

ORIGINAL RESEARCH

Mentally Unhealthy Days and Frequent Mental Distress Among Caregivers in North Carolina

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Keywords: Emmaline Keesee, Erin Kent, long term services and supports, caregivers, family caregiving, mental health, north carolina, NC Behavioral Risk Factor Surveillance System, mentally unhealthy days, supports

<https://doi.org/10.18043/001c.142245>

North Carolina Medical Journal

Vol. 86, Issue 2, 2025

BACKGROUND

Geographic variation in state services and supports for caregivers warrants a closer examination of factors associated with caregiver distress at the state level. We examined factors associated with mentally unhealthy days and frequent mental distress among caregivers as compared to non-caregivers in North Carolina.

METHODS

We used data from the North Carolina Behavioral Risk Factor Surveillance System optional caregiving modules (years 2011, 2017, and 2021). Multivariable zero-inflated negative binomial (ZINB) and logistic regression analyses incorporating sampling weights were used to predict the number of mentally unhealthy days (MUDs) out of the past month and the probability of frequent mental distress (FMD), defined as 14 or more MUDs in the past month. We provided socio-demographically adjusted marginal effects comparing caregivers to non-caregivers. We produced estimates using both the total sample and a subset of individuals without reported frequent physical distress (FPD), meaning those with less than 14 physically unhealthy days in the past month.

RESULTS

Caregivers had an average of 1.3 higher predicted number of mentally unhealthy days (95% CI, 0.8–1.9) and a 4 percentage-point higher probability of having frequent mental distress than non-caregivers (95% CI, 1.6–6.3) after controlling for sociodemographic covariates. Individuals with lower educational attainment and those unemployed had a higher average number of MUDs (P values < .05).

LIMITATIONS

Primary exposure and outcomes were self-reported measures, and study years were constrained to years that the caregiver module was implemented.

CONCLUSIONS

Further research is warranted to determine if improvements in long-term care services and supports (LTSS) and access may reduce caregiver distress. Useful strategies to support caregivers have been outlined by the National Strategy to Support Family Caregivers initiative to address caregivers' unmet needs.

Introduction

In North Carolina, approximately 1.3 million people identify as caring for a family member, partner, or friend with serious health problems, functional impairment, and/or disabilities.¹ Given the multitude of demands that accompany caregiving, caregivers face challenges alongside their care recipients to maintain their wellbeing.^{2,3} The availability of state-wide public health surveillance data makes it possible to track caregiver wellbeing in reference to non-caregivers and to identify whether particular caregivers are at an increased risk of distress.⁴ The need for improved caregiver support is gaining recognition at the national level, with the National Strategy to Support Family Caregivers,⁵ and in certain states, as exemplified by the passage of several recent master or multisector plans for aging. For example, in North Carolina, the 2024 launch of the Multisector Plan for Aging specifically highlights the need to strengthen family support.⁶

Examining both the impact that caregiving has on caregiver health outcomes and the connection between those outcomes and the availability of long-term services and supports (LTSS) is critical to developing new and improving existing LTSS for families. To better inform efforts at the national and state level, we used North Carolina-specific data from the North Carolina Behavioral Risk Factor Surveillance System (BRFSS) to describe and compare self-reported mentally unhealthy days (MUDs) and frequent mental distress (FMD) of caregivers and non-caregivers, as well as to examine factors associated with these mental health outcomes.

Methods

Datasets

This analysis pulled data from the 2011, 2017, and 2021 North Carolina BRFSS surveys and corresponding caregiving North Carolina state modules provided by the North Carolina Department of Health and Human Services. BRFSS is a cross-sectional telephone survey of non-institutionalized adults and is representative at the state level. It is conducted annually in all 50 states and the District of Columbia.⁷ Survey weight adjustments create state-representative samples using telephone source, education level, marital status, home ownership, age, sex, race, ethnicity, and region. The core BRFSS survey, implemented across all states, asks participants about self-reported health characteristics and behaviors. States may elect to include additional modules in a given study year focused on specific topics (e.g., family planning, diabetes, caregiving). North Carolina implemented the optional caregiving module in 2011, 2017, and 2021 to a subset of survey participants. In 2011, North Carolina self-designed its caregiver questionnaire, then switched in 2017 and 2021 to the standardized caregiving module provided as an option to all states. We pooled study years and adjusted survey weights accordingly.⁸ We determined participant characteristics and health outcomes using the core

BRFSS survey and optional caregiving modules. This study was deemed exempt from human subject research regulation by the University of North Carolina at Chapel Hill Institutional Review Board (IRB# 24-2029).

Sample

Our study sample included the subset of BRFSS survey respondents that were asked, “During the past 30 days, did you provide regular care or assistance to a friend or family member who has a health problem or disability?”.⁹ Response options included “yes,” “no,” “don’t know/not sure,” and “refused” for all study years. Those that responded “yes” were asked the entirety of the caregiving module questionnaire and were designated as caregivers in the base analysis. Those that responded “no” comprised the non-caregiver group. Respondents that refused or responded “don’t know/not sure” were excluded. Starting in 2017, modules included the additional response option, “care recipient died in the last 30 days.” Preliminary analyses showed that the number of respondents who chose this option in 2017 and 2021 was small. We excluded them from the base analysis because they were not asked the remainder of the caregiving module questionnaire and may have differed from caregivers with living care recipients in relevant ways. We ran an additional check including those respondents as caregivers, in recognition that those with a recently deceased care recipient may have been categorized as caregivers in the 2011 sample. Results of those checks are included in [Appendix A](#). Caregiving status (yes or no) was included as an indicator variable in models and was our primary exposure of interest.

Outcomes and Analysis

We performed a pooled cross-sectional analysis regressing the number of mentally healthy days and the probability of frequent mental distress on caregiving status and the covariates discussed below. The BRFSS core survey asks, “Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?” We included responses as the count variable mentally unhealthy days (MUDs). Values of “don’t know/not sure” or “refused” were marked as missing and excluded. We modeled the relationship between caregiving and MUDs using a zero-inflated negative binomial (ZINB) two-part model to account for excess zeros and overdispersion in count data. ZINB regression has been demonstrated to perform better in modeling mentally unhealthy days compared with Poisson distribution or negative binomial distribution.^{10,11} ZINB regression first uses a logit model to predict excess zeros, followed by a negative binomial regression on the count data. We present predicted marginal effects of caregiving on mentally unhealthy days for the negative binomial model in the body of the report and include the zero-inflated logit model output in [Appendix B](#) for reference.

We calculated our second outcome of interest, frequent mental distress (FMD), as a derivation of mentally unhealthy days.^{9,12} FMD was coded as an indicator equal to 1 if mentally unhealthy days were greater than or equal to 14 days, and 0 if mentally unhealthy days were less than 14 days. FMD serves to capture extreme values (greater than 14) that are less easily predicted with negative binomial regression. We used logit models to produce log odds of frequent mental distress given caregiving status and present marginal effects on the probability scale.¹³ For both the ZINB and logit models, we included the following set of categorical covariates: educational attainment, current employment status, health insurance status, survey year, age at survey, relationship status, number of adults in the respondent household, number of children in the respondent household, and race/ethnicity. Each covariate was categorized, as shown in [Table 1](#). Further stratification and interactions are explained below.

Stratifications and Interactions

Caregiving can create physical burden and worsen physical health outcomes among caregivers.¹⁴ We posit that pre-existing poor physical health can also negatively affect mentally unhealthy days independent of caregiving, influence one's ability to be a caregiver, or alter the relationship between caregiving and mental health. As a simple exploration of the relationship between caregiving, mental health, and physical health, we re-conducted our baseline models with a subsample of individuals without frequent physical distress (FPD), where frequent physical distress is defined as having 14 or more physically unhealthy days in the past month. This targeted a subsample of caregivers and non-caregivers who otherwise were relatively physically healthy by the limited definition of no frequent physical distress. We do not present results on a subsample of individuals with frequent physical distress, as this group size was underpowered. Results of the subsample regression are included alongside the total sample output in [Table 2](#) and [Table 3](#).

