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Physical and Mental Health Effects of Characteristics of Caregivers and the Caregiving Situation

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ABSTRACT

The present study investigated the effects of characteristics of caregivers and the caregiving situation on family caregivers' physical/mental health, using the multiple regression analysis with the time-series and cross-sectional data from the 2015-2018 Behavioral Risk Factor Surveillance System (BRFSS). The regression results indicated that the caregiving role could increase the risk of developing physical/mental health problems. Importantly, this study revealed that the characteristics of caregivers and care recipients were significantly associated with caregivers' physical/mental health outcomes. Especially the results showed that the caregiver support program was the most significant factor linked to caregivers' physical/mental health. It pointed to the importance of caregiver education and support programs for family caregivers to cope with the stress from providing care or daily assistance. The results also pinpointed which area of support services for informal caregivers would be a priority to enhance. Thus, the public health policymakers should re-evaluate the current long-term care program to establish a more effective caregiving structure, especially caregiver education and support programs for family caregivers, to improve the informal caregivers' quality of life.

Keywords: Caregiving, Health-Related Quality of Life, Caregiving Support Programs, BRFSS, Mental Health, Physical Health.

INTRODUCTION

Sustained growth in both the elderly population and the share of the elderly population was driven by an increase in the life expectancy over the last decades in the United States (Horner and Cullen, 2016) – the life expectancy at birth for males (females) had increased from 71.8 (78.8) years in 1990 to 76.1 (81.1) years in 2016 (National Centers for Health Statistics, 2017). The elderly population was expected to increase to 71 million by the year 2030 (Do, et al., 2014). It would approximately be a quarter of the U.S. population. Elderly individuals generally live the majority of their remaining years in good health and with little disability or need for care. At the same time, they play an important role in helping and supporting their families, such as taking on the parenting role for their grandchildren. However, once they experience ill health, other family members become their primary caregivers to them. The care for the elderly family members with chronic health conditions relied largely on family members and friends (Adelman, et al., 2014). It had been the tradition over the generations, and family caregivers were the backbone of long-term care at the home. The need for family caregivers is expected to

increase due to the continued growth in the older adult population. As a result, many adults who are not currently caregivers do expect to provide care in the future. Data that the present study used show 16.2 % of non-caregivers expected to provide care or assistance in the next 2 years.

A family caregiver called an informal caregiver provides care or assistance, typically unpaid, to someone who is normally family members, relatives, or family friends. Providing caregiving to family members in their homes brings enormous benefits to the care recipients and the families compared with nursing home care. A family member who provides care or assistance to someone with whom they have a personal relationship could be better to provide emotional support to their care recipients, especially care recipients with mental health problems. The study (Fauth, et al., 2012) found that a closer relationship between caregivers and care recipients was associated with positive health outcomes for care recipients. The study (Kershaw, et al., 2015) also reported that the nature of the patient/family caregiver experiences suggested that their mental and physical health may be interdependent. The study (Freedman and Spillman, 2014) noted that caregiver stress was a strong predictor that care recipients would stop receiving care at home where they prefer to be and move into nursing homes. Thus, informal caregivers' good health is important to not only the informal caregivers themselves but also care recipients. In addition, the family caregivers are a significant component of the healthcare system in the U.S. Reducing the use of nursing homes would be one of the public policy goals because nursing home care is costly, and transitioning from community to nursing home care could increase the likelihood of raising the demand for financial support from Medicaid (Janus and Doty, 2018).

The study (Adelman, et al., 2014) reported that the family caregivers provided as much as 90% of the long-term care needed by elderly family members in the United States. The study found that 32% of the caregivers had a high caregiver burden and 19% had a medium caregiver burden based on a measurement of time spent providing care and the care recipient's degree of dependency. The dependency of the elderly family members might lead to less desirable health outcomes for both care recipients and caregivers, such as poor physical and mental health, increasing the risk of abuse, and increasing the probability of institutionalization of the recipient of care (Arthur, 2018). According to the study (Roth, et al., 2015), a substantial number of public research on family caregiving had portrayed it as a stressful and burdensome experience with serious negative health consequences. Studies (Fauth, et al., 2012; Goren, et al., 2016; Peng, et al., 2018; Siddiqui and Khalid, 2019) examined the impact of caregiving for care recipients with mental disabilities on caregivers' health outcomes. Their results indicated that caring for family members with serious mental illness was significantly associated with the caregivers' mental health, wellbeing, and health-related quality of life.

In short, the earlier studies had focused on analyzing the impact of mostly the caregiving role on the caregivers' health outcomes and reported that the caregiving role was a significant risk factor for caregivers' mental and physical health. However, studies (Cameron, et al., 2016; Pendergrass, et al., 2018) pointed caregivers' characteristics that were crucial health determinants for informal caregivers, such as the health status of care recipients (functional problems or psychological diseases) and caregivers' roles (managing personal care or managing household tasks). Understanding how characteristics of caregivers and the

caregiving situation influence caregivers' health may help our society explore to find a more effective way of improving the health of informal caregivers. The aim of this study was thus to assess the impact of the caregiving-related characteristics on the health of informal caregivers as little comparative research existed. The care characteristics were the following: the relationship of care recipients, major diagnosis of care recipients, duration of caregiving, amount of caregiving, managing personal care and household tasks, and caregivers' most need.

A measure of caregivers' health outcomes in this study, one of the most significant current discussions in modern living, is health-related quality of life (HRQOL). Most of the conceptual definitions of HRQOL have been defined as a multi-dimensional concept that refers to a person or group's perception of their physical and mental health status. The conceptual boundaries of HRQOL, which varies depending on social stratification and local preferences, go beyond the conflict of the health-disease process, including also socio-economic, cultural factors, and additional aspects that contribute to health (Abdullah, 2014; Degu, et al., 2019; Santino, et al., 2019; Son, 2020). This study conducted a multiple regression analysis using the data from the 2015-2018 Behavioral Risk Factor Surveillance System (BRFSS) for adults aged 18 years or older. The BRFSS is a large-scale national health survey, a collaborative project between the Centers for Disease Control and Prevention (CDC) and all of the states in the United States. The BRFSS is designed to conduct monthly ongoing health-related telephone surveys to collect uniform state-specific data on health-related risk behaviors, chronic diseases and health conditions, access to health care, and use of preventive services related to the leading causes of death and disability in the United States. The detail of the BRFSS data is presented in section 3.

METHODS

The caregivers' physical/mental health outcomes were measured as HRQOL which was one of the most significant current discussions in modern living. The HRQOL could be a judgment of individuals' perceptions and reactions to not only their mental and physical health but also non-health-related areas, including family, friends, and household activities. The determinants of the HRQOL in public research had been widely used, especially socioeconomic factors, such as age, gender, marital status, employment status, income, race, and education. The study (Adelman, et al., 2014) reported that risk factors for the caregiver burden included female, low levels of educational attainment, residence with the care recipient, a higher number of hours providing care, depression, social isolation, financial stress, and lack of choice in being a caregiver. It suggested that a variety of variables was associated with caregivers' health. The independent variables in this study consisted of a set of independent variables: demographic characteristics, health behavior variables, and care characteristics. The dependent variable was the number of physically/mentally unhealthy days. The following model of health outcomes was developed (Son, 2016; Son, 2018):

$$H = f(d, z) \quad (1)$$

where 'H' denotes the number of physically/mentally unhealthy days. The number of unhealthy days ranges from 0 (no unhealthy days) to 30 (a logical maximum of 30 unhealthy days) during the past 30 days (Jia and Lubetkin, 2009; Clifford et al., 2013; Mahabaleshwarkar et al., 2013; Son, 2020). Earlier studies (Chen, et al., 2011; Mahabaleshwarkar, et al., 2013; Gandhi, et al., 2015) divided the number of unhealthy days into mutually exclusive categories using 14 days or more as a cutoff point for determining the presence of chronic physical or mental health

problems. However, using any cut-off value or the threshold of 14 days or more for the unhealthy days could be problematic. Hypothetically, a survey participant who reported zero unhealthy days during the past 30 days may not be differentiated in measuring health outcomes from the measurement of health outcomes for a participant who reported 13 unhealthy days if a study set the cutoff value. Because of this concern, the present study accounted for the actual number of unhealthy days that survey participants reported. Thus, the survey participants reported the more unhealthy days during the past 30 days as poorer his/her HRQOL. 'd' represents a group of socio-demographic variables (age, gender, marital status, educational level, employment status, income level, number of children, and race/ethnicity), selected health behavior variables (BMI, smoking status, and drinking status), and care characteristics. 'z' is a vector of all other relevant factors of health outcomes. The econometric specification for the health production function is the following:

