



# Difference in the physical and mental health of informal caregivers pre- and post-COVID-19 National Emergency Declaration in the United States.

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## ABSTRACT

**Background:** The burden of informal caregiving represents a chronic stressor for the informal caregivers (ICs). The study investigates differences in the physical and mental health of ICs and that of non-informal caregivers before and during COVID-19.

**Methods:** We used data from the 2019/2020 Behavioral Risk Factor Surveillance System (BRFSS) to investigate differences in the rates of days of poor physical and mental health among ICs compared to non-informal caregivers before and after the COVID-19 National Emergency Declaration (NED). A propensity score model simulated a pseudo experimental design, comparing ICs ("treated") with non-informal caregivers ("control"). A difference-in-difference regression model estimated the incidence rate ratios for days of poor physical and mental health as a function of IC status and time of care provision.

**Results:** A total of 44,583 respondents were identified with valid responses on informal caregiving status and key sociodemographic characteristics. Of those, 6.24% (n = 3073) were ICs, matched against 15,365 non-informal caregivers. In the matched sample (n = 18,848), the incidence rate for days of poor physical health among ICs was 17% (p = 0.003) higher compared to non-informal caregivers. The incidence rate for days of poor physical health was 23% (p < 0.001) lower in the post-NED compared to the pre-NED periods. The incidence rate for days of poor mental health was 44% (p < 0.001) higher among ICs compared to non-informal caregivers and 22% higher among respondents who took the survey post-NED compared to those who answered during the pre-NED period. No statistically significant differences were found between the two groups in their incidence rates for days of poor physical and mental health from the pre- to the post-NED period.

**Conclusion:** These findings suggest a need to balance between the benefits conferred by public health restrictions versus the mental health burden that may result among certain groups, including ICs, who experience higher negative mental health outcomes.

## 1. Introduction

US life expectancy at birth increased steadily over the past few decades (National Center for Health Statistics, 2023) resulting in a larger proportion of the adult population reaching older age (Alba & Maggio, 2022) and requiring some level of social support, including forms of caregiving (Plöthner, Schmidt, Jong, Zeidler, & Damm, 2019; Spillman et al., 2020). The US Census Bureau projects that at current rates, by 2035 there will be more adults who are 65+ years old than children under 18 years of age, and by 2060 the number of individuals 85+ years old will triple and the US will add a half million centenarians (Vespa,

2018). These growing numbers of older adults will put higher pressure on healthcare systems, informal caregiving, and on assisted living facilities. Social support, which includes various functional dimensions of perceived or received support will be paramount to overcome the challenge posed by these increasing aging population numbers. Forms of support include emotional, belonging, tangible and informational (Holt-Lunstad & Uchino, 2015). Robust evidence links various forms of social support to both physical and mental health outcomes (Bom, Bakx, Schut, & Van Doorslaer, 2019; Buyck et al., 2011; Cohen et al., 1985, pp. 73–94). Informal caregiving, defined as care provided by unpaid persons to support family or friends living with a chronic illness or disability, is a

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common form of social support (Mehri, Kinney, Brown et al., 2019; Petrini et al., 2019; Roth, Brown, Rhodes et al., 2018).

Pinquart and Sörensen (2005) assessed the difference between informal caregivers (ICs) and non-informal caregivers with respect to general subjective well-being, and physical health concluded that differences in favor of non-informal caregivers were significantly larger for general subjective well-being, and smaller for physical health. The study also reported that differences were modified by the relationship of the IC to the care recipient, gender, and age of the IC. These findings are supported by other studies, which found that informal caregiving embodies all the features of a chronic stress experience (Schulz & Sherwood, 2008). Informal caregiving creates physical and psychological strain on IC when provided over extended periods of time and is accompanied by a high level of unpredictability and uncontrollability. Informal caregiving also has the capacity to create secondary stress in multiple life domains such as work and family relationships, and frequently requires high levels of vigilance (Jang & Tang, 2020; Schulz & Sherwood, 2008; Vitaliano, Zhang, & Scanlan, 2003). Recent studies indicate that Informal caregiving-related social support will become ubiquitous in the future, as more than three quarters (e.g., 88%) of Americans expressed preference to be cared for at home as they age rather than receiving institutional care (The AP-NORC Center for Public Affairs Research, 2021). Thus, there is a need to further elucidate the nature of the association between informal caregiving and the physical and mental health of the IC. Studies are needed to investigate how to support ICs to minimize stress including during times when additional societal stressors may occur.

The theory of caregiver stress derived from the Roy Adaptation Model (Roy & Andrews, 1991; Tsai, 2003), states that an individual is an adaptive system affected by both internal and external stimuli, which include focal, contextual, and residual stimuli. Focal stimuli include external factors that confront an individual, such as the caregiver objective burden; whereas contextual stimuli refer to identifiable factors such as social support, stressful life events, and social roles that contribute to the effects of the focal stimuli. Finally, residual stimuli include factors that have unclear effects in the current situation such as race, age, gender, and type of relationship. According to this theory, the duties or tasks associated with being an IC (focal stimuli) activate a coping mechanism that prompts ICs to seek available physical and psychological resources (Tsai, 2003) to cope with the overwhelming demand on the provider of informal caregiving. Research has shown, for instance, that underlying external stressors upon the caregivers (e.g., unemployment, financial hardship, etc.) may exacerbate his/her stress thereby leading to a strenuous relationship between the care recipient and the care provider, and negative health outcomes for the ICs (Jones, Holstege, & Holstege, 1997). Consequently, ICs may be more likely to experience increased stress leading to adverse health outcomes (Mausbach et al., 2012; Rafnsson et al., 2017; Tsai, 2003).