Recognizing that circumstances for caregivers in North Carolina are relatively understudied, particularly regarding social and economic risk factors, we ran all models 4 more times with distinct interactions. First, we interacted caregiving with educational attainment. Educational attainment was divided into 4 categories: less than high school, high school degree, some college or technical school, and college or technical degree. In early descriptive analyses, we identified that important differences in mentally unhealthy days existed across categories and elected not to consolidate further. Second, we interacted caregiving with employment status in the following groupings: employed, out of work, homemaker or student, and retired or unable to work. The category "employed" included all individuals self-employed and employed for wages. "Out of work" were individuals that reported being out of work for less than one year or more than one year. To maintain a sufficient sample size, we consolidated homemakers with students and retirees with individuals

unable to work. Consolidated employment groupings presented with similar average mentally unhealthy days and similar age distributions. We interacted caregiving with health insurance status—insured or uninsured. Lastly, we interacted caregiving with survey year to better understand changes over time in caregiver and non-caregiver mental health differences and in light of the COVID-19 pandemic.

Sensitivity Analysis

We ran a series of sensitivity analyses on the un-interacted models to understand the robustness of our results. We excluded 2021 from the pooled analysis to demonstrate comparability of results before and after the COVID-19 pandemic. Missing values for all covariates were included as a distinct category to ensure missing values did not have a significant impact on results. We also substituted the zero-inflated negative binomial with a negative binomial model and the logit with a linear probability model. Finally, we provided alternative results for the interacted models under different variations of educational attainment, employment status, and health insurance status categorization, including categories for missingness, dichotomous specifications, and alternatively consolidated categories. All sensitivity analysis output is included in [Appendix A](#) and [Appendices C–E](#).

Results

A total of 2494 caregivers and 10,348 non-caregivers, representing 830,765 and 3,477,863 North Carolinians, respectively, were included in the analysis. [Table 1](#) includes summary statistics, and survey weights are applied to calculate proportions and standard errors. Caregivers were more likely to be female (62% versus 52%), over the age of 50 (58% versus 51%), and somewhat less likely to live with a child (29% versus 34%). Caregivers in the sample were less likely to have below a high school degree (11% versus 15%) than non-caregivers and more likely to have started college or a technical degree (37% versus 32%). However, caregivers and non-caregivers were similarly likely to have obtained said degree (25% versus 26%). Caregivers were less likely to be employed (51% versus 55%), more likely to be uninsured (15% versus 13%), and more likely to experience frequent physical distress (15% versus 12%). Missing data (“refused”, “not sure”, and missing survey response) were under 3% across all variables.

Caregivers reported an unadjusted average of 1.29 more mentally unhealthy days than non-caregivers and a higher probability of frequent mental distress (15% versus 11%). Results of regressing the probability of frequent mental distress and number of mentally unhealthy days on caregiving and covariates are shown in [Table 2](#). Covariates were coded as displayed in [Table 1](#), excluding missing values for all variables except number of adults in household, for which missing values were included as a distinct category. [Table 3](#), [Table 4](#), and [Figure 1](#) provide the output of 3 models interacting caregiving with

Table 1. Study Sample Characteristics by Caregiving Status

	Caregivers			Non-Caregivers		
	N	(WT%)	(%)	N	(WT%)	(%)
Total	2494	(19.28)	(19.42)	10,348	(80.72)	(80.58)
Survey Year	-	-	-	-	-	-
2011	999	(32.00)	(40.06)	3889	(34.23)	(37.58)
2017	755	(32.19)	(30.27)	3039	(30.56)	(29.37)
2021	740	(33.58)	(29.67)	3420	(37.44)	(33.05)
Sex	-	-	-	-	-	-
Male	863	(38.31)	(34.60)	4457	(48.21)	(43.07)
Female	1631	(61.69)	(65.40)	5889	(51.76)	(56.91)
Missing/unknown	0	(0.00)	(0.00)	2	(0.03)	(0.02)
Age	-	-	-	-	-	-
Under 50	756	(41.50)	(30.31)	3705	(47.88)	(43.07)
50 and over	1714	(57.47)	(68.72)	6489	(50.79)	(59.91)
Missing/unknown	24	(1.04)	(0.96)	154	(1.33)	(0.02)
Race	-	-	-	-	-	-
Black	474	(21.04)	(19.01)	1874	(21.11)	(18.11)
Other	161	(4.68)	(6.46)	849	(7.34)	(8.20)
White	1827	(73.02)	(73.26)	7398	(69.14)	(71.49)
Missing/unknown	32	(1.26)	(1.28)	227	(2.41)	(2.19)
Relationship Status	-	-	-	-	-	-
In relationship	1492	(59.90)	(59.82)	5760	(57.36)	(55.66)
Single	994	(39.76)	(39.86)	4533	(42.22)	(43.81)
Missing/unknown	8	(0.34)	(0.32)	55	(0.42)	(0.53)
Live with >= 1 Child	599	(28.90)	(24.02)	2860	(34.25)	(27.64)
Number of adults in household	-	-	-	-	-	-
0-2	1918	(68.69)	(76.90)	8351	(73.51)	(80.70)
3+	524	(29.61)	(21.01)	1689	(24.27)	(16.32)
Missing/unknown	52	(1.70)	(2.09)	308	(2.22)	(2.98)
Education	-	-	-	-	-	-
Less than high school	872	(24.62)	(34.96)	3767	(26.38)	(36.40)
High school degree	778	(36.74)	(31.19)	2699	(31.53)	(26.08)
Some college or technical school	652	(26.97)	(26.14)	2661	(27.16)	(25.72)
College or technical school degree	184	(11.39)	(7.38)	1196	(14.79)	(11.56)
Missing/unknown	8	(0.28)	(0.32)	25	(0.13)	(0.24)
Employment	-	-	-	-	-	-
Employed	1182	(50.64)	(47.39)	4994	(54.91)	(48.26)
Out of work	156	(7.24)	(6.26)	509	(5.93)	(4.92)
Homemaker or student	172	(9.73)	(6.90)	701	(8.68)	(6.77)
Retired or unable to work	971	(31.63)	(39.93)	4096	(29.95)	(39.58)
Missing/unknown	13	(0.75)	(0.52)	48	(0.52)	(0.46)
Has health insurance	-	-	-	-	-	-
Yes	2184	(85.09)	(87.57)	9128	(85.90)	(88.21)
No	300	(14.57)	(12.03)	1137	(12.86)	(10.99)
Missing/unknown	10	(0.34)	(0.40)	83	(1.24)	(0.80)
Outcomes	-	-	-	-	-	-

-	Caregivers			Non-Caregivers		
Mentally unhealthy days (WT Mean, WT SE)	4.91	(0.28)	-	3.62	(0.11)	-
Mentally unhealthy days (Mean, SD)	4.57	(8.90)	-	3.37	(7.82)	-
Frequent mental distress	-	-	-	-	-	-
MUD >= 14	352	(15.19)	(14.11)	1080	(11.25)	(10.44)
MUD < 14	2092	(83.03)	(83.88)	9100	(87.15)	(87.94)
Missing/unknown	50	(1.78)	(2.00)	168	(1.59)	(1.62)
Physically unhealthy days (WT Mean, WT SE)	4.63	(0.27)	-	3.86	(0.12)	-
Physically unhealthy days (Mean, SE)	4.69	(9.00)	-	4.36	(9.17)	-
Frequent physical distress	-	-	-	-	-	-
PUD >= 14	378	(14.92)	(15.16)	1443	(12.37)	(13.94)
PUD < 14	2077	(83.56)	(83.28)	8702	(85.92)	(84.09)
Missing/unknown	39	(1.53)	(1.56)	203	(1.71)	(1.96)

Table Note. The missing/unknown category includes missing, 'refused,' and 'not sure' survey responses.

MUD = mentally unhealthy days.