$$H_{ijt} = \beta_0 + x_{ijtk}\beta_k + s_j\delta_j + t_t\delta_t + u_{ijt} \quad (2)$$

where the subscript *i* denotes an individual observation, and subscript *k* represents the number of explanatory variables. H_{ijt} represents the number of physically/mentally unhealthy days of individual *i* in state *j* at interview year *t*; x_{ijtk} is a vector of personal characteristics including socio-demographic variables, selected health behavioral variables, and care characteristics; s_j is a state fixed-effect (30 dummy variables: 29 states and District of Columbia); and t_t represents the interview year (4 dummy variables: 2015, 2016, 2017, and 2018). β_0 is a fixed non-random constant; β_k is a coefficient matrix of the personal characteristics with a dimension k x 1; δ_j is a coefficient of the individual state *j*; δ_t is a coefficient of the interview year *t*; and u_{ijt} is an error term of the *i*th observation in state *j* at year *t*, an independent random variable with mean zero and constant standard error σ_u. It is generally assumed that Cov (r_{ijt}, u_{ijt}) = 0 and Cov (x_{ijtk}, u_{ijt}) = 0 (Mesbah, 2004; Jia and Lubetkin, 2009; Son and Lee, 2014) with expected value of u_{ijt}, $E(u_{ijt}) = 0$. Determinants associated with the health of informal caregivers were often highly interrelated (del -Pino-Casado, et al., 2017). The relationship among the caregiving variables in a multiple regression model could cause multicollinearity. In this concern, this study examined the caregiving variables separately in six different models. All models from equation (2) included socio-demographic variables, health behavioral variables, and one caregiving category.

EMPIRICAL IMPLEMENTATION

The data were obtained from the 2015-2018 BRFSS. The BRFSS was a monthly ongoing health-related telephone survey, a collaborative project between the CDC and all states in the United States and participating U.S. territories. The BRFSS collected uniform state-specific data on health-related risk behaviors, chronic diseases and health conditions, access to health care, and use of preventive services related to the leading causes of death and disability from the non-institutionalized adult population aged 18 years or older. The BRFSS operations were managed by state health departments that followed the guidelines provided by the states with technical assistance provided by the CDC. States from the beginning stratified population were allowed to collect region-wise data in their states. The BRFSS questionnaire had three parts: a core component as a standard set of questions asked by all states, optional CDC modules supported by the CDC as questions on specific topics that states elected to use on their questionnaires, and state-added questions developed or acquired by participating states which were added to their questionnaires. The state health department and the CDC agreed on the content of the core

component and optional modules each year. The BRFSS provided guidelines that all states must ask the core component questions without modification, but states may choose to add any, all, or none of the optional modules.

Questions related to caregiving in the BRFSS were administered as an optional module in 29 states and the District of Columbia from 2015 to 2018. Some of the states administered the caregiving module multiple times during the years. The total baseline observations for all 29 states and the District of Columbia were 225,177. Excluding observations that had missing values, unanswered questions, don't know/not sure, questions not asked, and refusals on each question, 166,724 survey participants (74.04% of the total baseline observations) completed all questions about perceived numbers of physically/mentally unhealthy days, socio-demographic variables, health behavior variables, and caregiver variables. Of those, 36,382 were self-identified as caregivers, and 130,342 were not caregivers.

Dependent Variables: Health-Related Quality of Life

The survey participants were asked about the number of physically and mentally unhealthy days during the preceding 30 days. Physical health status was measured using 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?" Mental health status was measured using the question: "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?" The number of physically/mentally unhealthy days was served as a measure of HRQOL. The number of unhealthy days ranged from 0 to 30 days with a logical maximum of 30 unhealthy days per month. The measure of HRQOL from the BRFSS had been tested and established for their validity and reliability in the previous studies (Anderson, et al., 2003; Brown, et al., 2004; Evenson and McGinn, 2005; Kapp, et al., 2009) and had been widely applied in public health studies.

Independent Variables

First, socio-demographic variables were age, male, marital status, education, employment, annual household income, race/ethnicity, and the number of children in the household. Second, health behavioral variables were Body Mass Index (BMI), current smoker, and current drinker. These demographic and health behavioral variables were largely used in public health research (Hessel, 2016; Horner and Cullen, 2016; Zhu, 2016; Shai, 2018; Son, 2020). Third, caregiving variables were the following: caregiver, a relationship of care recipients, major diagnosis of care recipients, duration of caregiving, amount of caregiving, and caregivers' most need.

The Socio-demographic Variables

The survey participants were asked about six categories of marital status: married, divorced, widowed, separated, never married, and a member of an unmarried couple. These were then classified into two marital subgroups: married (married or a member of an unmarried couple) and the others. Thus, the empirical results of 'married' were compared to the other marital status. Six levels of education were asked to survey respondents in the BRFSS. This study set 'college 1 year to 3 years' and 'college 4 years or more' as some college and above. In the demographics module of the BRFSS questionnaire, there were eight mutually exclusive categories of current employment status: employed for wages, self-employed, out of work for

more than 1 year, out of work for less than 1 year, a homemaker, a student, retired, and unable to work. The present study combined 'employed for wages' and 'self-employed' together and grouped the others. Thus, a dichotomous indicator was defined for 'employed' if respondents reported currently as 'employed for wages' or 'self-employed'.

High-income individuals might be likely to exhibit a higher level of demand for medical care and health services than low-income individuals since medical and health services in economics are, in general, assumed to be normal goods. The consumption of medical care and health services is expected to be positively associated with health outcomes. The BRFSS asked the survey participants for their annual household income from all sources. The participants could report one of the eight categories of income levels from 'less than $10,000' to '$75,000 or more'. This study dichotomized them into two groups: annual household income '$50,000 or more' and 'less than $50,000'. Race/ethnicity was another variable that was commonly used in studies on health disparities. Studies (Montgomery, et al., 2013; Simms, et al., 2013) investigated race-based health outcomes in adulthood. The studies found that non-Hispanic whites had less likelihood of having physically and mentally unhealthy days than other races. As the same as their studies, the present study divided race/ethnicity into four categories: Whites, but not Hispanic; Blacks, but not Hispanic; Hispanic; and other races.

The Health Behavioral Variables

It was largely recognized that health behaviors were the leading contributors to influence physical/mental health. Three health behavioral variables were examined in the empirical models. First, Body Mass Index (BMI), relative weight for height, was calculated as weight (kg) divided by square of height (meter). The BMI was significantly correlated to the total volume of body fat. Survey participants were asked for their height and weight. The CDC calculated and provided each participant's BMI. Four levels of BMI were reported in the calculated-variables module: normal weight ($18.50 \leq BMI < 25.00$), underweight ($BMI < 18.50$), overweight ($25.00 \leq BMI < 30.00$), and obese ($30.00 \leq BMI$). Second, a current smoker was defined as a respondent who now smoked cigarettes every day or some days. 18.3% of the respondents were current smokers. Third, a current drinker was defined as a respondent who had at least one drink of alcohol in the past 30 days. One drink was

Table 1: Caregiving Questions – Behavioral Risk Factor Surveillance System, 2015-2018

Variables	BRFSS Questions
Caregiver	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?
Relationship of care recipient	What is his/her relationship to you? a. Parents: *mother, father, mother-in-law, and father-in-law.* b. Spouse: *husband and wife.* c. Child. d. Other: *brother, grandparents, other relative, non-relative/family friend, and etc.*
Major diagnosis of care recipient	What is the main health problem, long-term illness, or disability that the person you care for has? a. Dementia: *Dementia or other Cognitive Impairment Disorders.* b. Cancer. c. Heart diseases: *Heart Disease, Hypertension, and Stroke.* d. Diabetes. e. Arthritis: *Arthritis/Rheumatism.* f. Mental illnesses: *mental illness, such as Anxiety, Depression, or Schizophrenia.* g. Disabilities: *developmental disabilities, such as Autism, Down's Syndrome, and Spina Bifda.* h. Respiratory conditions: *chronic respiratory conditions, such as Emphysema or COPD.* i. Others: *Asthma, injuries, old age/infirmity/frailty, and etc.*
Duration of caregiving	For how long have you provided care for that person? a. < 30 days. b. 1 month to < 6 months. c. 6 months to < 2 years. d. 2 years to < 5 years. e. > 5 years.
Amount of Caregiving	In an average week, how many hours do you provide care or assistance? a. ≤ 8 hours. b. 9 hours to 19 hours. c. 20 hours to 39 hours. d. ≥ 40 hours.
Managed personal care	In the past 30 days, did you provide care for this person by managing personal care, such as giving medications, feeding, dressing, or bathing?
Managed household tasks	In the past 30 days, did you provide care for this person by managing household tasks, such as cleaning, managing money, or preparing meals?
Caregivers' most need	Of the following support services, which one do you, as a caregiver, most need that you are not currently getting? a. Access to services: *help in getting access to services.* b. Support groups.

	c. Counseling: *Individual counseling to help cope with giving care.* d. Respite care. e. Classes: *classes about giving care, such as giving medications.* f. Don't need support: *you don't need any of these support services.*
Future caregiving (only currently non-caregivers)	In the next 2 years, do you expect to provide care or assistance to a friend or family member who has a health problem or disability?