A growing body of literature has emerged, contending that these negative associations may be overstated, and that informal caregiving provides stress-buffering adaptations that improves the impact of stress on major health outcomes such as mortality and extended longevity (Roth, Fredman, & Haley, 2015). This new line of inquiry considers that having a close family member living with a serious disability can lead to stress or depressive symptoms among family members regardless of whether the family member is providing care to the affected family member (Amirkhanyan & Wolf, 2003). Roth et al. (2015) argued that it is unclear whether or not the responsibilities and activities of caregiving can lead to an increase in overall stress levels.

While the two lines of arguments have the merit of informing our understanding of the nature of the relationship between informal caregiving and the health of the IC, neither considers the potential effect of major socioeconomic disruptions such as natural disasters or pandemics. The need to investigate this relationship is further heightened by the looming prospects of extreme weather conditions, such as flooding and other impacts of climate change, which increase the risk of people

experiencing stressful events (Heyman, Ross, & Wallace, 2022). Studies are needed to investigate how caregiving stressors may be amplified during prolonged periods of societal stress, such as during natural disasters or pandemics (Archer, Reiboldt, Claver, & Fay, 2021; MacLeod et al., 2021b).

The COVID-19 pandemic with its subsequent disruptions and restrictions closely fit the description of societal stress, in that although restrictive measures helped prevent the spread of the disease, they also caused unexpected harm. For instance, lockdowns forced people to live in isolation, restricting access to friends and family members and to the things that people enjoy for themselves and promote their well-being (Cockle, 2022). A cross-sectional study evaluated the impact of family caregiving during the COVID-19 pandemic, by comparing a select number of outcomes (anxiety, depression, fatigue, sleep disturbance, etc.) between ICs and non-informal caregivers and found that ICs reported higher anxiety, depression, fatigue, and sleep disturbance compared to non-informal caregivers (Beach, Schulz, Donovan, & Rosland, 2021). A systematic review and meta-analysis combining ten studies assessed the impact of the COVID-19 pandemic on the psychological well-being of caregivers (both formal and informal) of people with dementia and mild cognitive impairment and found that there was increased depression, anxiety, caregiver burden, and distress in caregivers (Soysal et al., 2023). Our study comparing the physical and mental health of ICs before and during COVID-19 found evidence that ICs reported lower days of poor physical health during COVID-19 compared with the period before the COVID-19 pandemic. However, the incidence rate for ICs reporting days of poor mental health was higher during COVID-19, although this difference was not statistically significant. Instead, we found evidence that some groups (e.g., younger ICs, or ICs from low income, or with lower educational attainment) incurred higher days of poor mental health (Ngamasana, Zarwell, & Gunn, 2023).

The primary hypothesis of this study is that there are variations in self-reported instances of poor physical and mental health between ICs and non-informal caregivers before the onset of COVID-19 and during the pandemic period in the US. Secondary hypotheses explored individual differences in poor physical and mental health indicators between ICs and non-informal caregivers (in reference to the caregiver objective burden aspect of the theory of caregiver stress), as well as during the pre-NED vs. post-NED periods (in reference to the contextual stimuli of the theory of caregiver stress). Additional secondary hypotheses explored how sociodemographic characteristics (residual stimuli), such as race-ethnicity, age, gender, level of education and household income, may be associated with the physical and mental health disparities and variations in experiences observed between ICs and non-informal caregivers.

## 2. Methods

The analysis used data from the 2019/2020 cross-sectional series of the Behavioral Risk Factor Surveillance System (BRFSS). BRFSS collects nationally representative data on US residents 18-years and older, regarding health-related risk behaviors, chronic health conditions, and use of preventive services (Center for Disease Control and Prevention, 2021). In 2020, despite the disruptions due to COVID-19, all 50 states, the District of Columbia, Guam, and Puerto Rico collected BRFSS data during each calendar month and met the criterion for a probability sample (Center for Disease Control and Prevention, 2021).

The BRFSS survey questionnaire features core modules and optional modules. Participants' health status and healthy days are assessed as part of the core measures, whereas provision of care to loved ones (e.g., informal caregiving) is assessed as part of the optional BRFSS modules. Core components consist of fixed core (e.g., standard set of questions asked by all states), rotating core (e.g., asked two distinct set of questions, each asked in alternating year by all states), and emerging core (e.g., usually focusing on late breaking issues). Optional modules feature

questions on specific topics that each state elects to use on their questionnaires. Further methodological details have been published elsewhere (Iachan, Pierannunzi, Healey, Greenlund, & Town, 2016). The 2019 BRFSS survey included 345,315 completed interviews and in 2020 there were 330,619 completed interviews.

*Informal caregiving status.* All respondents 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?” Based on responses to this question, an index variable, “informal caregiver (IC)”, flagged respondents who replied “yes” OR “the caregiving recipient died in the past 30 days”.