PUD = physically unhealthy days.

Source: author analysis.

educational attainment, employment status, and health insurance status, while adjusting for the covariates shown in [Table 2](#). Average marginal effects are shown relative to the reference group predicted mean when holding covariates constant and are on the probability scale for the logit regression models (columns 1 and 2, [Tables 2](#) and [3](#)) and in the number of mentally unhealthy days for the ZINB models (columns 3 and 4, [Tables 2](#) and [3](#)). Columns 2 and 4 show the results of limiting the sample to individuals without frequent physical distress (less than 14 physically unhealthy days). State-representative survey weights were used to generate all estimates and standard errors provided in the main results. Unweighted results are provided in [Appendix F](#) and [Appendix G](#).

Caregivers had 1.3 more predicted mentally unhealthy days on average (95% CI, 0.8–1.9) than non-caregivers when holding covariates constant. In addition, being a caregiver was associated with a 4.0 percentage-point higher predicted probability of having frequent mental distress when compared to non-caregivers (95% CI, 1.6–6.3). Interaction effects shown in [Table 3](#) indicate that the level of educational attainment was inversely proportional to the predicted number of additional mentally unhealthy days associated with caregiving. Among those with less than a high school education, caregivers were predicted to have 2.1 more mentally unhealthy days than non-caregivers (95% CI, 0.6–3.6). For those with a high school degree, some college or technical school, and a college or technical degree, the difference between caregiver and non-caregiver average MUDs was 1.6, 1.4, and 0.6, respectively (95% CI, 0.5–2.7; 0.5–2.4; 0.02–1.3). The probability of frequent mental distress outcomes followed a similar trajectory, though statistical significance was maintained only in the difference between caregivers and non-caregivers with some college or technical education.

Table 2. Average Marginal Effects (AME) of Caregiving on Probability of Frequent Distress and Number of Mentally Unhealthy Days

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	Total Sample	No FPD	Total Sample	No FPD
	(1)	(2)	(3)	(4)
	Ref. Mean	Ref. Mean	Ref. Mean	Ref. Mean
	AME	AME	AME	AME
	[95% CI]	[95% CI]	[95% CI]	[95% CI]
Caregiving status	-	-	-	-
Non-caregiver (ref. mean)	0.115	0.079	3.618	2.685
Caregiver (AME)	0.040***	0.041***	1.345***	1.268***
	[0.016, 0.063]	[0.018, 0.063]	[0.779, 1.911]	[0.760, 1.776]
Education	-	-	-	-
College or technical school degree (ref. mean)	0.084	0.059	2.934	2.256
Some college or technical school (AME)	0.046***	0.040***	1.185***	0.963***
	[0.027, 0.065]	[0.022, 0.057]	[0.723, 1.646]	[0.548, 1.378]
HS degree (AME)	0.038***	0.032***	0.942***	0.798**
	[0.019, 0.058]	[0.014, 0.051]	[0.419, 1.464]	[0.306, 1.291]
No HS degree (AME)	0.082***	0.042*	1.952***	1.098**
	[0.050, 0.114]	[0.008, 0.076]	[1.167, 2.737]	[0.283, 1.913]
Employment	-	-	-	-
Employed (ref. mean)	0.091	0.082	3.101	2.847
Out of work (AME)	0.095***	0.085**	2.753***	2.284***
	[0.048, 0.142]	[0.034, 0.136]	[1.678, 3.828]	[1.118, 3.450]
Homemaker or student (AME)	-0.019	-0.024*	-0.322	-0.445
	[-0.043, 0.005]	[-0.048, -0.001]	[-0.910, 0.266]	[-1.003, 0.113]
Retired or unable to work (AME)	0.104***	0.004	2.444***	-0.04
	[0.076, 0.132]	[-0.020, 0.025]	[1.827, 3.054]	[-0.561, 0.462]
Health insurance status	-	-	-	-
Uninsured (ref. mean)	0.140	0.093	4.410	3.036
Insured (AME)	-0.021	-0.007	-0.628	-0.133
	[-0.052, 0.011]	[-0.036, 0.022]	[-1.412, 0.155]	[-0.829, 0.563]
Survey year	-	-	-	-
2011 (ref. mean)	0.101	0.072	3.297	2.518
2017 (AME)	0.031**	0.017	0.725**	0.395
	[0.010, 0.052]	[-0.004, 0.038]	[0.227, 1.223]	[-0.069, 0.860]
2021 (AME)	0.034***	0.027**	1.032***	0.850***
	[0.014, 0.055]	[0.008, 0.047]	[0.537, 1.526]	[0.403, 1.297]
Age group	-	-	-	-
Less than 50 (ref. mean)	0.172	0.116	5.186	3.889
50 and above (AME)	-0.080***	-0.055***	-2.202***	-1.752***
	[-0.108, -0.053]	[-0.078, -0.033]	[-2.773, -1.632]	[-2.254, -1.249]
Relationship status	-	-	-	-
Single (ref. mean)	0.143	0.100	4.434	3.286
In a relationship (AME)	-0.038***	-0.024*	-1.003***	-0.632**

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
-	[-0.057, -0.019]	[-0.044, -0.005]	[-1.452, -0.555]	[-1.054, -0.210]
Number of adults in household	-	-	-	-
0-2 adults (ref. mean)	0.116	0.083	3.707	2.834
3+ (AME)	0.024*	0.014	0.621*	0.365
-	[0.001, 0.046]	[-0.007, 0.035]	[0.062, 1.180]	[-0.124, 0.854]
Missing (AME)	0.023	-0.016	0.284	-0.292
-	[-0.040, 0.086]	[-0.054, 0.022]	[-1.203, 1.772]	[-1.250, 0.665]
Children in household	-	-	-	-
0 Children (ref. mean)	0.122	0.087	3.887	2.975
1+ (AME)	0.002	0	-0.019	-0.121
-	[-0.021, 0.025]	[-0.021, 0.020]	[-0.541, 0.502]	[-0.579, 0.337]
Race	-	-	-	-
White (ref. mean)	0.127	0.088	3.978	2.978
Black (AME)	-0.011	-0.003	-0.236	-0.127
-	[-0.032, 0.011]	[-0.024, 0.019]	[-0.770, 0.298]	[-0.618, 0.363]
Other (AME)	-0.029	-0.013	-0.565	-0.222
-	[-0.060, 0.001]	[-0.043, 0.016]	[-1.407, 0.277]	[-1.020, 0.576]
# Subpopulation observations	12,084	10,174	12,084	10,174

Table Note. * $P < .05$, ** $P < .01$, *** $P < .001$. Estimates of frequent mental distress were estimated using logistic regression and results are presented on the probability scale. Mentally unhealthy days were modeled using a zero-inflated negative binomial model and represent counts. Standard errors are informed by survey weights.

The reference category mean is the predicted average holding covariates constant.

For columns 1 and 2, the AME can be interpreted as the percentage-point change in the probability of frequent mental distress associated with column variable category when holding covariates constant and in reference to the comparison group probability (ref. mean). Columns 3 and 4 AME represent the change in mentally unhealthy days associated with the column variable category holding covariates constant and in reference to the comparison group predicted mean.

FPD = frequent physical distress and is defined as having 14 or more physically unhealthy days in the past month.

AME = average marginal effect.

HS = high school.

Source: author analysis.

Unemployed caregivers were predicted to have 2.3 more mentally unhealthy days on average than unemployed non-caregivers (95% CI, 0.1–4.5). The next largest difference between caregivers and non-caregivers by employment status was among the employed, with caregivers having 1.5 more mentally unhealthy days on average (95% CI, 0.9–2.2) and a 4.8 percentage-point higher likelihood of experiencing frequent mental distress (95% CI, 1.8–7.8). The predicted average number of mentally unhealthy days and probability of frequent mental distress were similar for caregivers and non-caregivers in the homemaker or student and the retired or unable to work categories. Among individuals with health insurance, caregiving was associated with 1.2 more MUDs on average (95% CI, 0.7–1.8) and a 3.8 percentage-point higher probability of FMD (95% CI, 1.3–6.2). The MUD burden associated with caregiving increased among the uninsured. Uninsured caregivers had 2.0 more MUDs on average (95% CI, 0.7–3.5). We found no evidence that the probability of frequent mental distress was different among uninsured groups.

