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Depressive symptoms in caregivers immediately after stroke

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Abstract

Background: Caregivers of stroke survivors often suffer depressive symptoms that interfere with their own health. Early recognition may lead to attenuation of symptoms and better health and well-being for caregivers.

Purpose: We examined characteristics of caregivers and stroke survivors associated with caregivers' depressive symptoms in the early poststroke period.

Methods: We conducted a prospective, longitudinal exploratory observational study with a convenience sample of 63 caregivers of older adult (> 65 years) stroke survivors recruited from urban acute-care settings. We enrolled caregivers by 2 weeks poststroke (T1) and revisited them 4 weeks later (T2). Depressive symptoms were measured using the Patient Health Questionnaire-9. A separate unadjusted linear mixed model was computed to explore significant associations between each caregiver or stroke-survivor characteristic and depressive symptoms.

Results: Caregivers, on average, reported mild depressive symptoms at T1 and T2. Each of the following characteristics was independently associated with caregiver depressive symptoms over the first 6 weeks poststroke: caregiver uncertainty ($p < 0.001$), perceived stress ($p < 0.001$) but not cortisol levels ($p = 0.858$ on waking, $p = 0.231$ evening), coping ($p < 0.001$), social support ($p = 0.006$), race ($p = 0.022$), income ($p = 0.001$), time spent on care ($p = 0.039$), and stroke-survivor race ($p = 0.033$) and functional status ($p = 0.003$). At T2, caregiver depressive symptoms were correlated with evening cortisol level ($p = 0.001$).

Conclusions: Caregiver and stroke-survivor characteristics may help identify caregivers at highest risk for early depressive symptoms and guide interventions aimed at their resolution.

Keywords

Caregivers; Coping; Cortisol; depression; Depressive Symptoms; stroke; Stress; Uncertainty

Introduction

A recent meta-analysis suggested that approximately 40% of caregivers of stroke survivors experience depressive symptoms.¹ Others reported that the depressive symptoms were moderately intense in 18% of these caregivers.² Depressive symptoms have been associated with lower quality of life in caregivers of stroke survivors³ and those with depressive symptoms experience difficulty with caregiving tasks (e.g., assisting with mobility).⁴

Stroke is a sudden catastrophic change for stroke survivors and their caregivers alike. The need to assume a new role as informal caregiver in a relatively short period of time after a sudden, unexpected illness event such as stroke may precipitate or exacerbate depressive symptoms in the early poststroke period, leaving caregivers at high risk for developing untoward health outcomes. Several factors influencing depressive symptoms in this population have been identified in the extant literature. Severity of stroke and older age of the stroke survivor,⁵ female caregiver gender, caregiver race, relationship to the stroke survivor,¹ hours spent daily providing care,⁶ and younger age of the caregiver⁷ were associated with depression in caregivers of stroke survivors. Caregivers who reported greater satisfaction with social support had less depression and better general health over the first 3 months poststroke.⁸ Depression in caregivers of stroke survivors was also predicted by less perceived availability of social support, level of physical functioning of caregivers and low life satisfaction.⁹

Depression in caregivers for hospitalized stroke survivors was associated with family functioning, activities of daily living, education and recurrent stroke¹⁰ and reported to have decreased over 9 months post-stroke.¹¹ One factor thought to be protective is a sense of coherence, defined as “the global orientation that expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that (1) the stimuli deriving from one’s internal and external environments in the course of living are structured, predictable, and explicable; (2) the resources are available to one to meet the demands posed by these stimuli; and (3) these demands are challenges, worthy of investment and engagement”¹², p.19. A high sense of coherence at 1 month poststroke predicted less depressive symptoms at 12 months poststroke,⁶ underscoring the importance of understanding factors associated with depressive symptoms in the early poststroke period. Without this knowledge, the ability to develop strategies to assess and manage depressive symptoms is limited.

In caregivers of stroke survivors, significant stress was reported within the first year poststroke.¹³ Caregivers’ perceived stress includes “domestic upset, negative feelings toward the patient and personal distress in relation to the patient.”¹⁴, p.124. Salivary cortisol has been measured to assess stress in caregivers, especially those caring for dementia patients; these caregivers have an increase in cortisol levels when compared to non-caregivers.¹⁵⁻¹⁸ Stroke-survivor caregivers with depression have been shown to have lower salivary cortisol levels

across the day than caregivers without depression.⁷ Physiological stress in the early poststroke period has not been well studied in caregivers for stroke survivors who may have experienced stress or depressive symptoms. Thus, we included both physiologic and self-reported (perceived) stress measures in this exploratory study.