### 2.1. Predictor and covariates

The survey date and amount of time care was provided were used to produce an indicator to represent whether informal caregiving began before March 13th, 2020, which is when the US government issued a COVID-19 National Emergency Declaration (NED), resulting in nationwide lockdowns (Staff, 2020). The time indicator allowed for comparison of the health of IC to that of non-informal caregivers during the two periods of interest (i.e., pre-, and post-NED).

*Duration of care provision* was organized into five distinct categories (i.e., less than 30 days, one month to less than six months, six months to two years, two years to less than five years, and five years or more) that made it difficult to control for the duration of care before and after the NED. To mitigate confounding the analysis by comparing IC with a longer experience of caregiving with those with shorter experience, the analysis excluded any IC whose care provision started two or more years ago.

*Sociodemographic characteristics.* Analyses in this paper controlled for race/ethnicity of the study participants (i.e., Hispanic, non-Hispanic multiracial, non-Hispanic White, non-Hispanic Black, non-Hispanic other race), age group (i.e., 18–24, 25–34, 35–44, 45–54, 55–64, 65+), household income in ranges, and sex assigned at birth (i.e., male or female). Analyses also controlled for highest level of education of the respondents (i.e., did not graduate high school, graduated high school, attended college/technical school, graduated from College/Technical).

### 2.2. Outcomes

Participants were asked to report about their healthy days by answering the question: “Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?” and “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?”. Based on respondents’ answers to the two abovementioned questions, we defined two distinct outcomes by number of days within the previous 30 days of: 1) poor physical health, including physical illness and injury and 2) poor mental health, including stress, depression, and problems with emotions.

### 2.3. Analysis

Descriptive statistics were provided to summarize both covariates and outcomes. A complete case analysis was performed, including only respondents who provided valid data on the abovementioned socio-demographic characteristics (i.e., age, sex, race/ethnicity, level of education, household, and income) and whether they provided care to a loved one during the periods under study. A propensity score model was used to simulate a pseudo experimental design with observational data, thereby creating treatment (“IC”) and control (“non-informal caregiver”) groups from the same sample, using a matching ratio of one treated to five controls to achieve good balance across the two groups. The following covariates were used to balance the two groups: age, gender, race/ethnicity, education, and household income. Standardized

mean differences (SMDs $\leq$ 0.20) were used as thresholds to assess covariate balance between the two groups.

A difference-in-difference model was performed on the matched data to estimate the impact of COVID-19 restrictions on physical and mental health of ICs and non-informal caregivers. Given the count nature of the outcome variables (number of days of poor mental or physical health) and potential for over-dispersion, and given the common denominator of 30 days for the count, marginal structural negative binomial regression models estimated the average treatment effect for the treated (ATT), defined as the difference between the average number of days of poor mental and physical health among participants who were IC, and the average number of poor mental and physical health among non-informal caregivers. All analyses were weighted according to BRFSS methodology and performed in SAS® Enterprise Guide 8.2.

## 3. Results

Our sample (Table 1) included 44,583 respondents who provided valid responses on the caregiving module of the BRFSS 2019; 2020. Of those, 6.24% (n = 3073) were IC. The proportions of IC within each age group were similar, oscillating between 5.36% for those aged 18–24 to 7.30% for those 55–64 years old. Across levels of educational attainment, those with no high school diploma had the lowest proportion (4.64%) of IC, whereas those who attended college or technical school but did not graduate had the highest proportion (7.33%) of IC. More minor differences by household income were observed in proportions of IC. Within race-ethnic groups, Hispanic had the lowest proportions of IC (4.61%) whereas non-Hispanic multiracial had the highest proportion (7.04%) of IC. More female (7.15%) reported being IC, compared to males 5.34%.

Each of the 3073 ICs were matched to five controls through propensity score matching. A matching ratio beyond five to one did not yield an adequate balance (e.g., some SMD were above 0.20). The final sample after matching included 18,438 participants. In the matched data (Table 2), ICs had, on average, higher numbers of poor physical (mean 4.14; standard deviation (SD) 0.25) and mental health (mean 5.65; SD 0.30) days compared to non-informal caregivers (3.53 SD: 0.10; and 3.34; SD: 0.10; respectively for days of poor physical and mental health). Across the sample, the average number of days of poor physical health decreased from 3.95 (SD: 0.12) before COVID-19 NED to 3.15 (SD: 0.16) after COVID-19 NED; whereas the average days of poor mental health increased from 3.66 (SD: 0.12) before COVID-19 NED to 4.17 (SD: 0.19) after COVID-19 NED.

Male respondents reported a slightly higher average numbers of days of poor physical and mental health (3.96; SD: 0.13 and 4.40; SD: 0.14) compared to females (3.29; SD: 0.14 and 3.12; SD: 0.16), respectively. At younger ages (18–24), respondents reported a higher average number of days of poor mental health (5.93; SD 0.56) and lower average number of days poor of physical health (1.77; SD 0.28). However, at older ages (55+), respondents reported a higher average number of days of poor physical health (4.54, SD 0.23 and 4.19, SD 0.15, respectively for 55–64 and 65+) and lower average number of days of poor mental health (3.31, SD 0.18 and 2.23, SD 0.11 for 55–64 and 65+, respectively).