Table 3. Average Marginal Effects (AME) of Caregiving Interacted with Education, Employment, Insurance Status, and Survey Year on Mentally Unhealthy Days and Frequent Mental Distress

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	Total Sample	No FPD	Total Sample	No FPD
-	(1)	(2)	(3)	(4)
-	Ref. Mean	Ref. Mean	Ref. Mean	Ref. Mean
-	AME	AME	AME	AME
-	[95% CI]	[95% CI]	[95% CI]	[95% CI]
Education and caregiving	-	-	-	-
Non-caregiver, college educated (ref. mean)	0.082	0.057	2.804	2.133
Caregiver, college educated (AME)	0.009	0.008	0.642*	0.602*
-	[-0.018, 0.037]	[-0.015, 0.031]	[0.018, 1.265]	[0.088, 1.115]
-	-	-	-	-
Non-caregiver, some college or technical school (ref. mean)	0.119	0.087	3.838	2.927
Caregiver, some college or technical school (AME)	0.055*	0.060**	1.441**	1.468**
-	[0.013, 0.098]	[0.016, 0.104]	[0.520, 2.362]	[0.581, 2.355]
-	-	-	-	-
Non-caregiver, high school educated (ref. mean)	0.116	0.084	3.562	2.752
Caregiver, high school educated (AME)	0.032	0.037	1.635**	1.526**
-	[-0.012, 0.077]	[-0.007, 0.080]	[0.535, 2.736]	[0.414, 2.638]
-	-	-	-	-
Non-caregiver, less than high school educated (ref. mean)	0.154	0.087	4.477	2.936
Caregiver, less than high school educated (AME)	0.066	0.07	2.123**	2.124**
-	[-0.019, 0.152]	[-0.019, 0.160]	[0.619, 3.628]	[0.527, 3.720]
Employment and caregiving	-	-	-	-
Non-caregiver, employed (ref. mean)	0.082	0.075	2.812	2.597
Caregiver, employed (AME)	0.048**	0.036*	1.527***	1.301***
-	[0.018, 0.078]	[0.007, 0.066]	[0.884, 2.171]	[0.675, 1.927]
-	-	-	-	-
Non-caregiver, out of work (ref. mean)	0.174	0.150	5.381	4.573
Caregiver, out of work (AME)	0.066	0.086	2.297*	2.643*
-	[-0.048, 0.180]	[-0.036, 0.209]	[0.121, 4.473]	[0.250, 5.036]
Non-caregiver, homemaker or student (ref. mean)	0.070	0.054	2.683	2.285
Caregiver, homemaker or student (AME)	0.012	0.022	0.504	0.610
-	[-0.039, 0.062]	[-0.029, 0.073]	[-0.631, 1.640]	[-0.480, 1.700]
Non-caregiver, retired or unable to work (ref. mean)	0.191	0.076	5.432	2.574
Caregiver, Retired or Unable to Work (AME)	0.028	0.048*	0.673	1.201*
-	[-0.021, 0.076]	[0.006, 0.091]	[-0.330, 1.676]	[0.282, 2.119]
Health insurance and caregiving	-	-	-	-

-	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	Non-caregiver, insured (ref. mean)	0.112	0.075	3.540
Caregiver, insured (AME)	0.038**	0.045***	1.236***	1.273***
-	[0.013, 0.062]	[0.021, 0.069]	[0.655, 1.817]	[0.741, 1.805]
-	-	-	-	-
Non-caregiver, uninsured (ref. mean)	0.130	0.095	4.013	2.799
Caregiver, uninsured (AME)	0.050	0.036	2.014**	1.216*
-	[-0.022, 0.123]	[-0.034, 0.106]	[0.682, 3.346]	[0.030, 2.402]
-	-	-	-	-
Year and caregiving	-	-	-	-
Non-caregiver, 2011 (ref. mean)	0.088	0.062	2.957	2.221
Caregiver, 2011 (AME)	0.062**	0.060**	1.786***	1.589***
-	[0.021, 0.104]	[0.017, 0.103]	[0.969, 2.603]	[0.803, 2.376]
-	-	-	-	-
Non-caregiver, 2017 (ref. mean)	0.125	0.077	3.735	2.609
Caregiver, 2017 (AME)	0.036	0.045*	1.470**	1.575***
-	[-0.004, 0.076]	[0.007, 0.084]	[0.532, 2.408]	[0.695, 2.456]
-	-	-	-	-
Non-caregiver, 2021 (ref. mean)	0.131	0.094	4.179	3.230
Caregiver, 2021 (AME)	0.019	0.022	0.692	0.584
-	[-0.021, 0.059]	[-0.014, 0.059]	[-0.128, 1.512]	[-0.128, 1.297]
-	-	-	-	-
# Subpopulation Observations	12,084	10,174	12,084	10,174

Table Note. Table 3 shows results of adding 4 interactions with caregiving (education, employment, health insurance status, and survey year) sequentially to the 4 main models in the analysis. We provide reference group (non-caregiver) predicted means and marginal effects associated with caregiving, holding covariates constant. Covariate marginal effects of each model are not shown (age group, relationship status, number of adults in household, children in household, race). Estimates of frequent mental distress were estimated using logistic regression, and results are presented on the probability scale. Mentally unhealthy days were modeled using a zero-inflated negative binomial model and represent counts. Standard errors are informed by survey weights.

For columns 1 and 2, the AME can be interpreted as the percentage-point change in the probability of frequent mental distress associated with column variable category when holding covariates constant and in reference to the comparison group predicted probability (ref. mean). Columns 3 and 4 AME represent the change in mentally unhealthy days associated with the column variable category holding covariates constant and in reference to the comparison group predicted mean.

FPD = frequent physical distress and is defined as having 14 or more physically unhealthy days in the past month.

AME = average marginal effect.

HS = high school.

* $P < .05$, ** $P < .01$, *** $P < .001$.

Source: author analysis.

Our exploration of survey-year effects showed that caregivers had 1.8 more mentally unhealthy days than non-caregivers on average in 2011 (95% CI, 1.0–2.6), which fell to 1.5 in 2017 (95% CI, 0.5–2.4) and 0.7 in 2021 (95% CI, –0.1 to 1.5). Notably, the highest predicted non-caregiver MUD mean was in 2021 (4.1). Our sensitivity analysis excluding the 2021 survey year shows that disparities between caregivers and non-caregivers increased as a

Table 4. Predicted Average Number of Mentally Unhealthy Days for Caregivers Versus Non-Caregivers by Health Insurance Status, Employment Status, and Educational Attainment

	Predicted Average Number of Mentally Unhealthy Days	
	Caregivers	Non-Caregivers
-	Predicted Avg	Predicted Avg
-	[95% CI]	[95% CI]
Education status	-	-
College or technical school degree	3.446	2.804
-	[2.868, 4.024]	[2.510, 3.099]
Some college or technical school	5.279	3.838
-	[4.407, 6.151]	[3.439, 4.237]
Highschool degree	5.198	3.562
-	[4.153, 6.243]	[3.106, 4.019]
Less than high school degree	6.600	4.477
-	[5.100, 8.101]	[3.740, 5.214]
Employment	-	-
Employed	4.339	2.812
-	[3.725, 4.954]	[2.544, 3.079]
Out of work	7.678	5.381
-	[5.549, 9.806]	[4.310, 6.452]
Homemaker or student	3.187	2.683
-	[2.140, 4.234]	[2.102, 3.264]
Retired or unable to work	5.966	5.432
-	[5.029, 6.903]	[4.858, 6.005]
Health insurance status	-	-
Insured	4.744	3.497
-	[4.195, 5.292]	[3.263, 3.732]
Uninsured	6.258	4.162
-	[4.906, 7.610]	[3.383, 4.942]