***Source*: 2015-2018 Behavioral Risk Factor Surveillance System (BRFSS).**

Equivalent to a 12-ounce beer, a 5-ounce glass of wine, or a drink with one shot of liquor. 55.6% of the respondents reported as a current drinker.

Caregiving Variables

Questions related to caregiving were administered as a part of the optional modules in 29 states, the District of Columbia (D.C.), and Puerto Rico (in 2016) from 2015 to 2018. The present study excluded Puerto Rico. Some states administered the module in multiple years: 18 states in 2015 (Alabama, Hawaii, Idaho, Illinois, Indiana, Iowa, Kentucky, Louisiana, Mississippi, New Jersey, Oregon, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia, Wisconsin, and Wyoming); 11 states and D.C. in 2016 (Arkansas, District of Columbia, Georgia, Minnesota, Missouri, Montana, Nevada, New Jersey, North Dakota, Oregon, South Dakota, Tennessee); 5 states in 2017 (Alaska, Hawaii, New Mexico, Oregon, Rhode Island); and 3 states in 2018 (Georgia, New Jersey, Oregon). Table 1 shows the list of questions for the caregiver module in the BRFSS questionnaires. The following caregiver screening question was administered in the BRFSS survey: "During the past 30 days, did you provide regular care or assistance to a friend or family member that has a health problem or disability?" Respondents who responded 'yes' and 'caregiving recipients died in past 30 days' to the question were classified as caregivers, and then they completed the caregiver module by responding to questions about their primary care recipient and themselves. 21.8% of the survey participants provided regular care or assistance to a friend or family member during the past 30 days. If the caregiver had more than one care recipient, the caregiver was asked to answer the module questions about the recipient who required the most care.

Table 2: Care Characteristics – Behavioral Risk Factor Surveillance System, 2015-2018

Care Recipients Characteristics	Mean	Caregivers Characteristics	Mean
Relationship of CR		**Duration of caregiving**	
Parents	0.382 (0.486)	< 30 days	0.191 (0.393)
Spouse	0.145 (0.352)	1 month to < 6 months	0.124 (0.329)
Child	0.092 (0.290)	6 months to < 2 years	0.185 (0.389)
Others	0.381 (0.486)	2 years to < 5 years	0.202 (0.402)
Major diagnosis of CR		> 5 years	0.298 (0.457)
Dementia	0.090 (0.287)	**Amount of caregiving (hours per week)**	
Cancer	0.089 (0.285)	≤ 8 hours	0.573 (0.495)
Heart diseases	0.073 (0.261)	9 hours to 19 hours	0.135 (0.342)
Diabetes	0.059 (0.236)	20 hours to 39 hours	0.107 (0.309)
Arthritis	0.053 (0.225)	≥ 40 hours	0.186 (0.389)
Mental illnesses	0.045 (0.208)	**Managing personal care**	0.529 (0.499)
Disabilities	0.041 (0.197)	**Managing household tasks**	0.799 (0.401)
Respiratory conditions	0.036 (0.186)	**Caregivers' most need**	
Others	0.513 (0.500)	Access to services	0.090 (0.286)
		Support groups	0.028 (0.165)
		Counseling	0.025 (0.157)
		Respite care	0.025 (0.155)
		Classes	0.016 (0.124)
		Don't need support	0.817 (0.387)
Future caregiving (only currently non-caregivers: n = 122,804)			0.162 (0.369)

***Notes*: Standard deviations (S.D.) are in parentheses. Means and Standard Deviations are weighted by the BRFSS sample weight factor. All means are statistically significant using two tailed t-test with 95% confidence interval.**

Table 3: Descriptive Statistics of Caregivers and Non-Caregivers[a]

Variables	Total (n = 166,724: 100%)	Caregivers (n = 36,382: 21.8%)	Non-Caregivers (n = 130,342: 78.2%)
Physically unhealthy days	4.129 (8,554)	4.972 (9.142)	3.893 (8.368)
Mentally unhealthy days	3.875 (8.104)	5.452 (9.449)	3.433 (7.625)
Age	48.572 (17.162)	49.528 (16.028)	48.304 (17.458)
Male	0.504 (0.500)	0.437 (0.496)	0.523 (0.499)
Married	0.579 (0.494)	0.601 (0.490)	0.573 (0.495)
Some college or above	0.596 (0.491)	0.600 (0.490)	0.595 (0.491)
Employed	0.598 (0.490)	0.575 (0.494)	0.605 (0.489)
Income $50, 000 or more	0.499 (0.500)	0.461 (0.498)	0.510 (0.500)
Number of children	0.707 (1.124)	0.694 (1.140)	0.710 (1.120)
Race			
White, non-Hispanic	0.719 (0.449)	0.732 (0.443)	0.715 (0.451)
Black, non-Hispanic	0.132 (0.338)	0.146 (0.354)	0.128 (0.334)
Hispanic	0.081 (0.273)	0.061 (0.239)	0.087 (0.282)
Other	0.068 (0.251)	0.061 (0.239)	0.070 (0.255)
BMI[b]			
Normal weight	0.306 (0.461)	0.283 (0.450)	0.313 (0.464)
Underweight	0.015 (0.123)	0.015 (0.122)	0.015 (0.123)
Overweight	0.355 (0.479)	0.338 (0.473)	0.360 (0.480)
Obese	0.323 (0.468)	0.364 (0.481)	0.312 (0.463)
Current smoker	0.183 (0.386)	0.238 (0.426)	0.167 (0.373)
Current drinker	0.556 (0.497)	0.533 (0.499)	0.562 (0.496)

***Notes*: a. Standard deviations (S.D.) are in parentheses. Means and Standard Deviations are weighted by the BRFSS sample weight factor. All means are statistically significant using two tailed t-test with 95% confidence interval. b. Body Mass Index (BMI): weight (kg) divided by square of height (meter): normal weight ((18.50 ≤ BMI < 25.00); underweight (BMI < 18.50); overweight ((25.00 ≤ BMI < 30.00); and obese (30.00 ≤ BMI).**

Descriptive statistics for care recipients and caregivers are shown in Table 2. Questions about respondents' primary care recipients were 'relationship of care recipients' and 'major diagnosis of care recipients'. From the questions in the caregiver module related to the relationship of the care recipient to the caregiver, this study regrouped into four subgroups. After regrouping, 38.2%, 14.5%, 9.2%, and 38.1% of care recipients were parents, spouses, children, and others, respectively. The other characteristic of care recipients was a major diagnosis of care recipients. The prevalence of the care recipient's major diagnoses was listed from the most to the least in Table 2: Dementia (9.0%), Cancer (8.9%), heart diseases (7.3%), diabetes (5.9%), arthritis (5.3%), mental illnesses (4.5%), and disabilities (4.1%), respiratory conditions (3.6%), and others (51.3%). Five questions were asked about themselves as caregivers. First of all, the duration of caregiving for care recipients was asked to the caregivers. 50 % of all caregivers had provided care for the care recipients for 2 years or longer. Second, the caregivers were asked about caregiving hours per week. 57.3% of caregivers provided the care for 8 hours or less per week, and 18.6% of caregivers provided the care for 40 or more hours per week. Next, caregivers were asked to answer 'yes' or 'no' to the questions about managing personal care and managing household tasks. 52.9% and 79.9% of the caregivers provided to manage personal care and household tasks, respectively. Lastly, the BRFSS asked the caregivers about

their most needs that they were not currently getting. The majority of caregivers (81.7%) didn't need any support. Among the other caregivers, 'help in getting access to services' was the most needed (9.0%). Additionally, the BRFSS asked only non-caregivers at the time of interviewing about the expectation of providing care or assistance in the next 2 years. 16.2 % of non-caregivers were expected to provide care or assistance in the next 2 years.