Respondents identifying themselves as non-Hispanic multiracial reported, on average, the highest number of days of poor physical (4.13; SD 0.45) and mental (5.73; SD 0.75) health; whereas non-Hispanic Other races reported the lowest average number of days of both physical (2.52; SD 0.27) and mental (2.95; SD 0.39) health. Respondents with lower educational attainment (e.g., no high school degree) had the highest average number of days of poor physical (5.47; SD 0.54) and mental (6.54; SD 0.85) health. Those with higher educational attainment had the lowest average number of days of poor physical (2.65; SD 0.12) and mental (3.17; SD 0.14) health.

Income showed an unequivocal trend with those in households earning less than \$15,000 annually reporting the highest average number of days of poor physical (8.76; SD 0.53) and mental (8.52; SD

**Table 1**  
Baseline characteristics of study participants (unweighted counts and weighted percentages) – complete case analysis.

	Total	Non-Informal Caregivers	Informal Caregivers
<b>N (%)</b>	44,583 (100)	41,510 (93.11)	3073 (6.89)
<b>Caregiving Period</b>			
Before COVID-19 NED	29,273 (65.66)	27,005 (92.85)	2268 (7.15)
After COVID-19 NED	15,310 (34.34)	14,505 (95.32)	805 (4.68)
<b>Sex</b>			
Female	23,409 (49.73)	21,547 (92.85)	1862 (7.15)
Male	21,174 (50.27)	19,963 (94.66)	1211 (5.34)
<b>Age Category</b>			
18-24	2347 (10.16)	2201 (94.64)	146 (5.36)
25-34	4808 (16.10)	4522 (94.20)	286 (5.80)
35-44	5768 (17.18)	5401 (93.63)	367 (6.37)
45-54	6837 (17.03)	6334 (93.53)	503 (6.47)
55-64	8640 (16.85)	7952 (92.70)	688 (7.30)
65+	16,183 (22.68)	15,100 (94.10)	1083 (5.90)
<b>Race/Ethnicity</b>			
N-H White	31,400 (61.06)	29,196 (93.12)	2204 (6.88)
N-H Black	3997 (13.23)	3725 (94.16)	272 (5.84)
Hispanic	4189 (19.05)	3951 (95.39)	238 (4.61)
N-H, multiple Race	1592 (1.29)	1461 (92.96)	131 (7.04)
N-H, Other races	3405 (5.37)	3177 (94.47)	228 (5.53)
<b>Education</b>			
Did Not Graduate High School	3477 (12.99)	3305 (95.36)	172 (4.64)
High School Graduate	11,637 (28.09)	10,869 (94.36)	768 (5.64)
Some College/Tech	12,422 (30.74)	11,477 (92.67)	945 (7.33)
College/Tech Graduate	17,047 (28.18)	15,859 (93.60)	1188 (6.40)
<b>Household Income</b>			
Less than \$15,000	4329 (10.49)	4055 (94.63)	274 (5.37)
\$15,000 - \$24,999	7444 (10.78)	6940 (93.93)	504 (6.07)
\$25,000 - \$34,999	4599 (9.59)	4291 (94.21)	308 (5.79)
\$35,000 - \$49,999	6203 (12.52)	5776 (93.83)	427 (6.17)
\$50,000+	22,008 (50.96)	20,448 (93.43)	1560 (6.57)

Note: Percentages in the first column are reported out of the total sample (N = 44,583), while percentages in the second and third columns are reported by row within each variable.

0.69) health; whereas those in the highest income bracket (i.e., \$50,000+) reported the lowest average number of days of poor physical (2.52; SD 0.11) and mental (2.92; SD 0.12) health over the prior 30 days.

Overall, the reported average number of days of poor physical and mental health differed within and between the two groups (ICs and non-informal caregivers), as well as before and after COVID-19 NED (see Fig. 1). Before the COVID-19 NED, IC reported a higher average number of days of poor physical health (mean: 4.41; std. error: 0.29), compared to non-informal caregivers (mean: 3.81; std. error: 0.13). Likewise, ICs reported, on average, a higher number of days of poor mental health (mean: 5.20; std. error: 0.18) compared to non-informal caregivers (mean: 3.16; std. error: 0.13). After the COVID-19 NED, the reported

**Table 2**  
Weighted average number of days of poor physical and mental health over the prior 30 days by baseline characteristics (5:1 matched sample).