Table Note. Values in the table correspond to those visualized in [Figure 1](#). Predicted averages shown are predictive margins produced with zero-inflated negative binomial models, the results of these models are shown in [Table 3](#), column 3. Estimates are dependent on holding covariates as they are. Source: author analysis.

result ([Appendix A](#)). This could relate to the broader population being more likely to report mentally unhealthy days during the COVID-19 pandemic, thus reducing the relative burden of interest.^{15,16}

Regression results for the same models, but among a subset of those without frequent physical distress (columns 2 and 4 of [Tables 2](#) and [3](#)), identified a pattern of similar statistical significance and smaller or similar effect size compared to the total sample. The smaller effects associated with caregiving among those without frequent physical distress suggest that physical health may mediate the relationship between caregiving and mental health, with physically healthier caregivers having somewhat better mental health. An exception of note is that retired individuals without frequent physical distress had 1.2 additional mentally unhealthy days than non-caregivers, while we find no evidence of a difference between retired caregivers and non-caregivers

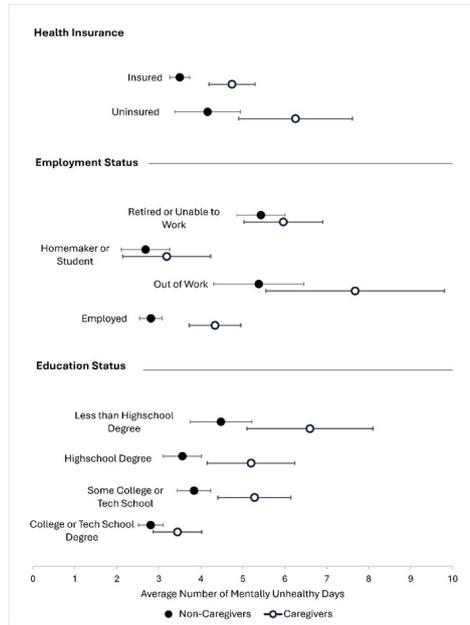


Figure 1. Predicated Average Number of Mentally Unhealthy Days for Caregivers Versus Non-Caregivers by Health Insurance Status, Employment Status, and Educational Attainment

X-axis = predicted average number of mentally unhealthy days.

Legend = Non-Caregivers; Caregivers

Source: author analysis.

using the total sample. Similarly, the predicted change in probability of frequent mental distress nearly doubled in the subsample compared to the total (a 4.8 versus 2.8 percentage-point difference).

Discussion

In our analysis of North Carolina BRFSS data pooled for survey years 2011, 2017, and 2021, caregivers had a higher number of unhealthy days and a higher probability of frequent mental distress than non-caregivers. Caregivers with lower educational attainment who were unemployed and uninsured had a significantly higher number of mentally unhealthy days than their counterpart non-caregivers. Similarly, these same subgroups had a higher probability of experiencing frequent mental distress. Stratification by self-reporting of frequent physical distress indicated that physical health may mediate the relationship between caregiving and mental health, though the degree of mediation differs across socioeconomic subgroups.

Findings from our study are similar to other studies using BRFSS data to compare caregiver and non-caregiver physical and mental health. A study using multi-state 2009 BRFSS data found worse self-rated health, more physical and more mental distress, and higher dissatisfaction with life than non-caregivers.¹⁷ Another multi-state analysis of 2021 BRFSS data examined rates of depressive disorders and found higher probability among caregivers who were female, American Indian/Alaskan Native or non-reporting race,

low income, and with low educational attainment.¹⁸ A study focusing on baby boomers found that caregivers were 1.39 times more likely to experience frequent mental distress.¹⁹ Finally, a study of cancer caregivers using multistate 2015 BRFSS data found that having unmet support service needs and higher caregiving intensity was associated with more mentally unhealthy days.²⁰

Qualitative studies reveal that specific challenges caregivers encounter are tied to unmet supportive needs, including barriers to accessing respite and help with coordinating care needs.²¹⁻²³ Caregivers cite the unpredictability of their circumstances, which often keeps them out of the labor force, sometimes socially isolated, and unable to attend to their own personal health needs.²²⁻²⁴ A study interviewing North Carolinian caregivers during the COVID-19 pandemic (2022) noted the recurrent theme of caregivers facing work-related and financial stress while caregiving for loved ones.²¹ Several individuals reported specific employment choices they made because of caregiving, such as quitting or cutting back hours. Furthermore, the recognition that their own physical health required attention and finding time to care for themselves was a challenge among caregivers' interviews. Few analyses have examined the health insurance status and subsequent mental health of caregivers, but it is widely recognized that caregiving, particularly with unmet LTSS needs, can negatively impact caregiver physical health.²⁵ The overall financial burden of caregiving combined with poorer physical health could result in higher stress among uninsured caregivers relative to non-caregivers.

Caregivers in North Carolina, particularly those with lower educational attainment and unemployment, may have fewer options for finding respite and accessing additional services. This can lead to caregivers being inadequately prepared, feeling overwhelmed, and more likely to experience burnout, as evident from our findings on distress. Resources for caregivers in North Carolina exist, and many organizations are committed to bolstering them. However, a recent state-by-state comparison of LTSS (including the availability of paid family and medical leave, Medicaid waivers for family supports, and respite programs) found significant variability and ranked North Carolina in the bottom quintile.²⁶ Additionally, North Carolina has a long waitlist for Medicaid home- and community-based services.²⁷ Furthermore, the LTSS 2023 State Scorecard Report curated by the AARP ranked North Carolina 49th on "Support for Family Caregivers," pointing to significant opportunity to improve the caregiver experience in the state.²⁸

Our study has some limitations that are important to note. All measures, including caregiving identification, distress, and additional covariates, are self-reported. Our sample is limited to the years that the caregiving module was offered, though these years span the COVID-19 pandemic. Finally, our outcome measure was based on a single item, mentally unhealthy days; however, the unhealthy days measures have been shown to have good

criterion and construct validity as compared to gold-standard measures of mental health-related quality of life, such as the SF-36 Mental Component Summary score.^{9,29,30} Our study has notable strengths, as well. We used a population-based resource that allows caregivers to self-identify, which creates a natural comparison between caregivers and non-caregivers.

Conclusion

In conclusion, caregivers in North Carolina report higher distress than non-caregivers. Additionally, caregivers with low socio-economic status experience even higher distress. Future research should continue to leverage population-based surveys for policy development and planning, particularly at the state and local level where most LTSS are delivered. As North Carolina increasingly recognizes the importance of family and friend caregivers, further research is warranted to understand how LTSS quality, access, and utilization may relate to caregiver well-being.

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Disclosure of interests

The authors have no conflicts of interest to report.

Financial support

The authors received no funding for this work.

Published: July 30, 2025 EDT.