RESULTS

Descriptive Analysis

Socio-demographic characteristics of caregivers and non-caregivers are displayed in Table 3. On average, caregivers had 4.972 physically unhealthy days and 5.452 mentally unhealthy days during the past 30 days; on the other hand, non-caregivers had 3.893 physically unhealthy days and 3.433 mentally unhealthy days. In other words, caregivers had 27.72% more physically unhealthy days and 58.81% more mentally unhealthy days than non-caregivers had during the past 30 days. These implied that the caregiving role was a significant detriment to caregivers' health. Caregivers were, on average, one year older than non-caregivers. 50.4% of survey respondents were male, but only 43.7% of caregivers were males and 56.3% of caregivers were females. This disproportionate gender distribution indicated that women were involved in caregiving roles more than men. As a result, women were expected to experience greater physical/mental strain. Caregivers compared to non-caregivers had a slightly larger proportion of 'married' and 'some college or above'.

The descriptive statistics also showed that caregivers were less likely to be 'employed' compared to non-caregivers. The informal caregivers would face a trade-off between providing care and working opportunities under a time constraint. Thus, an increase in hours of providing care reduced working hours. The study (He and Mchenry, 2016) found that an increase in working hours per week by 10% reduced the probability of providing informal care by about 2 percentage points among women of the prime caregiving ages (40-64 years). The proportion of caregivers who earned 'annual income $50,000 or more' was smaller than the proportion of non-caregivers. Caregivers were less likely to have children in their households compared to non-caregivers. The share of Whites and Blacks, non-Hispanic among caregivers was higher than the share of Whites and Blacks, non-Hispanic among non-caregivers; on the other hand, the fraction of Hispanics and other races among caregivers was lower than the fraction of Hispanics and other races among non-caregivers. The percentage of caregivers who were 'normal weight' and 'overweight' was lower than the percentage of non-caregivers. The proportion of 'obese' among caregivers was higher than the proportion of 'obese' among non-caregivers. The prevalence of currently smoking cigarettes for caregivers (23.8%) was significantly higher than the prevalence for non-caregivers (16.7%). A slightly lower proportion of caregivers reported as 'current drinkers' compared to non-caregivers.

Table 4: Regression Results for the Number of Physically Unhealthy Days[a]

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Age	0.029 (20.995)	0.029 (20.935)	0.029 (21.090)	0.029 (20.787)	0.029 (20.967)	0.029 (21.045)
Male	-0.329 (-8.056)	-0.327 (-8.001)	-0.330 (-8.079)	-0.331 (-8.116)	-0.328 (-8.035)	-0.319 (-7.803)
Married	-0.310 (-6.885)	-0.308 (-6.780)	-0.305 (-6.775)	-0.303 (-6.963)	-0.315 (-6.994)	-0.311 (-6.919)
Some college or above	-0.433 (-9.865)	-0.434 (-9.886)	-0.431 (-9.824)	-0.429 (-9.784)	-0.427 (-9.738)	-0.455 (-10.365)
Employed	-3.125 (-68.111)	-3.127 (-68.093)	-3.124 (-68.083)	-3.125 (-68.109)	-3.116 (-67.881)	-3.128 (-68.214)
Income $50, 000 or more	-1.534 (-32.604)	-1.536 (-32.624)	-1.533 (-32.590)	-1.529 (-32.494)	-1.529 (-32.485)	-1.522 (-32.383)
Number of children	-0.090 (-4.628)	-0.092 (-4.712)	-0.090 (-4.631)	-0.091 (-4.656)	-0.091 (-4.691)	-0.091 (-4.655)
Race						
White, non-Hispanic	---	---	---	---	---	---
Black, non-Hispanic	-0.704 (-11.099)	-0.701 (-11.045)	-0.703 (-11.070)	-0.703 (-11.080)	-0.705 (-11.118)	-0.722 (-11.388)
Hispanic	-0.124 (-1.569)[b]	-0.125 (-1.580)[b]	-0.128 (-1.624)[b]	-0.119 (-1.510)[b]	-0.131 (-1.660)[b]	-0.137 (-1.734)[b]
Other	0.227 (2.673)	0.228 (2.677)	0.225 (2.642)	0.219 (2.581)	0.219 (2.573)	0.217 (2.552)
BMI						
Normal weight	---	---	---	---	---	---
Underweight	1.101 (6.713)	1.100 (6.706)	1.106 (6.743)	1.093 (6.665)	1.098 (6.694)	1.106 (6.748)
Overweight	0.502 (10.080)	0.501 (10.064)	0.502 (10.088)	0.502 (10.078)	0.505 (10.141)	0.504 (10.124)
Obese	1.838 (36.043)	1.837 (36.024)	1.837 (36.032)	1.833 (35.961)	1.840 (36.085)	1.838 (36.083)
Current smoker	2.005 (37.672)	2.006 (37.703)	2.004 (37.649)	2.000 (37.589)	2.004 (37.651)	2.007 (37.754)
Current drinker	-1.185 (-27.828)	-1.185 (-27.822)	-1.186 (-27.839)	-1.176 (-27.587)	-1.178 (-27.653)	-1.189 (-27.931)
Caregiver	0.588 (12.165)					
Relationship of CR[c]						
Parents		0.643 (8.825)				
Spouse		0.509 (4.366)				
Child		0.754 (5.292)				
Others		0.505 (6.963)				

Major diagnosis of CR[c]				
Dementia	0.090 (0.614)[b]			
Cancer	0.747 (5.081)			
Heart diseases	0.568 (3.502)			
Diabetes	1.017 (5.650)			
Arthritis	1.054 (5.570)			
Mental illnesses	1.108 (5.388)			
Disabilities	0.187 (0.862)[b]			
Respiratory conditions	0.970 (4.215)			
Others	0.465 (7.169)			
Duration of caregiving				
< 30 days		0.198 (1.973)		
1 month to < 6 months		0.235 (1.900)[b]		
6 months to < 2 years		0.349 (3.424)		
2 years to < 5 years		0.626 (6.397)		
> 5 years		1.077 (13.149)		
Amount of caregiving				
≤ 8 hours			0.422 (6.829)	
9 hours to 19 hours			0.101 (0.837)[b]	
20 hours to 39 hours			0.939 (6.961)	
≥ 40 hours			0.997 (9.589)	
Caregivers' most need				
Access to services				1.964 (13.446)
Support groups				0.763 (2.949)
Counseling				2.896 (10.648)

Respite care						2.385 (8.649)
Classes						2.267 (6.525)
Don't need support						0.223 (4.187)
Year dummy	yes	yes	yes	yes	yes	yes
State dummy	yes	yes	yes	yes	yes	yes
R-square	0.109	0.109	0.109	0.109	0.109	0.110

Notes: **a. The constant and coefficients of states and years are not shown. The t-statistics are in parentheses. All estimated coefficients are statistically significant at 95 percent level of confidence except bs. Regressions are weighted by the BRFSS sample weight factor. Sate and year coefficients are not shown. There are 3,602,019 observations in the regressions. c. CR represents care recipients.**

Regression Results

Tables 4 and 5 present the results from a multiple regression for the informal caregivers' physical and mental health outcomes. The number of unhealthy days during the past 30 days was regressed on caregiving variables in six separate empirical models. All models controlled socio-demographic variables, health behavioral variables, state fixed effects, and year fixed effects. The t-statistics indicated that most of the estimated coefficients were statistically significant at a 95 percent level of confidence. The last row of the tables showed R-squared values, which represented the overall fit of goodness, ranged from 0.087 to 0.110 which were relatively low. The low values suggested the regression models were a poor fit with the data in a conventional sense. At first glance, all of the key factors to influence survey participants' physical/mental health were not in the empirical models since the present study primarily focused on examining the impact of caregiving role on the caregivers' physical/mental health rather than examining the determinants of health.