	Weighted average (SD) number of days of poor Physical health over the prior 30 days	Weighted average (SD) number of days of poor Mental health over the prior 30 days
<b>Informal Caregiving Status</b>		
Non-Informal Caregiver	3.53 (0.10)	3.34 (0.10)
Informal Caregiver	4.14 (0.25)	5.65 (0.30)
<b>Caregiving Period</b>		
Before COVID-19 NED	3.95 (0.12)	3.66 (0.12)
After COVID-19 NED	3.15 (0.16)	4.17 (0.19)
<b>Sex</b>		
Female	3.29 (0.14)	3.12 (0.16)
Male	3.96 (0.13)	4.40 (0.14)
<b>Age Category</b>		
18-24	1.77 (0.28)	5.93 (0.56)
25-34	2.22 (0.23)	6.26 (0.42)
35-44	3.21 (0.28)	4.51 (0.33)
45-54	3.56 (0.27)	4.68 (0.32)
55-64	4.54 (0.23)	3.31 (0.18)
65+	4.19 (0.15)	2.23 (0.11)
<b>Race/Ethnicity</b>		
N-Hispanic White	3.75 (0.11)	3.72 (0.11)
N-H Black	3.68 (0.30)	4.33 (0.41)
Hispanic	3.47 (0.40)	4.46 (0.50)
N-H, multiple Race	4.13 (0.45)	5.73 (0.75)
N-H, Other races	2.52 (0.27)	2.95 (0.39)
<b>Education</b>		
Did Not Graduate High School	5.47 (0.54)	6.54 (0.85)
High School Graduate	4.25 (0.21)	4.17 (0.22)
Some College/Tech	4.13 (0.19)	3.95 (0.18)
College/Tech Graduate	2.65 (0.12)	3.17 (0.14)
<b>Household Income</b>		
Less than \$15,000	8.76 (0.53)	8.52 (0.69)
\$15,000 - \$24,999	6.04 (0.30)	5.35 (0.30)
\$25,000 - \$34,999	4.67 (0.36)	4.85 (0.40)
\$35,000 - \$49,999	4.05 (0.27)	4.15 (0.26)
\$50,000+	2.52 (0.11)	2.92 (0.12)

NED: National Emergency Declaration.

average number of days of poor physical health for both ICs and non-informal caregivers decreased (3.81 versus 3.09 for non-informal caregivers, and 4.41 versus 3.44 for ICs); however, ICs reported, on average, a higher number of days poor physical health compared to non-informal caregivers. The average days of poor mental health increased for both groups after the NED, substantially widening the difference between non-informal caregivers and ICs (3.16–3.63 for non-informal caregivers, and 5.20 to 6.85 for ICs).

Comparing the average number of days of poor physical health across race/ethnicity and income stratifications (Fig. 2, Panel A), among respondents from the lower earning households, non-Hispanic white participants reported the highest average number of days of poor physical health (mean: 10.15, SD: 0.71) and non-Hispanic participants of other races reported, on average, the lowest number of days of poor physical health (4.54, SD: 1.33) in this income category. In the higher income groups, Hispanic participants reported the highest average



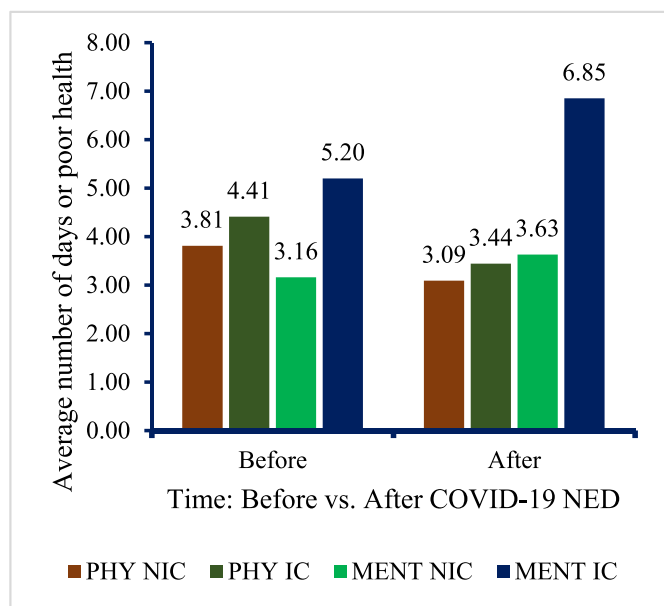


Fig. 1. Average number of days of poor physical and mental health, between ICs and non-informal caregivers before and after COVID-19 NED.

number of days of poor physical health (mean: 3.21, SD: 0.68); while people who are non-Hispanic and another race reported the lowest average number of poor physical health (mean: 1.83, SD: 0.31).

Compared to physical health, the average number of days of poor mental health (Fig. 2, Panel B) indicated a different trend across income and race/ethnicity strata. In the lowest income bracket, non-Hispanic multiracial respondents reported, on average, the highest number of days of poor mental health (12.55 days, SD: 2.89). In comparison, participants who indicated that they were non-Hispanic, and another race reported the lowest average number of days of poor mental health (mean: 5.43; SD: 1.45). In the highest income bracket, non-Hispanic Black participants reported the highest average number of days of poor mental health (3.57 days, SD: 0.63), however in this higher income group, differences were smaller compared to the observed differences in lower income brackets.