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Appendices

Appendix A. Results of Sensitivity Analyses with the Base (Un-interacted) Model

-	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	Total Sample	No FPD	Total Sample	No FPD
-	Ref. Mean	Ref. Mean	Ref. Mean	Ref. Mean
-	AME	AME	AME	AME
-	[95% CI]	[95% CI]	[95% CI]	[95% CI]
Base model output	-	-	-	-
Non-caregiver (ref. mean)	0.115	0.079	3.618	2.685
Caregiver (AME)	0.040***	0.041***	1.345***	1.268***
-	[0.016, 0.063]	[0.018, 0.063]	[0.779, 1.911]	[0.760, 1.776]
Caregivers with deceased care recipients included				
Non-caregiver (ref. mean)	0.114	0.079	3.607	2.682
Caregiver (AME)	0.040***	0.041***	1.348***	1.267***
-	[0.017, 0.063]	[0.019, 0.063]	[0.792, 1.904]	[0.765, 1.769]
2011 and 2017 survey years only	-	-	-	-
Non-caregiver (ref. mean)	0.108	0.071	3.459	2.475
Caregiver (AME)	0.048**	0.052***	1.464***	1.415***
-	[0.019, 0.078]	[0.023, 0.080]	[0.745, 2.182]	[0.777, 2.053]
Covariate missingness categories included	-	-	-	-
Non-caregiver (ref. mean)	0.114	0.079	3.606	2.682
Caregiver (AME)	0.040***	0.041***	1.348***	1.267***
-	[0.017, 0.063]	[0.019, 0.063]	[0.792, 1.904]	[0.765, 1.769]
Linear probability	-	-	-	-
Non-caregiver (ref. mean)	0.115	0.079	-	-
Caregiver (AME)	0.041***	0.042***	-	-
-	[0.018, 0.064]	[0.019, 0.064]	-	-
Negative binomial regression	-	-	-	-
Non-caregiver (ref. mean)	-	-	3.616	2.689
Caregiver (AME)	-	-	1.453***	1.477***
-	-	-	[0.856, 2.050]	[0.904, 2.051]

Table Note. Appendix A includes the results of 5 sensitivity analyses and the baseline results presented in the primary manuscript. Covariate estimates are not included but mirror those used in the base model.

FPD = frequent physical distress

AME = average marginal effect

* $P < .05$, ** $P < .01$, *** $P < .001$

Source: author analysis.

Appendix B. Zero-Inflated Negative Binomial Regression, Logit Model Output Corresponding to [Table 1](#) Results

	Total Sample		No FPD	
	Log Odds	95% CI	Log Odds	95% CI
Caregiving status	-	-	-	-
Non-caregiver	Ref	-	Ref	-
Caregiver	-0.446***	[-0.598, -0.294]	-0.496***	[-0.674, -0.317]
Education	-	-	-	-
College or technical school degree	Ref	-	Ref	-
Some college or technical school	-0.014	[-0.159, 0.131]	0.063	[-0.104, 0.230]
High school degree	0.141	[-0.017, 0.298]	0.251**	[0.069, 0.433]
No High school degree	-0.058	[-0.285, 0.169]	0.241	[-0.059, 0.541]
Employment	-	-	-	-
Employed	Ref	-	Ref	-
Out of work	-0.750***	[-1.064, -0.437]	-0.694***	[-1.056, -0.332]
Homemaker or student	-0.109	[-0.366, 0.148]	-0.133	[-0.424, 0.157]
Retired or unable to work	-0.229**	[-0.383, -0.075]	0.237*	[0.0483, 0.427]
Health insurance status	-	-	-	-
Uninsured	Ref	-	Ref	-
Insured	-0.024	[-0.244, 0.197]	-0.100	[-0.361, 0.160]
Survey year	-	-	-	-
2011	Ref	-	Ref	-
2017	-0.090	[-0.251, 0.073]	0.004	[-0.191, 0.199]
2021	-0.138	[-0.295, 0.021]	-0.108	[-0.294, 0.079]
Age group	-	-	-	-
< 50	Ref	-	Ref	-
>= 50	0.867***	[0.701, 1.032]	0.888***	[0.698, 1.078]
Relationship status	-	-	-	-
Single	Ref	-	Ref	-
In a relationship	0.309***	[0.177, 0.442]	0.259**	[0.101, 0.417]
Number of adults in household	-	-	-	-
0-2	Ref	-	Ref	-
3+	0.014	[-0.144, 0.173]	0.038	[-0.144, 0.219]
Missing	0.059	[-0.374, 0.492]	0.146	[-0.358, 0.650]
Children in household	-	-	-	-
0	Ref	-	Ref	-
1+	0.003	[-0.160, 0.166]	0.053	[-0.133, 0.241]
Race	-	-	-	-
White	Ref	-	Ref	-
Black	0.084	[-0.079, 0.247]	0.093	[-0.099, 0.285]
Other	0.273*	[0.009, 0.536]	0.208	[-0.099, 0.515]
Constant	0.155	[-0.139, 0.449]	0.058	[-0.294, 0.412]
Inalpha	0.075	[-0.022, 0.172]	0.264	[0.143, 0.385]
Alpha	1.078	[0.979, 1.188]	1.302	[1.154, 1.469]

Table Note. Results are interpreted as the log odds of having *zero* mentally unhealthy days. An alpha > 0 is indicative of overdispersion and points to the appropriate use of the zero inflated negative binomial model.

Ref = reference category

* $P < .05$, ** $P < .01$, *** $P < .001$

FPD = frequent physical distress

Source: author analysis.

Appendix C. Adjustments to Model with Caregiving and Educational Attainment Interaction

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	Total Sample	No FPD	Total Sample	No FPD
-	Ref. Mean	Ref. Mean	Ref. Mean	Ref. Mean
-	AME	AME	AME	AME
-	[95% CI]	[95% CI]	[95% CI]	[95% CI]
Dichotomous education	-	-	-	-
Non-caregiver, college or technical degree (ref. mean)	0.083	0.057	2.839	2.142
Caregiver, college or technical degree (AME)	0.009	0.008	0.634*	0.599
-	[-0.018, 0.036]	[-0.015, 0.031]	[0.005, 1.262]	[0.085, 1.113]
Non-caregiver, no college or technical degree (ref. mean)	0.125	0.086	3.856	2.862
Caregiver, no college or technical degree (AME)	0.047**	0.053***	1.613***	1.599
-	[0.018, 0.077]	[0.023, 0.083]	[0.907, 2.318]	[0.920, 2.278]
Combined high school and less than high school education	-	-	-	-
Non-Caregiver, college or technical degree (ref. mean)	0.083	0.057	2.834	2.142
Caregiver, college or technical degree (AME)	0.009	0.008	0.631*	0.599
-	[-0.018, 0.036]	[-0.015, 0.031]	[0.004, 1.258]	[0.084, 1.114]
-	-	-	-	-
Non-caregiver, some college or technical school (ref. mean)	0.120	0.087	3.857	2.932
Caregiver, some college or technical school (AME)	0.055*	0.060**	1.430**	1.464
-	[0.013, 0.098]	[0.016, 0.104]	[0.505, 2.354]	[0.577, 2.351]
-	-	-	-	-
Non-caregiver, high school degree or less (ref. mean)	0.129	0.085	3.854	2.801
Caregiver, high school degree or less (AME)	0.041*	0.046*	1.786***	1.716
-	[0.001, 0.081]	[0.007, 0.086]	[0.857, 2.715]	[0.779, 2.653]
-	-	-	-	-
Combined some college and college education	-	-	-	-
Non-caregiver, at least some college or technical school (ref. mean)	0.104	0.074	3.404	2.578
Caregiver, at least some college or technical school (AME)	0.040**	0.040**	1.163***	1.104
-	[0.012, 0.069]	[0.012, 0.067]	[0.512, 1.813]	[0.521, 1.687]
-	-	-	-	-
Non-caregiver, high school degree (ref. mean)	0.116	0.084	3.562	2.745
Caregiver, high school degree (AME)	0.032	0.036	1.636**	1.527
-	[-0.013, 0.077]	[-0.007, 0.079]	[0.530, 2.742]	[0.407, 2.648]
-	-	-	-	-
Non-caregiver, less than high school degree (ref. mean)	0.152	0.086	4.417	2.888
Caregiver, less than high school degree (AME)	0.065	0.068	2.089**	2.057
-	[-0.020,	[-0.020,	[0.599,	[0.484,

-	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	0.150]	0.156]	3.579]	3.630]

Table Note. The table shows the results of adjustments to education categories used in the interacted model.

* $P < .05$, ** $P < .01$, *** $P < .001$.

Source: author analysis.