Physically unhealthy days

Table 4 showed the results of the regression analysis for physical health outcomes. Columns (1)-(6) indicated that significant correlations existed between physically unhealthy days and all of the socio-demographic variables except age. In other words, respondents who were male, married, some college or above as their level of education, employed, and with income $50,000 or more were less likely to experience physically unhealthy days than their counterparts. The number of children aged 18 years or less in the household was associated with a reduction in physically unhealthy days. Respondents who were Blacks (non-Hispanic) or Hispanics had fewer physically unhealthy days compared with Whites (non-Hispanic), while respondents who reported as other races had more physically unhealthy days compared with Whites (non-Hispanic). Respondents who were underweight, overweight, or obese were estimated to have more physically unhealthy days than respondents who were normal weight. The estimated coefficients for current smokers suggested that cigarette smoking was significantly associated with a higher incidence of having physically unhealthy days: smokers had about 50% more physically unhealthy days than non-smokers based on an average of 4.129 physically unhealthy days for all observations (Table 3). On the other hand, respondents who reported as current drinkers had fewer physically unhealthy days than respondents who were non-drinkers. One of the reasons for this result could be the causality relationship between the two variables.

Thus, it is recommended in future studies to examine whether alcoholic consumption helps individuals to improve their physical health or more physically active individuals have more opportunities to consume alcoholic beverages. The study (Piazza-Gardner and Barry, 2012) reported that 17 reviewed studies supported alcohol consumers of all ages were more physically active than non-drinking peers.

All of the caregiving variables were negatively associated with physical health outcomes. The estimated coefficient of 0.588 for the caregiver implied that being a caregiver raised the likelihood of having physically unhealthy days by 0.588 days per month. The average of physically unhealthy days for non-caregivers was 3.893 days (Table 3). With respect to the results above, respondents who reported themselves as a caregiver could have 15.1% more physically unhealthy days than respondents who were non-caregivers. Column 2 showed the estimates for the relationship of the care recipient with caregivers. The magnitude of the estimates of the four relationships ranged from 0.505 to 0.754 which suggested that 'providing care to whom' was not a significant factor to influence the caregivers' physical health differently. Caregivers who provided regular care or assistance to care recipients with Diabetes, Arthritis, or mental illness were the worst physical health outcomes compared with caregivers who provided care or assistance to care recipients with other health problems. This result was supported by the studies (Goren, et al., 2016; Siddiqui and Khalid, 2019) that found that caring for care recipients with mental illness seriously impacted caregivers' health outcomes.

The estimated coefficients were 0.198, 0.235, 0.349, 0.626, and 1.077 days for caregivers who provided care or assistance for the duration of fewer than 30 days, 1 month to 6 months, 6 months to 2 years, 2 years to 5 years, and longer than 5 years, respectively. It suggested that the longer the duration of caregiving, the informal caregivers had more physically unhealthy days. Column 5 showed the estimates of the weekly amount of caregiving hours on the caregivers' physical health. The caregivers who provided care or assistance 20 hours or more per week experienced significantly more physically unhealthy days than non-caregivers and caregivers who provided care or assistance less than 20 hours per week. In column 6, the magnitude of estimated coefficients for the caregivers' most need category indicated that 'not getting the need of support' was a serious risk factor to influence informal caregivers' physical health. The variables in the caregivers' most need category were the highest contributors toward negative.

Table 5: Regression Results for the Number of Mentally Unhealthy Days[a]

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Age	-0.064 (-48.340)	-0.065 (-48.702)	-0.064 (-48.292)	-0.064 (-48.470)	-0.064 (-48.318)	-0.064 (-48.231)
Male	-1.101 (-28.128)	-1.100 (-28.080)	-1.100 (-28.072)	-1.106 (-28.251)	-1.092 (-27.903)	-1.078 (-27.597)
Married	-0.653 (-15.147)	-0.686 (-15.730)	-0.647 (-14.992)	-0.656 (-15.201)	-0.664 (-15.384)	-0.655 (-15.219)
Some college or above	-0.213 (-5.068)	-0.215 (-5.119)	-0.212 (-5.037)	-0.209 (-4.964)	-0.200 (-4.769)	-0.253 (-6.037)
Employed	-2.048 (-46.557)	-2.043 (-46.410)	-2.046 (-46.494)	-2.046 (-46.507)	-2.023 (-45.983)	-2.046 (-46.620)
Income $50, 000 or more	-1.188 (-26.356)	-1.183 (-26.214)	-1.193 (-26.450)	-1.184 (-26.253)	-1.168 (-25.893)	-1.171 (-26.034)
Number of children	-0.085 (-4.556)	-0.090 (-4.802)	-0.087 (-4.675)	-0.085 (-4.569)	-0.090 (-4.815)	-0.085 (-4.551)
Race						
White, non-Hispanic	---	---	---	---	---	---
Black, non-Hispanic	-1.010 (-16.612)	-0.997 (-16.384)	-0.995 (-16.349)	-1.007 (-16.550)	-1.013 (-16.666)	-1.042 (-17.163)
Hispanic	-0.678 (-8.964)	-0.677 (-8.958)	-0.674 (-8.904)	-0.676 (-8.934)	-0.690 (-9.130)	-0.712 (-9.430)
Other	0.000 (0.001)[b]	-0.000 (-0.001)[b]	0.004 (0.050)[b]	-0.009 (-0.113)[b]	-0.019 (-0.230)[b]	-0.008 (-0.099)[b]
BMI						
Normal weight	---	---	---	---	---	---
Underweight	1.174 (7.465)	1.164 (7.399)	1.178 (7.487)	1.170 (7.440)	1.152 (7.329)	1.182 (7.532)
Overweight	0.298 (6.239)	0.298 (6.240)	0.300 (6.279)	0.298 (6.252)	0.299 (6.268)	0.299 (6.289)
Obese	1.339 (27.390)	1.339 (27.401)	1.344 (27.487)	1.337 (27.354)	1.338 (27.380)	1.337 (27.413)
Current smoker	2.811 (55.106)	2.822 (55.311)	2.821 (55.276)	2.810 (55.091)	2.797 (54.821)	2.824 (55.494)
Current drinker	-0.208 (-5.104)	-0.203 (-4.972)	-0.208 (-5.100)	-0.198 (-4.844)	-0.189 (-4.637)	-0.214 (-5.243)
Caregiver	1.619 (34.914)					
Relationship of CR[c]						
Parents		1.575 (22.567)				
Spouse		2.027 (18.153)				
Child		2.286 (16.731)				
Others		1.247 (17.949)				

Major diagnosis of CR[c]				
Dementia	1.476 (10.511)			
Cancer	1.663 (11.792)			
Heart diseases	1.813 (11.658)			
Diabetes	1.103 (6.390)			
Arthritis	1.659 (9.143)			
Mental illnesses	2.626 (13.314)			
Disabilities	1.791 (8.602)			
Respiratory conditions	2.328 (10.552)			
Others	1.319 (21.198)			
Duration of caregiving				
< 30 days		1.103 (11.466)		
1 month to < 6 months		1.478 (12.470)		
6 months to < 2 years		1.275 (13.062)		
2 years to < 5 years		1.514 (16.128)		
> 5 years		2.130 (27.128)		
Amount of caregiving				
≤ 8 hours			1.020 (17.240)	
9 hours to 19 hours			1.665 (14.431)	
20 hours to 39 hours			1.911 (14.778)	
≥ 40 hours			2.828 (28.367)	
Caregivers' most need				
Access to services				3.326 (23.786)
Support groups				4.720 (19.065)
Counseling				6.638 (25.496)

Respite care						3.870 (14.659)
Classes						2.101 (6.318)
Don't need support						0.960 (18.876)
Year dummy	yes	yes	yes	yes	yes	yes
State dummy	yes	yes	yes	yes	yes	yes
R-square	0.087	0.087	0.087	0.087	0.088	0.092

Notes: **a. The constant and coefficients of states and years are not shown. The t-statistics are in parentheses. All estimated coefficients are statistically significant at 95 percent level of confidence except bs. Regressions are weighted by the BRFSS sample weight factor. Sate and year coefficients are not shown. There are 3,602,019 observations in the regressions. c. CR represents care recipients.**

Physical health outcomes. Especially, caregivers who didn't get the support of 'counseling', 'respite care', and 'classes' experienced 2.267-2.896 days more physically unhealthy days during the past 30 days than non-caregivers. In other words, those caregivers were likely to have more physically unhealthy days by 58.2%-74.4% than non-caregivers. In contrast, the informal caregivers who didn't currently need any support had only 0.223 days more physically unhealthy days than non-caregivers.