3.1. Incidence rate ratios for reported days of poor physical health

Table 3 presents the unadjusted and covariate-adjusted incidence rate ratios and corresponding p-values from the weighted negative binomial regressions, using the 5:1 matched data. To address our secondary hypotheses (caregiver objective burden), the incidence rate for

days of poor physical health differed statistically between ICs and non-informal caregivers. For instance, the incidence rate for days of poor physical health among IC was 15% ( $p = 0.006$ ) and 17% ( $p = 0.003$ ) higher compared to non-informal caregivers in the unadjusted and covariate-adjusted models, respectively. To address additional secondary hypotheses (contextual stimuli), the incidence rates for reporting days of poor physical health were 18% ( $p < 0.001$ ) and 23% ( $p < 0.001$ ) lower during post-NED compared to pre-NED periods in the unadjusted and covariate adjusted models, respectively. However, in addressing our primary hypothesis, no statistically significant changes in incidence rates for days of poor physical health were found when comparing ICs to non-informal caregivers before vs. after COVID-19 NED ( $IRR = 1.02$ ;  $p = 0.803$ ). While addressing further secondary hypotheses (residual stimuli), significant differences were found among certain sociodemographic characteristics. The incidence rates for days of poor physical health were lower at younger ages (e.g., 65+;  $p < 0.001$ ) compared to older ages (65+). The incidence rates for days of poor physical health were lower for males ( $IRR: 0.91$ ;  $p = 0.007$ ) compared to females; and across stratifications of race-ethnicity, the incidence rates for days of poor physical health were lower among non-Hispanic Black individuals ( $IRR: 0.87$ ;  $p = 0.019$ ) and non-Hispanic individuals of Other races ( $IRR: 0.76$ ;  $p = 0.001$ ) compared to non-Hispanic White individuals. The incidence rate for days of poor physical health was at least 30% ( $p < 0.001$ ) higher for all participants with lower educational attainment compared to those who graduated from college or technical school. Those in lower income households experienced higher incidence of days of poor physical health ( $IRR \geq 1.59$ ;  $p < 0.001$ ) compared to those in households with income over \$50K.

3.2. Incidence rate ratios for reported days of poor mental health

In addressing secondary hypotheses (caregiver objective burden), the covariate-adjusted incidence rates for days of poor mental health were 44% ( $p < 0.001$ ) higher among ICs compared to non-informal caregivers and 22% ( $p < 0.001$ ) higher among respondents who took the surveys after COVID-19 NED compared to those who took the survey before COVID-19 NED. However, in addressing our primary hypothesis, no statistically significant changes in mental health days reported between ICs and non-informal caregivers were found between pre- and post-NED periods ( $IRR = 1.02$ ;  $p = 0.855$ ). Similar results were extracted from the unadjusted model ( $IRR = 1.12$ ;  $p = 0.259$ ).

While addressing additional secondary hypotheses (residual stimuli), significant results were found by certain sociodemographic characteristics. In the adjusted model, males had substantially lower incidence rates ( $IRR 0.67$ ;  $p < 0.001$ ) for days of poor mental health compared to females. The incidence rates for days of poor mental health were at least 55% higher at younger ages ( $p < 0.0001$ ) compared to older ages (65+).

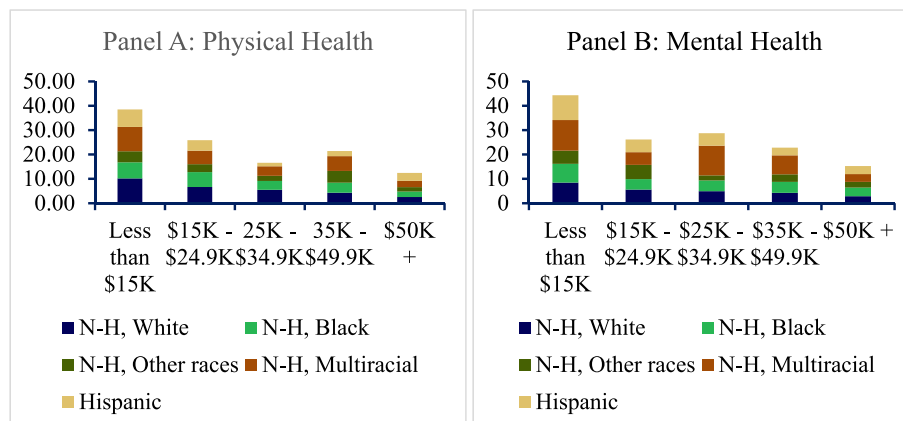


Fig. 2. Average number of days of poor physical/Mental health, across race/ethnicity and income categories.

