to 0.03		0.01	−0.02 to 0.04		0.08	0.03 to 0.14	***
Post-college	0.05	−0.02 to 0.12		0.16	0.09 to 0.24	***	−0.04	−0.08 to −0.01	*	0.00	−0.03 to 0.03		0.12	0.05 to 0.20	***
Sex (male = 1)	0.01	−0.03 to 0.05		0.03	−0.01 to 0.07		−0.02	−0.05 to 0.01		0.01	−0.01 to 0.03		0.00	−0.02 to 0.01	
No. of household members	−0.01	−0.03 to 0.01		−0.01	−0.03 to 0.00		0.01	−0.01 to 0.02		0.00	−0.01 to 0.01		0.00	−0.003 to 0.01	
No. of children in household	0.01	−0.01 to 0.03		0.02	−0.005 to 0.04		0.01	−0.01 to 0.03		0.01	−0.01 to 0.02		0.00	−0.01 to 0.01	

Table 4 (continued)

Characteristic	Unpaid time off			Cut back hours			Quit work			Early retirement			Cut back school		
	dy/dx	95% CI	Sig.	dy/dx	95% CI	Sig.	dy/dx	95% CI	Sig.	dy/dx	95% CI	Sig.	dy/dx	95% CI	Sig.
Urban residence	−0.03	−0.08 to 0.03		−0.06	−0.12 to −0.01	*	0.00	−0.04 to 0.03		0.00	−0.03 to 0.02		0.01	−0.01 to 0.03	
Service-connected disability	0.03	−0.04 to 0.10		−0.02	−0.08 to 0.04		0.05	−0.01 to 0.10		0.01	−0.03 to 0.04		0.01	−0.02 to 0.04	
n	2603			2581			2582			2592			2576		

ADL activities of daily living, *CG* caregiver, *CI* confidence interval, *dy/dx* marginal effect, *IADL* instrumental activities of daily living, *Ref* reference category, *SE* standard error, *Sig.* significance

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$

in which to deliver the benefit. However, replacement cost methods likely underestimate the true costs of family caregiving from the caregiver and societal perspectives.

Similarly, opportunity cost approaches based on static market wages may also understate the true opportunity costs of informal care provision. Existing work has found that accounting for the lower labor market returns women aged 55 years and older experience after an informal caregiving spell results in a 2-year cost of informal care that is seven times that found using current foregone wages [15]. These estimates, like most of the existing literature, overlook disruptions to the accumulation of human capital *early* in an individual' career. Few data sources are available that would allow researchers to reliably estimate the economic consequences of these types of disruptions. However, studies looking at retirement savings and economic security in old age may reflect important avenues by which younger caregivers are affected later in their career trajectory.

A key strength of this study was that we were able to include a wide age range of intensive caregivers and directly ask these caregivers about their assessment of whether their caregiving duties impacted a number of economic outcomes. However, our study has limitations to consider. First, this study uses a cross-sectional dataset, so we provide only a snapshot of caregiving and economic outcomes. Second, the caregiving literature is grappling with issues relating to the endogeneity of caregiving and labor market outcomes, often using panel data methods and instrumental variable techniques to disentangle the effect of caregiving. Rich family structure variables were not available to us, which precluded using an instrumental variables approach. Results from the existing literature suggest, therefore, that our estimates may understate the total effect of caregiving on the labor force outcomes. That said, there is some evidence that endogeneity bias ultimately may not be a necessary consideration in this strain of research. After controlling for repeated observations among individuals over time using fixed effects, and with empirically strong instruments, Van Houtven et al. [9] could not reject exogeneity between informal care and work. Our models control for a rich set of variables at the caregiver and care recipient level, and we also know that caregiving is less of a choice in the event of injury (e.g., the military caregivers in the sample), which may minimize the risk of endogeneity bias. Without an ability to measure the presence or magnitude of the bias, our estimates can be interpreted as conservative estimates of the effect of caregiving on these important outcomes. We also note that our focus on a subgroup of intensive caregivers who were less likely to have had a choice in their care provision [19] may decrease the level of bias we would expect to see in an analysis of caregivers' labor market outcomes. Third, for the caregiver-only models (Table 4), respondents were asked to relate their work and schooling decisions to their caregiving decisions,

which means that they could be over-estimating the role of caregiving in relation to these outcomes (justification bias). The bias from this would lead to an over-estimate of the relationship. Thus, the downward bias that would appear if endogeneity is present, combined with an upward bias if justification bias is present, would have countervailing effects in unknown ways on the estimates presented in Table 4.

Nevertheless, the value of this unique dataset is that it describes caregiving effects among a broad age range and type of caregiver. This helps illustrate the importance of expanding the spillovers from informal care that researchers typically consider—beyond quitting work entirely, economic spillovers to absenteeism and to investment in human capital through education could have substantial effects on the economic security of caregivers over their life course. Further, though we have focused on factors that affect human capital accumulation, there are also other less studied economic outcomes related to lost raises, lower productivity, the economic costs associated with negative health effects of caregiving, and out-of-pocket costs. To truly understand the opportunity costs of informal care, we need more evidence surrounding all of these potential societal costs of care. With such data, programs that aim to mitigate the costs of caregiving may be more effective.

5 Conclusion

It is unlikely that researchers and policy makers hoping to calculate caregiver costs will take such a wide breadth of opportunity costs into account—particularly when it is so difficult to quantify these costs. However, even if these opportunity costs cannot be routinely included in economic evaluations of healthcare interventions or used to quantify caregiver costs for stipend policies, policy makers and researchers need to understand them. The higher the opportunity costs of unpaid care provision, the less likely it is that caregivers will provide this care, which will impact their future supply. Furthermore, the higher the direct costs observed by caregivers, the less cost effective this 'free' source of care is to society. These direct and indirect costs are important when calculating net benefits of informal care from a societal perspective.

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Author contributions JJ, CVH, TT, and RR contributed to the conceptualization and drafting of the manuscript. JJ and CVH conducted the analysis. RR and TT provided expertise surrounding the data as well as the survey methodology.

Compliance with Ethical Standards

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Conflict of interest Josephine Jacobs, Courtney Van Houtven, Terri Tanielian, and Rajeev Ramchand have no conflicts of interest to declare.

Informed consent Review by the Stanford Human Research Protection Program determined that this study did not meet the definition of human subjects research.

Data Availability Statement The dataset that supports these findings was used with the permission of RAND Corporation and is not publicly available. The STATA® code and model underpinning the research are available upon request from the corresponding author.

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