Appendix D. Adjustments to Model with Caregiving and Employment Status Interaction

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	Total Sample	No FPD	Total Sample	No FPD
-	Ref. Mean	Ref. Mean	Ref. Mean	Ref. Mean
-	AME	AME	AME	AME
-	[95% CI]	[95% CI]	[95% CI]	[95% CI]
All Categories – Employment	-	-	-	-
Non-caregiver, employed for wage (ref. mean)	0.087	0.078	2.876	2.637
Caregiver, employed for wage (AME)	0.040*	0.028	1.414***	1.177
-	[0.007, 0.073]	[-0.003, 0.058]	[0.722, 2.105]	[0.530, 1.824]
Non-caregiver, out of work 1+ year (ref. mean)	0.209	0.171	5.651	4.572
Caregiver, out of work 1+ year (AME)	0.129	0.142	3.501*	3.695
-	[-0.047, 0.305]	[-0.039, 0.323]	[0.630, 6.372]	[0.653, 6.736]
Non-caregiver, out of work < 1 year (ref. mean)	0.162	0.138	5.437	4.759
Caregiver, out of work < 1 year (AME)	0.003	0.018	0.857	1.052
-	[-0.140, 0.147]	[-0.133, 0.169]	[-2.029, 3.744]	[-2.049, 4.153]
Non-caregiver, homemaker (ref. mean)	0.075	0.055	2.999	2.538
Caregiver, homemaker (AME)	0.021	0.049	0.374	0.826
-	[-0.049, 0.092]	[-0.030, 0.129]	[-1.110, 1.859]	[-0.764, 2.416]
Non-caregiver, student (ref. mean)	0.078	0.056	2.587	2.124
Caregiver, student (AME)	-0.009	-0.017	0.45	-0.077
-	[-0.087, 0.069]	[-0.072, 0.039]	[-1.581, 2.482]	[-1.319, 1.166]
Non-caregiver, retired (ref. mean)	0.092	0.049	2.990	1.844
Caregiver, retired (AME)	0.022	0.044*	0.566	1.158
-	[-0.016, 0.060]	[0.004, 0.084]	[-0.230, 1.362]	[0.318, 1.997]
Non-caregiver, unable to work (ref. mean)	0.366	0.172	10.564	5.804
Caregiver, unable to work (AME)	-0.005	0.036	-0.097	0.816
-	[-0.110, 0.100]	[-0.091, 0.164]	[-2.312, 2.118]	[-2.131, 3.763]
-	-	-	-	-
Alternative combination categories (isolating homemaker and retired)	-	-	-	-
Non-caregiver, employed for wage (ref. mean)	0.089	0.078	2.909	2.645
Caregiver, employed for wage (AME)	0.047**	0.036*	1.545***	1.289
-	[0.015, 0.079]	[0.006, 0.066]	[0.870, 2.221]	[0.651, 1.927]
Non-caregiver, out of work (ref. mean)	0.193	0.156	5.564	4.616
Caregiver, out of work (AME)	0.075	0.089	2.522*	2.741
-	[-0.042, 0.192]	[-0.034, 0.213]	[0.311, 4.733]	[0.372, 5.110]
Non-caregiver, homemaker (ref. mean)	0.076	0.055	3.028	2.541
Caregiver, homemaker (AME)	0.023	0.05	0.351	0.839
-	[-0.049,	[-0.030,	[-1.145,	[-0.752,

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
-	0.094]	0.129]	1.848]	2.429]
Non-caregiver, retired (ref. mean)	0.079	0.045	2.702	1.728
Caregiver, retired (AME)	0.02	0.041*	0.577	1.074
-	[-0.014, 0.054]	[0.004, 0.078]	[-0.152, 1.307]	[0.298, 1.850]
Non-caregiver, student or unable to work (ref. mean)	0.256	0.101	7.614	3.611
Caregiver, student or unable to work (AME)	0.027	0.031	0.786	1.06
-	[-0.057, 0.111]	[-0.043, 0.106]	[-0.960, 2.533]	[-0.671, 2.790]
-	-	-	-	-
Dichotomous employment	-	-	-	-
Non-caregiver, employed for wage (ref. mean)	0.090	0.078	2.969	2.655
Caregiver, employed for wage (AME)	0.040*	0.028	1.418***	1.173
-	[0.007, 0.074]	[-0.003, 0.059]	[0.719, 2.117]	[0.526, 1.821]
Non-caregiver, all else (ref. mean)	0.137	0.077	4.242	2.693
Caregiver, all else (AME)	0.039*	0.057***	1.101**	1.495
-	[0.006, 0.072]	[0.024, 0.091]	[0.378, 1.824]	[0.762, 2.228]

Table Note. * $P < .05$, ** $P < .01$, *** $P < .001$.

Source: author analysis.

Appendix E. Adjustments to Model with Caregiving and Insurance Status Interaction

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	Total Sample	No FPD	Total Sample	No FPD
-	Ref. Mean	Ref. Mean	Ref. Mean	Ref. Mean
-	AME	AME	AME	AME
-	[95% CI]	[95% CI]	[95% CI]	[95% CI]
Health insurance for under 65	-	-	-	-
Non-caregiver, insured (ref. mean)	0.034*	0.039**	1.286***	1.263
Caregiver, insured (AME)	[0.005, 0.064]	[0.012, 0.066]	[0.603, 1.969]	[0.621, 1.904]
-	[-0.026, 0.117]	[0.013, 0.074]	[0.530, 3.430]	[0.020, 2.887]
-	-	-	-	-
Non-caregiver, uninsured (ref. mean)	0.045	0.042**	1.922**	1.239
Caregiver, uninsured (AME)	[-0.027, 0.116]	[0.012, 0.072]	[0.501, 3.343]	[-0.124, 2.602]
-	[0.005, 0.065]	[0.013, 0.067]	[0.633, 2.032]	[0.631, 1.912]

Table Note. * $P < .05$, ** $P < .01$, *** $P < .001$.

Source: author analysis.

Appendix F. Average Marginal Effects of Caregiving on Frequent Mental Distress and the Number of Mentally Unhealthy Days Reported—Without Survey Weights

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	Total Sample	No FPD	Total Sample	No FPD
	(1)	(2)	(3)	(4)
	Ref. Mean	Ref. Mean	Ref. Mean	Ref. Mean
	AME	AME	AME	AME
	[95% CI]	[95% CI]	[95% CI]	[95% CI]
Caregiving status	-	-	-	-
Non-caregiver (ref. mean)	0.106	0.066	3.352	2.340
Caregiver (AME)	0.042***	0.045***	1.398***	1.435***
	[0.026, 0.057]	[0.030, 0.059]	[0.971, 1.824]	[1.037, 1.833]
Education	-	-	-	-
College or technical school degree (ref. mean)	0.082	0.055	2.825	2.123
Some college or technical school (AME)	0.047***	0.035***	1.302***	0.957***
	[0.033, 0.061]	[0.022, 0.047]	[0.931, 1.672]	[0.628, 1.286]
	-	-	-	-
HS degree (AME)	0.035***	0.029***	0.825***	0.631***
	[0.021, 0.049]	[0.016, 0.042]	[0.449, 1.200]	[0.287, 0.976]
	-	-	-	-
No HS degree (AME)	0.080***	0.035**	1.896***	0.821**
	[0.057, 0.103]	[0.013, 0.057]	[1.221, 2.570]	[0.205, 1.438]
Employment	-	-	-	-
Employed (ref. mean)	0.081	0.071	2.855	2.583
	-	-	-	-
Out of work (AME)	0.089***	0.066***	2.488***	1.751***
	[0.061, 0.118]	[0.037, 0.095]	[1.664, 3.311]	[0.939, 2.562]
	-	-	-	-
Homemaker or student (AME)	0	-0.005	0.055	-0.032
	[-0.018, 0.018]	[-0.023, 0.013]	[-0.406, 0.517]	[-0.484, 0.421]
	-	-	-	-
Retired or unable to work (AME)	0.079***	0	1.787***	-0.177
	[0.063, 0.095]	[-0.014, 0.014]	[1.363, 2.211]	[-0.529, 0.175]
Health insurance status	-	-	-	-
Uninsured (ref. mean)	0.138	0.081	4.227	2.756
	-	-	-	-
Insured (AME)	-0.028**	-0.007	-0.698*	-0.165
	[-0.048, -0.008]	[-0.023, 0.010]	[-1.254, -0.141]	[-0.614, 0.284]
Survey year	-	-	-	-
2011 (ref. mean)	0.096	0.062	3.176	2.262
	-	-	-	-
2017 (AME)	0.027***	0.014*	0.521**	0.285
	[0.013, 0.040]	[0.002, 0.026]	[0.163, 0.879]	[-0.021, 0.591]
	-	-	-	-
2021 (AME)	0.033***	0.029***	0.944***	0.836***