**Table 3**  
Incidence rate ratios (IRRs) from weighted negative binomial regression using the 5:1 matched sample.

Characteristics	Days of Poor Physical Health		Days of Poor Mental Health	
	Unadjusted Model	Covariate Adjusted Model	Unadjusted Model	Covariate Adjusted Model
	IRR (p-value)	IRR (p-value)	IRR (p-value)	IRR (p-value)
<b>Informal Caregiving Status</b>				
No	Ref.	Ref.	Ref.	Ref.
Yes	1.15 (0.006)	1.17 (0.003)	1.67 (<0.001)	1.44 (<0.001)
<b>Caregiving Period</b>				
Before COVID-19 NED	Ref.	Ref.	Ref.	Ref.
After COVID-19 NED	0.82 (<0.001)	0.77 (<0.001)	1.16 (0.001)	1.22 (<0.001)
<b>Difference-in-Differences<sup>a</sup></b>	0.94 (0.559)	1.02 (0.803)	1.12 (0.259)	1.02 (0.855)
<b>Sex</b>				
Female		<b>Ref.</b>		<b>Ref.</b>
Male		0.91 (0.007)		0.67 (<0.001)
<b>Age Category</b>				
18-24		0.35 (<0.001)		2.81 (<0.001)
25-34		0.50 (<0.001)		3.21 (<0.001)
35-44		0.69 (<0.001)		2.25 (<0.001)
45-54		0.86 (0.006)		2.33 (<0.001)
55-64		1.04 (0.383)		1.53 (<0.001)
65+		Ref.		Ref.
<b>Race/Ethnicity</b>				
N-H White		Ref.		
N-H Black		0.87 (0.019)		0.91 (0.120)
Hispanic		1.00 (0.947)		0.78 (<0.001)
N-H, multiple Race		1.10 (0.518)		1.27 (0.116)
N-H, another race		0.76 (0.001)		0.75 (0.001)
<b>Education</b>				
No High School		1.42 (<0.001)		1.27 (0.009)
High School Graduate		1.30 (<0.001)		1.10 (0.065)
Some College/Tech College/Tech Graduate		1.30 (<0.001)		1.11 (0.024)
		Ref.		Ref.
<b>Household Income</b>				
Less than \$15,000		3.26 (<0.001)		2.65 (<0.001)
\$15,000 - \$24,999		2.25 (<0.001)		1.98 (<0.001)
\$25,000 - \$34,999		1.68 (<0.001)		1.83 (<0.001)
\$35,000 - \$49,999		1.59 (<0.001)		1.52 (<0.001)
\$50,000+		Ref.		Ref.

<sup>a</sup> Ref.: Informal Caregiver Status: non-informal caregivers, Time of survey: Before COVID-19 NED.

The incidence rates for days of poor mental health were 22% ( $p < 0.001$ ) lower among Hispanic and 25% ( $p < 0.001$ ) among non-Hispanic other races compared to non-Hispanic White participants. Lower educational attainment was generally associated with higher incidence rates ( $IRR > 1.11$ ;  $p < 0.024$ ), except for high school graduates. Finally, respondents from households with lower income had incidence rates at

least 52% higher ( $p < 0.001$ ) for days of poor mental health compared to higher income households (i.e., 50K+).

#### 4. Discussion

We examined the relationship between informal caregiving status and the reported numbers of days of poor physical and mental health before and during COVID-19 restrictions triggered in the aftermath of the COVID-19 NED. Results revealed several key findings regarding the characteristics of IC and the impact of caregiving on health outcomes.

The proportion of IC varied across different sociodemographic groups. Informal caregiving was most reported by participants who were female adults, older (e.g., 55–64 years), non-Hispanic Black, with no high school degree, and those with household incomes of at least \$50,000. These findings are consistent with previous research that has shown variations in informal caregiving prevalence across different age groups, educational levels, household income, and race-ethnicity (Do, Cohen, & Brown, 2014; Fry, Passel, & Cohn, 2020; Oedekoven et al., 2019).

Analysis of the matched data revealed that ICs reported a higher average number of days of poor physical and mental health compared to non-informal caregivers. These findings align with previous studies that have reported higher levels of poor physical and mental health among ICs compared to non-informal caregivers (Dang et al., 2020; Hughes, Liu, & Baumbach, 2021; MacLeod et al., 2021a). We found that the reported average number of days of poor physical health across the matched sample decreased between the period preceding the COVID-19 NED and the period during which the COVID-19 NED was enacted. A recent multi-country study of informal caregiving revealed an association with perceived stress, sleep problems, and depression, each of which are known risk factors for chronic physical conditions such as cardiovascular diseases and asthma (Jacob et al., 2020; Koyanagi et al., 2018). In this study, despite the overall decrease, ICs consistently reported higher numbers of days of poor physical health compared to non-informal caregivers, which might be explained by cumulative stress and lack of sleep. In terms of mental health, the reported average number of days of poor mental health increased across the matched sample after COVID-19 NED, possibly due to information overload, misinformation, anxiety, loneliness, etc.

ICs had significantly higher incidence rates of reporting days of poor physical and mental health compared to non-informal caregivers both in the unadjusted and covariate-adjusted models. Although the mechanism through which such relationship exists were not investigated, our findings suggest that the underlying relationship is more or less likely mediated through stress buffering mechanisms (Tsai, 2003).

These analyses also showed that the incidence rate for reporting days of poor physical health was significantly lower after COVID-19 NED compared to the period before COVID-19 NED, whereas the incidence rate for reporting days of poor mental health was significantly higher in the period after COVID-19 NED compared to the period before COVID-19 NED. Many reasons could have contributed to this, including the more flexible lifestyle that some people experienced during the lockdowns, the lower rates of diseases' transmission following periods of larger isolation, and potentially the fact that the pre-COVID-19 NED period included the winter season during which there are higher rates of negative health outcomes (Audi et al., 2020; de Freitas et al., 2022; Ferrante et al., 2020).

In addressing secondary hypotheses, although we found that days of both poor physical and mental health significantly differed by caregiving status (ICs vs. non-informal caregivers) and period (before vs. after COVID-19 NED), the changes over time in these health outcome gaps between ICs and non-informal caregivers were not significant based on the difference-in-differences (primary hypothesis) assessed within the negative binomial regression models. While we did not see an increase in the gap between ICs and non-informal caregivers between the pre- and post-NED periods in relative/rate terms, there was an

overall increase in the rate of poor mental health days across the overall sample post-NED which could potentially compound on an already higher rate experienced among ICs (Beach et al., 2021; Soysal et al., 2023), which also is consistent with the caregiver stress model (Jones et al., 1997; Tsai, 2003).