Mentally unhealthy days

Table 5 showed the regression results on mental health outcomes. The negative signs of estimated coefficients for the socio-demographic variables suggested that respondents who reported male, married, some college or above as their level of education, employed, and with income $50,000 or more were estimated to have fewer mentally unhealthy days than their counterparts. 'Employed' was significantly associated with a reduction in the mentally unhealthy days: the survey participants who were employed had fewer mentally unhealthy days by about 2 days during the past 30 days than the participants who reported the other employment status. Also, age and the number of children aged 18 years or less in the household were associated with a reduction in the mentally unhealthy days. Respondents who were Blacks (non-Hispanic) or Hispanics were estimated to have fewer mentally unhealthy days than Whites (non-Hispanic), while the number of mentally unhealthy days for respondents who reported 'other races' was correspondingly estimated to the number of mentally unhealthy days for respondents who were Whites (non-Hispanic). Respondents who were underweight, overweight, or obese were predicted to have more mentally unhealthy days than respondents who were normal weight. The estimated coefficient of current smokers indicated that cigarette smoking was significantly associated with a higher incidence of experiencing mentally unhealthy days: the survey participants who were categorized as 'current smokers' had more mentally unhealthy days by about 2.8 days than the participants who were not current smokers. The result implied that smokers had a likelihood of 81.6% more mentally unhealthy days than non-smokers using the average of mentally unhealthy days of 3.433 for all observations (Table 3). On the other hand, respondents who reported as current drinkers had fewer mentally unhealthy days than respondents who were non-drinkers.

Column (1) indicated that caregiving was significantly associated with mental health outcomes. The coefficient of 1.619 implied that caregivers were estimated to have more mentally unhealthy days by 1.619 days during the past 30 days than non-caregivers. In other words, caregivers would have more mentally unhealthy days by 47.2% than non-caregivers based on the average of 3.433 days (Table 3). Column (2) showed the estimates for the relationship of the care recipient with caregivers. Caregivers who provided care or assistance to their spouse or their child had the worst mental health outcomes among the caregivers. In column (3), caregivers who provided care or assistance to care recipients with mental illness or respiratory conditions had a highly likelihood of having more mentally unhealthy days by 2.626 days and 2.328 days, respectively, than non-caregivers. The estimated coefficients for the variables were relatively greater than other variables in the same caregiving category. In other words, these variables had the most significant impact on caregivers' mental health in the caregiving category.

Caregivers who provided care for the care recipients for longer than 5 years were more likely to have mentally unhealthy days by 2.130 days than non-caregivers, whereas caregivers who provided care shorter than 5 years were more likely to have mentally unhealthy days by 1.103-1.514 days than non-caregivers. In other words, the negative impact of the caregiving role on the mental health outcomes was significantly large when the duration of caregiving was longer than 5 years. Column (5) showed that the longer the hours of caregiving per week, the more mentally unhealthy days the informal caregivers had: the estimated coefficients were 1.020, 1.665, 1.911, and 2.828 for caregivers who provided care or assistance per week for 8 hours or less, 9 to 19 hours, 20 to 39 hours, and 40 hours or more, respectively. The need for caregivers had the most significant negative impact in terms of the magnitude of estimated coefficients on mental health outcomes compared with the other caregiving categories. Column (6) showed that caregivers who reported 'not getting one of the support services' had a likelihood of having more mentally unhealthy days by 2.101-6.638 days than non-caregivers, whereas caregivers who reported 'no need of support services' had a likelihood of having more mentally unhealthy days only by 0.960 days than non-caregivers. This result was meaningful because if caregivers received all of their need for support services, their mental health outcomes would improve significantly.

DISCUSSION

The present study investigated the effects of characteristics of caregivers and the caregiving situation on the health of informal caregivers, using the multiple regression analysis with the time-series and cross-sectional data from the 2015-2018 BRFSS for adults aged 18 years or older. The regression results indicated that the survey respondents who were the informal caregivers were estimated to have more physically/mentally unhealthy days than non-caregivers. This result reflected that the caregiving role can lead to an increased risk of developing physical/mental health problems. The negative mental health effects of the caregiving role were greater than the physical health effects. The present study also revealed that the care characteristics were strong determinants of informal caregivers' health. The duration of caregiving was associated with an increase in adverse impacts on caregivers' physical and mental health: the results showed that the estimates of the number of physically/mentally unhealthy days increased as the duration of caregiving extended. Importantly the magnitude of the estimated coefficient leaped at the duration of caregiving as

'longer than 5 years'. Thus, the health risk for informal caregivers could fall if the public health system identifies and fellows up the family caregivers who provide care longer than 5 years and assists special care to them. The number of caregiving hours was also a significant risk factor to influence informal caregivers' health, especially '40 or more hours per week'. It suggested informal caregivers provide care or assistance less than 40 hours per week to lower the negative health impact.

The results also showed that the caregiver support program was the most significant factor for caregivers' physical/mental health outcomes. The absence of support services, such as the informal caregivers needed the 'support services', but not provided, had the greatest negative impact on caregivers' health among the caregiving categories. Especially caregivers who didn't get the support of 'counseling', 'respite care', and 'classes' were estimated to have 58.2%-74.4% more physically unhealthy days than non-caregivers. In contrast, the informal caregivers who didn't currently need any support were estimated to have only 5.73% more physically unhealthy days than non-caregivers. The variables in the same caregiving category had even a greater negative impact on mental health outcomes. Caregivers who reported not getting any of the support services had a likelihood of having more mentally unhealthy days by 61.20%-193.36% during the past 30 days than non-caregivers, whereas caregivers who reported no need for support services had a likelihood of having more mentally unhealthy days by only 27.96% than non-caregivers. The results implied that the informal caregivers' health outcomes would improve significantly if they received all of their needs of support services. However, few caregivers obtained the information, and more than 80 % of caregivers reported needing more information on caregiving although a vast amount of information about caregiving was publicly available through disease-specific and caregiving organizations (Peterson, et al., 2016). As a result, informal caregivers received little preparation to perform their caregiving role to the best of their family (Northouse, et al., 2010).

For enhancing the effectiveness of caregiving support programs and services, the present study suggests families and communities as follows: first of all, as people continue to live longer, more family members are expected to provide ongoing care to aging family members with a chronic condition and disability and other special needs than ever before. Thus, it is important to educate the public on both the important role of caregivers and the importance of maintaining caregivers' health and well-being. Caregivers' health is important for not only caregivers themselves and care recipients but also delaying nursing home admission. The delayed nursing home admission is beneficial for families and societies. Nursing homes are affiliated with some troubling outcomes such as questionable quality of care and quality of life, premature mortality, and psychological or emotional distress for families. Also, reducing the use of nursing homes would be one of the public policy goals because nursing home care is costly, and transitioning from community to nursing home care could increase the likelihood of raising the demand for financial support from Medicaid (Janus and Doty, 2018). Second, for increasing the awareness of the importance of the caregiving role, the public health system educates the healthcare providers on the health risks for caregivers and encourages family caregivers to access available information and supportive programs and services. Third, for improving the caregiving supporting system, public health departments evaluate the effectiveness of the caregiver training and support programs and the hole between workforce capacity and anticipated demand for services to support family caregivers. Finally, the public health

departments encourage the informal caregivers to get regular check-ups, use preventive services, and engage in self-care to maintain their health to ensure that caregivers, especially with chronic diseases or a disability, obtain self-management programs.

This study does have some limitations which have to be pointed out. First, although several earlier studies have proven the reliability of the measure of HRQOL from the BRFSS, and it has been widely used in health research, the self-reported health status may be subjective by the individual survey participants. The self-reported health assessments are just the individual participants' self-perceptions of mental/physical health. It does not indicate direct evidence of the health status of individuals, including previous and current diseases (diagnosed by physicians) and clinical parameters measured in the hospital. Second, the BRFSS had collected information on family caregivers from the 29 states and the District of Columbia from 2015 to 2018. The data did not represent all caregivers. The prevalence of family caregiving across the states could be varied because of socio-economic and demographic differences. High-income/highly-educated informal caregivers would have more knowledge of the caregiving role and accessibility of the caregiver support programs than their counterparts. Also, they are more efficient to manage their health (more efficient producers of health) than their counterparts. At the same time, high-income states may provide quality support services for informal caregivers compared with low-income states. If the income distribution of the states that implemented the caregiving module was skewed toward the high-income states, the negative effect of caregiving on physical and mental health would be underestimated. Third, the study (Godfrey, et al., 2018) insisted that the impact of caregiving without self-identification remained poorly understood. Family members who provided care or daily assistance to other family members may not be identified as a caregiver. Their caregiving role might increase gradually because physical disabilities or diseases of older adults might develop progressively, and particularly spousal caregivers with even high levels of daily assistance interpreted as an extension of spousal responsibilities. As a result, informal caregivers could be unaware of the caregiving role from their family responsibilities, and self-identification may be delayed. Thus, dealing with the self-reported family caregiving data would be faced with missing data or measurement error that the Type I error in which was the rejection of a true null hypothesis: an informal caregiver was treated as a non-caregiver.