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
-	[0.018, 0.047]	[0.016, 0.041]	[0.557, 1.331]	[0.503, 1.170]
-				
Age group	-	-	-	-
Less than 50 (ref. mean)	0.163	0.105	5.021	3.597
-	-	-	-	-
50 and above (AME)	-0.070***	-0.049***	-2.015***	-1.573***
-	[-0.088, -0.052]	[-0.064, -0.034]	[-2.464, -1.567]	[-1.947, -1.198]
Relationship status	-	-	-	-
Single (ref. mean)	0.141	0.093	4.406	3.163
-	-	-	-	-
In a relationship (AME)	-0.050***	-0.031***	-1.436***	-0.946***
-	[-0.062, -0.038]	[-0.042, -0.020]	[-1.766, -1.107]	[-1.240, -0.653]
Number of adults in household	-	-	-	-
0-2 Adults (ref. mean)	0.111	0.074	3.556	2.587
-	-	-	-	-
3+ (AME)	-0.013	-0.014	-0.568	-0.371
-	[-0.043, 0.018]	[-0.043, 0.014]	[-1.414, 0.278]	[-1.169, 0.428]
-	-	-	-	-
Missing (AME)	-0.002	-0.007	-0.322	-0.344
-	[-0.018, 0.014]	[-0.022, 0.009]	[-0.777, 0.133]	[-0.749, 0.062]
Children in household	-	-	-	-
0 Children (ref. mean)	0.111	0.074	3.565	2.606
-	-	-	-	-
1+ (AME)	0.011	0.002	0.218	0.029
-	[-0.005, 0.026]	[-0.010, 0.015]	[-0.169, 0.606]	[-0.290, 0.347]
Race	-	-	-	-
White (ref. mean)	0.120	0.078	3.709	2.675
-	-	-	-	-
Black (AME)	-0.013	-0.008	-0.167	-0.097
-	[-0.027, 0.001]	[-0.021, 0.005]	[-0.549, 0.215]	[-0.433, 0.239]
-	-	-	-	-
Other (AME)	-0.029**	-0.018*	-0.585*	-0.41
-	[-0.047, -0.010]	[-0.035, -0.002]	[-1.112, -0.057]	[-0.866, 0.046]
-	-	-	-	-
# Subpopulation observations	12,084	10,174	-	-

Table Note. * $P < .05$, ** $P < .01$, *** $P < .001$.

Source: author analysis.

Appendix G. Average Marginal Effects of Caregiving by Education Attainment, Employment Status, Health Insurance Status, and Survey Year—No Survey Weights

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
	Total Sample	No FPD	Total Sample	No FPD
-	(1)	(2)	(3)	(4)
-	Ref. Mean	Ref. Mean	Ref. Mean	Ref. Mean
-	AME	AME	AME	AME
-	[95% CI]	[95% CI]	[95% CI]	[95% CI]
Education and caregiving	-	-	-	-
Non-caregiver, college educated (ref. mean)	0.076	0.049	2.621	1.910
Caregiver, college educated (AME)	0.034**	0.034**	1.062***	1.106***
-	[0.010, 0.058]	[0.012, 0.055]	[0.547, 1.576]	[0.631, 1.582]
-	-	-	-	-
Non-caregiver, some college or technical school (ref. mean)	0.121	0.081	3.833	2.763
Caregiver, some college or technical school (AME)	0.043**	0.048**	1.527***	1.662***
-	[0.014, 0.072]	[0.019, 0.076]	[0.767, 2.286]	[0.887, 2.437]
-	-	-	-	-
Non-caregiver, high school educated (ref. mean)	0.111	0.077	3.373	2.489
Caregiver, high school educated (AME)	0.035*	0.038*	1.437***	1.371***
-	[0.005, 0.065]	[0.008, 0.068]	[0.644, 2.231]	[0.578, 2.164]
-	-	-	-	-
Non-caregiver, less than high school educated (ref. mean)	0.147	0.070	4.315	2.476
Caregiver, less than high school educated (AME)	0.089**	0.123***	2.184*	2.624**
-	[0.025, 0.153]	[0.051, 0.194]	[0.485, 3.883]	[0.787, 4.462]
-	-	-	-	-
Employment and caregiving	-	-	-	-
Non-caregiver, employed (ref. mean)	0.073	0.065	2.576	2.320
Caregiver, employed (AME)	0.043***	0.036***	1.447***	1.384***
-	[0.024, 0.063]	[0.017, 0.056]	[0.970, 1.924]	[0.889, 1.880]
-	-	-	-	-
Non-caregiver, out of work (ref. mean)	0.159	0.121	5.188	4.071
Caregiver, out of work (AME)	0.060	0.084*	0.952	1.529
-	[-0.007, 0.127]	[0.014, 0.155]	[-0.689, 2.593]	[-0.222, 3.281]
-	-	-	-	-
Non-caregiver, homemaker or student (ref. mean)	0.076	0.060	2.705	2.302
Caregiver, homemaker or student (AME)	0.027	0.035	1.027	1.297*
-	[-0.019, 0.074]	[-0.014, 0.084]	[-0.041, 2.096]	[0.092, 2.503]
-	-	-	-	-
Non-caregiver, retired or unable to work (ref. mean)	0.153	0.060	4.416	2.095
Caregiver, retired or unable to work (AME)	0.038**	0.055***	1.225**	1.649***

	Probability of Frequent Mental Distress		Number of Mentally Unhealthy Days	
-			[0.431, 2.019]	[0.914, 2.383]
-	[0.009, 0.067]	[0.027, 0.083]	-	-
-	-	-	-	-
Health insurance and caregiving	-	-	-	-
Non-caregiver, insured (ref. mean)	0.104	0.064	3.276	2.319
Caregiver, insured (AME)	0.034***	0.044***	1.314***	1.415***
-	[0.018, 0.050]	[0.028, 0.059]	[0.875, 1.753]	[0.997, 1.832]
-	-	-	-	-
Non-caregiver, uninsured (ref. mean)	0.119	0.076	3.835	2.456
Caregiver, uninsured (AME)	0.095***	0.067**	1.998**	1.564**
-	[0.047, 0.143]	[0.022, 0.112]	[0.807, 3.189]	[0.498, 2.629]
-	-	-	-	-
Year and caregiving	-	-	-	-
Non-caregiver, 2011 (ref. mean)	0.083	0.050	2.820	1.908
Caregiver, 2011 (AME)	0.066***	0.067***	1.860***	1.894***
-	[0.042, 0.090]	[0.044, 0.091]	[1.238, 2.481]	[1.293, 2.495]
-	-	-	-	-
Non-caregiver, 2017 (ref. mean)	0.116	0.066	3.461	2.239
Caregiver, 2017 (AME)	0.037**	0.042**	1.215***	1.317***
-	[0.009, 0.065]	[0.016, 0.069]	[0.525, 1.906]	[0.657, 1.977]
-	-	-	-	-
Non-caregiver, 2021 (ref. mean)	0.126	0.085	3.935	2.908
Caregiver, 2021 (AME)	0.013	0.023	0.907*	0.835*
-	[-0.015, 0.041]	[-0.005, 0.050]	[0.203, 1.611]	[0.186, 1.484]
-	-	-	-	-

Table Note. * $P < .05$, ** $P < .01$, *** $P < .001$.

Source: author analysis.