Beyond caregiving status, we found significant differences by sociodemographic characteristics such as income, education, age, and race/ethnicity. For example, we found significantly higher incidence rates for days of poor mental and physical health for all lower income groups compared to those with a household income at least \$50,000, which may be exacerbated by job losses and the subsequent loss of wages/income, in alignment with the theory of caregiver stress (Jones et al., 1997; Tsai, 2003). For education, we found that those in all lower educational attainment groups experienced significantly higher incidence rates for days of poor physical health compared to those with a college or technical degree, and individuals with no high school degree or some college without a college degree experienced significantly higher rates for days of poor mental health compared to those with a college or technical degree. An international study (Gloster et al., 2020) assessed the impact of COVID-19 on mental health and found that higher education was associated with lower levels of stress. The underlying mechanism through which education plays a buffering role against negative health outcomes has been documented in relation to a stress buffering model (Mandemakers & Monden, 2010). Individuals with high education have more cognitive abilities to appraise and cope with the stress, and have better access to resources (e.g., tangible, informational support) to help them cope with the stress (Holt-Lunstad & Uchino, 2015). In terms of age, all younger age groups had significantly higher incidence rates of days of poor mental health compared to those 65+ years old, and those 18–54 years old with significantly lower incidence rates for days of poor physical health compared to those aged 65+. We found that, across race/ethnicity groups, non-Hispanic Black and non-Hispanic participants of another race had significantly lower incidence rates for days of poor physical health, as well as Hispanic and non-Hispanic individuals of another race with significantly lower incidence rates for days of poor mental health, compared to non-Hispanic White participants. These findings align with previous studies that documented significantly higher burden of mental and physical health among these groups (Gloster et al., 2020).

#### 4.1. Limitations

Informal caregiving was asked as an optional module in the survey, therefore, the results from the study may not be generalizable to the entire US population. Comparisons between the pre-COVID-19 NED (mostly fall and winter) and the post-COVID-19 NED periods might be confounded by seasonal conditions such as increased rates of respiratory virus (e.g., influenza) and other viral infections. Furthermore, results from the analyses could be confounded by multicollinearity – for example, age and race-ethnicity are not independent, with some ethnic groups having larger younger populations compared to others. Other limitations include the difficulty to accurately distinguish between ICs who provided care before and after COVID-19 NED. The type of relationship to the caregiver and the types of disability and care needs among individual recipients imply a wide range of variations in experiences which we are unable to account for in this analysis. Another limitation to this study relates to the fact that only recent ICs (i.e., with duration of care provision of less than two years ago) were included. Thus, ICs with care recipients who died in the past 30 days prior to the survey could have had a dual IC and non-informal caregiver status. However, such a situation is less likely to impact their physical or mental health immediately and it would likely be reflected in the experience of only a small segment of the study population. Finally, we recognize that the study did not control for other sociodemographic factors that could potentially affect physical and mental health outcomes, including but not limited to lifestyle and health status/comorbidities.

## 5. Conclusion

In this secondary study of a nationally representative data, we did not find evidence that the incidence rates for days of poor physical and mental health varied significantly between ICs and non-informal caregivers in the period pre- and post-COVID-19 NED. However, we found evidence that the incidence rates for days of poor physical and mental health stood higher among ICs compared to non-informal caregivers. Besides, we also found that the incidence rates for days of poor physical health were lower while the incidence rates for days of poor mental health increased between the period pre- and post- COVID-19 NED among adults in the U.S. These findings indicate a need to balance the benefits conferred by some physical restrictions with potential negative consequences on mental health during long periods of uncertainty or prolonged emergencies, such as during pandemics. Specific strategies should be developed to buffer against stress and cope with additional burdens for informal caregivers who already experience higher levels of negative mental health outcomes compared to non-informal caregivers.

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

The authors gave consent for publication of the final manuscript.

### Availability of data and materials

Data sharing is not applicable to this article as this article is a secondary data analysis of a publicly available dataset.

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### Research data for this article

Survey data used in this article are anonymized and publicly available on the Substance Abuse and Mental Health (SAMHSA) website.

### Ethical statement

All authors declare no conflict of interest. We used publicly available data and did not need IRB approval nor funding.

We are very excited to share the findings from this article with you. We appreciate your time and assistance with the review process. We look forward to hearing from you in regard to this submission.

### CRediT authorship contribution statement

**Conception and design of study:** EL Ngamasana, L H Gunn. **Acquisition of data (laboratory or clinical):** EL Ngamasana. **Data analysis and/or interpretation:** EL Ngamasana, L H Gunn. **Drafting of manuscript and/or critical revision:** EL Ngamasana, M Zarwell, L Eberly, L H Gunn. **Approval of final version of manuscript:** EL Ngamasana, M Zarwell, L Eberly, L H Gunn.

### Declaration of competing interest

The authors declare no conflict of interests.

### Data availability

BRFSS data are publicly available and can be accessed at no cost.

However, our codes can be made available on request

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