In conclusion, informal caregiving could be inevitable due to family tradition or demographic changes over the years. It had enormous benefits for care recipients that family members or close relatives were their caregivers (Lund, et al., 2015; Arthur, 2018). Nevertheless, this study found the caregiving was a crucial detrimental activity for the informal caregivers' health. Importantly, this study revealed that the characteristics of caregivers and the caregiving situation were significantly associated with family caregivers' physical/mental health outcomes. Especially the results showed that the caregiver support program was the most significant factor linked to caregivers' physical/mental health: when caregivers didn't receive their needs, they experienced the worst health outcomes among the care characteristics. It pointed to the importance of caregiver education and support programs for family caregivers. The results also pinpointed which area of support services for informal caregivers would be a priority to enhance. The caregiving role can last for months or years, and the tasks can be emotionally, physically, socially, and financially demanding. Public health policymakers should re-evaluate the current long-term care program to establish a more effective caregiving

structure, especially caregiver education and support programs for family caregivers, to improve the informal caregivers' quality of life, especially caregiver education and support programs for family caregivers.

References

Adelman, Ronald D.; Tmanova, Lyubov L.; Delgado, Diana; Dian, Sarah; and Lachs, Mark S. (2014). Caregiver Burden: a Clinical Review. *Journal of the American Medical Association*, Vol. 311 (10), pp. 1052-1060. DOI: 10.1001/jama.2014.304.

Abdullah, Lazim. (2014). Modeling of Health Related Quality of Life Using an Integrated Fuzzy Inference System and Linear Regression. *Procedia Computer Science*, Vol. 42, pp. 99-105. DOI: 10.1016/j.procs.2014.11.039.

Andreson, E. M.; Catlin, T. K.; Wyrwich, K. W.; and Jackson-Thompson, J. (2003). Retest Reliability of Surveillance Questions on Health Related Quality of Life. *Journal of Epidemiology and Community Health*, Vol. 57 (5), 339-343. DOI: 10.1136/jech.57.5.339.

Arthur, Paul B. (2018). Informal Caregiving for Persons with Chronic Conditions: Trends and Considerations. *Advances in Aging Research*, Vol. 7, pp. 78-89. DOI: 10.4236/aar.2018.74007.

Brown, W. J.; Trost, S. G.; Bauman, A.; Munnery, k.; and Owen, N. (2004). Test-Retest Reliability of Four Physical Activity Measures Used in Population Surveys. *Journal of Science and Medicine in Sport*, Vol. 7 (2), pp. 205-215. DOI: 10.1016/s1440-2440(04)80010-0.

Cameron, Jill I.; Chu, Leslie M.; Matte, Andrea; Tomlinson, George; Chan, Linda; Thomas, Claire; Freiedrich, Jan O.; Mehta, Sangeeta; Lamontagn, Francois; Levasseur, Melanie; Ferguson, Niall D.; Adhikari, Neill K. J.; Rudkowski, Jill C.; Meggison, Hilary; Skrobik, Yoanna; Flannery, John; Bayley, Mark; Batt, Jane; dos Santos, Claudia; Abbey, Susan E.; Tan, Adrienne; Lo, Vincent; Mathur, Sunita; Parotto, Matteo; Morris, Denise; Flockhart, Linda; Fan, Eddy; Lee, Christie M.; Wilcox, Elizabeth; Ayas, Najib; Choong, Karen; Fowler, Robert; Scales, Damon C.; Sinuff, Tasnim; Cuthbertson, Brian H.; Rose, Louise; Robles, Priscila; Burns, Stacey; Cypel, Marcelo; Singer, Lianne; Chaparro, Cecilia; Chow, Chung-Wai; Keshavjee, Shaf; Brochard, Laurent; Hébert, Paul; Slutsky, Arthur S.; Marshall, John C.; Cook, Deborah; and Herridge, Margaret S. (2016). One-Year Outcomes in Caregivers of Critically Ill Patients. *New England Journal of Medicine*, Vol. 374 (19), pp. 1831-1841. DOI: 10.1056/NEJMoa1511160.

Chen, H. Y.; Baumgardner, D. J.; and Rice, J. P. (2011). Health-Related Quality of Life among Adults With Multiple Chronic Conditions in the United States, Behavioral Risk Factor Surveillance System, 2007. *Preventing Chronic Disease*, Vol. 8, pp. 1-9.

Clifford, E. L.; Collins, M. M.; Buckley, C. M.; Fitzgerald, A. P.; and Perry, I. J. (2013). Unhealthy Days and Quality of Life in Irish Patients with Diabetes. *PLoS ONE*, Vol. 8 (12): e81102. Doi:10.1371/journal.pone.0081102.

Degu, Hiwot; Wondimagegnehu, Abigiya; Yifru, Yared Mamushet; and Belachew, Ayele. (2019). Is Health Related Quality of Life Influenced by Diabetic Neuropathic Pain among Type II Diabetes Mellitus Patients in Ethiopia. *PLOS ONE*, Vol. 14 (2): e0211449. DOI: 10.1371/journal.pone.0211449.

del -Pino-Casado, Rafael; , Pedro A. Palomino-Moral, Pedro A.; del Mar Pastor-Bravo, Maria: and Frías-Osuna, Antonio. (2017). Determinants of Depression in Primary Caregivers of Disabled Older Relatives: a Path Analysis. *BMC Geriatrics*, Vol. 17 (274). DOI: 10.1186/s12877-017-0667-1.

Do, Elizabeth K.; Cohen, Steven A.; and Brown, Monique J. (2014). Socioeconomic and Demographic Factors Modify the Association between Informal Caregiving and Health in the Sandwich Generation. *BMC Public Health*, Vol. 14 (1): 362. DOI: 10.1186/1471-2458-14-362.

Evenson, K.R. and McGinn, A.P. (2005). Test-Retest Reliability of Adults Surveillance Measures for Physical Activity and Inactivity. *American Journal of Preventive Medicine*, Vol. 28 (5), pp. 470-478. DOI: 10.1016/j.amepre.2005.02.005.

Fauth, Elizabeth; Hess, Kyle; Piercy, Kathy; Norton, Maria; Corcoran, Chris; Rabins, Peter; Lyketsos, Constantine; and Tschanz, JoAnn. (2012). Caregivers' Relationship Closeness with the Person with Dementia Predicts Both Positive and Negative Outcomes for Caregivers' Physical Health and Psychological Well-being. *Aging & Mental Health*, Vol. 16 (6), pp. 699–711. DOI: 10.1080/13607863.2012.678482.

Freedman, Vicki A. and Spillman, Brenda C. (2014). Disability and Care Needs among Older Americans. *The Milbank Quarterly*, Vol. 92 (3), pp. 509-541. DOI: 10.1111/1468-0009.12076.

Gandhi, P. K.; Gentry, W. M.; Kibert II, J. L.; Lee, E. Y.; Jordan, W.; Bottorff, M. B.; and Huang, I. C. (2015). The Relationship between Four Health-Related Quality-of-Life Indicators and Use of Mammography and Pap Test Screening in US Women. *Quality of Life Research*, Vol. 24 (9), pp. 2113-2128. DOI: 10.1007/s11136-015-0968-9.

Godfrey, Wesley B.; Yorgason, Jeremy B.; Zhang, Yue; Hicken, Bret L.; Chen, Wei; and Rupper, Randall W. (2018). Variability in Spousal Perceptions of Caregiving and Its Relationship to Older Caregiver Health Outcomes. *Journal of General Internal Medicine*, Vol. 33 (9), pp. 1504-1511. DOI: 10.1007/s11606-018-4408-8.

Goren, Amir; Montgomery, William; Kahle-Wrobleski, Kristin; Nakamura, Tomomi; and Ueda, Kaname. (2016). Impact of Caring for Persons with Alzheimer's Disease or Dementia on Caregivers' Health Outcomes: Findings from a Community Based Survey in Japan. *BMC Geriatrics*, Vol. 16 (1): 122. DOI: 10.1186/s12877-016-0298-y.

He, Daifeng and Mchenry, Peter. (2016). Does Formal Employment Reduce Informal Caregiving? *Health Economics*, Vol. 25, pp. 829-843. DOI: 10.1002/hec.3185.

Hessel, Philipp. (2016). Does Retirement (Really) Lead to Worse Health among European Men and Women Across All Educational Levels? *Social Science & Medicine*, Vol. 151, Issue C, pp.19-26. DOI: 10.1016/j.socscimed.2015.12.018.

Horner, Elizabeth Mokyr and Cullen, Mark R. (2016). The Impact of Retirement on Health: Quasi-Experimental Methods Using Administrative Data. *BMC Health Services Research*, Vol. 16:68, pp.1-9. DOI 10.1186/s12913-016-1318-5.

Janus, Alexander L and Doty, Pamela. (2018). Trends in Informal Care for Disabled Older Americans, 1982–2012. *Gerontologist*, Vol. 58 (5), pp. 863–871. DOI: 10.1093/geront/gnx076.

Jia, H. and Lubetkin, E. I. (2009). Time Trends and Seasonal Patterns of Health-Related Quality of Life Among U.S. Adults. *Public Health Report*, Vol. 124, pp. 692-701. DOI: 10.1177/003335490912400511.

Kapp, J. M.; Jackson-Thompson, J.; Petroski, G. F.; and Schootman, M. (2009). Reliability of Health-Related Quality of Life Indicators in Cancer Survivors from a Population-Based Sample, 2005, BRFSS. *Public Health*, Vol. 123 (4), pp. 321-325. DOI: 10.1016/j.puhe.2008.10.005.

Kershaw, Trace; Ellis, Katrina R.; Yoon, Hyojin; Schafenacker, Ann; Katapodi, Maria; and Northouse, Laurel. (2015). The Interdependence of Advanced Cancer Patients' and Their Family Caregivers' Mental Health, Physical Health, and Self-Efficacy Over Time. *Annals of Behavioral Medicine*, Vol. 49 (6), pp. 901-911. DOI: 10.1007/s12160-015-9743-y.

Lund, Line; Ross, Lone; Petersen, Morten Aagaard; and Groenvold, Mogens. (2015). The Interaction between Informal Cancer Caregivers and Health Care Professionals: a Survey of Caregivers' Experiences of Problems and Unmet Needs. *Support Care Cancer*, Vol. 23, pp. 1719–1733. DOI: 10.1007/s00520-014-2529-0.

Mahabaleshwarkar, R., Khanna, R., West Strum, D. & Yang, Y. (2013). Association between Health-Related Quality of Life and Colorectal Cancer Screening. *Population Health Management*, Vol. 16, pp. 178-189. DOI: 10.1089/pop.2012.0044.

Mesbah, Mounir. (2004). Measurement and Analysis of Health Related Quality of Life and Environment Data. *Environmetrics*, Vol. 15, pp. 471-481. DOI: 10.1002/env.680.

Montgomery, A.E.; Cutuli, J.J.; Evans-Chase, M.; Treglia, D.; and Culhane, D.P. (2013). Relationship among Adverse Childhood Experiences, History of Active Military Service, and Adult Outcomes: Homelessness, Mental Health, and Physical Health. *American Journal of Public Health*, Vol. 103 (Suppl. 2), pp. S262-S268. DOI: 10.2105/AJPH.2013.301474.

National Center for Health Statistics, Centers for Disease Control and Prevention. (2017). https://www.cdc.gov/nchs/data/hus/2017/015.pdf.

Northouse, Laurel L.; Katapodi, Maria C.; Song, Lixin Song; Zhang, Lingling; and Mood, Darlene W. (2010). Interventions with Family Caregivers of Cancer Patients: Meta-Analysis of Randomized Trials. *Cancer Journal for Clinicians*, Vol. 60 (5), pp. 317-339. DOI: 10.3322/caac.20081.

Pendergrass, Anna; Malnis, Cintia; Graf, Uta; Engel, Sabine Enge; and Graessel, Elmar. (2018). Screening for Caregivers at Risk: Extended Validation of the Short Version of the Burden Scale for Family Caregivers (BSFC-s) with a Valid Classification System for Caregivers Caring for an Older Person at Home. *BMC Health Services Research*, Vol. 18 (1): 229. DOI: 10.1186/s12913-018-3047-4.

Peng, Li-Min; Chiu, Yi-Chen; Liang, Jersey; and Chang, Ting Huan. (2018). Risky Wandering Behaviors of Persons with Dementia Predict Family Caregivers' Health Outcomes. *Aging & Mental Health*, Vol. 22 (12), pp. 1650-1657. DOI: 10.1080/13607863.2017.1387764.

Peterson, Kendra; Hahn, Howard; Lee, Amber J.; Madison, Catherine A.; and Atri Alireza. (2016). In the Information Age, Do Dementia Caregivers Get the Information They Need? Semi-Structured Interviews to Determine Informal Caregivers' Education Needs, Barriers, and Preferences. *BMC Geriatrics*, Vol. 16 (1): 164. DOI: 10.1186/s12877-016-0338-7.

Piazza-Gardner, Anna K. and Barry, Adam E. (2012). Examining Physical Activity Levels and Alcohol Consumption: Are People Who Drink More Active? *American journal of health promotion*, Vol.26 (3), p.e95-e104. DOI: 10.4278/ajhp.100929-LIT-328.

Roth, David L.; Fredman, Lisa; and Haley, William E. (2015). Informal Caregiving and Its Impact on Health: A Reappraisal from Population-Based Studies. *Gerontologist*, Vol. 55 (2), pp. 309-319. DOI: 10.1093/geront/gnu177.

Santino, Chelsey; Zeeshan, Muhammad; Hamidi, Mohammad; Hanna, Kamil; Saljuqi, Abdul Tawab; Kulvatunyou, Narong; Haddadin, Zaid; Northcutt, Ashley; and Joseph, Bellal. (2019). Prospective Evaluation of Health-Related Quality of Life in Geriatric Trauma Patients. *Surgery*, Vol. 166 (3), pp. 403-4-7. DOI: 10.1016/j.surg.2019.04.031.

Shai, Ori. (2018). Is Retirement Good for Men's health? Evidence Using a Change in the Retirement Age in Israel. *Journal of Health Economics*, Vol. 57, pp.15-30. DOI: 10.1016/j.jhealeco.2017.10.008.

Siddiqui, Salma and Khalid, Javeria. (2019). Determining the Caregivers' Burden in Caregivers of Patients with Mental Illness. *Pakistan Journal of Medical Sciences*, Vol. 35 (5), pp. 1329-1333. DOI: 10.12669/pjms.35.5.720.

Simms, K.; Hacker, D.S.; Parker, A.J.; Figuereo, M.E.; and Bock, S. (2013). Do Past or Present Adverse Relationship Experiences Have Greater Impact on Mental and Physical Health? *Advances in Mental Health*, Vol. 11(2), pp. 122-130. https://doi.org/10.5172/jamh.2013.11.2.122.

Son, Chong-Hwan. (2020). The Effects of Retirement on Health-Related Quality of Life of Retirement-Aged Adults for Four Marital Status Subgroups. *International Journal of Economic Sciences*, Vol. IX (1), pp. 179-201. DOI: 10.20472/ES.2020.9.1.010.

Son, Chong-Hwan. (2018). Health-Related Quality of Life in Consequences from Frequency-Quantity Measures of Alcohol Consumption Patterns. *International Journal of Happiness and Development*, Vol. 4 (3), pp.236-260. DOI: 10.1504/IJHD.2018.093729.

Son, Chong-Hwan. (2016). The Effect of Adverse Childhood Experiences on Self-Reported Physical and Mental Health Outcomes in Adulthood. *Journal of Economics and Behavioral Studies*, Vol. 8 (3), pp.101-114. DOI: 10.22610/jebs.v8i3(J).1292.

Son, C.H. and Lee, D.H. (2014). The Effects of Alcohol Consumption Patterns on Cardiovascular Disease: An Empirical Study with Behavioral Risk Factor Surveillance System Data. *The Empirical Economics Letters*, Vol. 13 (7), pp. 723-730.

Zhu, Rong. (2016). Retirement and Its Consequences for Women's Health in Australia. *Social Science & Medicine*, Vol. 163 (Aug.), pp.117-125. DOI: 10.1016/j.socscimed.2016.04.003.