In addition to factors related to depression in the current literature as described above, the caregiver coping model developed by Schulz et al.¹⁹ and the model of perceived uncertainty in illness by Mishel²⁰ suggested the majority of variables used in this study. The caregiver coping model identifies five categories of variables: (a) objective conditions conducive to stress (e.g., functional status, patient affective state, other manifestations of disability, prognosis, etc.), (b) individual perceptions of stress or burden, (c) short-term responses to stress, (d) enduring outcomes of perceived stress (e.g., psychological well-being, life satisfaction, depression, and physical well-being) and (e) individual and situational condition variables (e.g., health, income, social support, satisfaction with social contacts, coping strategies, etc.) that influence the relations among the other categories.¹⁹ Mishel's model explains that uncertainty occurs when decision makers cannot define meaning for illness-related events, predict what will happen next or predict the consequences from the event).²¹

The early weeks poststroke likely present an important window to support healthy outcomes for caregivers.⁶ If healthcare providers understand the characteristics associated with depressive symptoms in the early poststroke period we will be better prepared to identify caregivers at risk and design interventions targeting those most likely to benefit. Thus, the purpose of this study was to explore characteristics of caregivers and stroke survivors associated with caregiver depressive symptoms in the early weeks following a family member's stroke. We hypothesized that caregiver's psychosocial (uncertainty, perceived stress, coping capacity, and social support), physiological (cortisol) and physical (chronic illness) characteristics, stroke survivor's functional status and clinical characteristics, and sociodemographic characteristics of both the caregiver and the stroke survivor would be associated with early onset depressive symptoms in caregivers.

Methods

We conducted a prospective, longitudinal, exploratory observational study using a convenience sample of caregivers. Following institutional review board approval, the research team, including the principal investigator and research assistants, recruited caregivers from acute-care settings in two academic health-science centers in Philadelphia, Pennsylvania. We enrolled caregivers at the hospital within the first 2 weeks following their relatives' stroke (baseline: T1) and revisited them 4 weeks later (~6 weeks poststroke: T2). We expected that by 6 weeks poststroke, stroke survivors would be discharged to home, rehabilitation hospitals or nursing homes where they would continue to recover over time and that caregivers would be more involved in direct care for their relatives than at Time 1. Assessing depression and other caregiver (e.g., uncertainty, coping capacity) and stroke survivor (i.e., functional status) characteristics measured at both time points without any intervention allows us to observe whether depression and these selected characteristics change naturally over time during the early poststroke period. This study conforms to the STROBE Guidelines.

Sample

We included caregivers if they (a) self-identified as a family member and the expected primary caregiver for an older adult (age 65 or older) who had been diagnosed within the past 2 weeks with new or recurrent ischemic or hemorrhagic stroke, (b) communicated in English, (c) demonstrated capacity for informed consent, and (d) were 21 years of age or older. To collect relevant health information, we also reviewed medical records of stroke survivors after we obtained informed consent and Health Insurance Portability and Accountability Act of 1996 authorization from stroke survivors or their surrogates, depending on the decisional capacity of the stroke survivor.

Study Variables and Instruments

Depressive symptoms.—The Patient Health Questionnaire (PHQ-9) is a 9-item scale used as a diagnostic screening measure for major and minor depression.²² This scale assesses the frequency of symptoms such as disinterest, low mood, and sleep disruption or tiredness over the past 2 weeks, and each item scores from 0 (Not at all) to 3 (Nearly every day). Total scores range between 0 and 27; severity of depression can be described as none (score 1 to 4), mild (5 to 9), moderate (10 to 14), moderately severe (15 to 19) and severe (20 to 27).²² Reliability assessed with Cronbach's alpha was estimated at .84 at T1 and .89 at T2.

Caregiver Characteristics

Uncertainty.—Uncertainty was measured using the 31-item Mishel Uncertainty in Illness Scale for Family Members.²³ Items capture uncertainty defined as a caregiver's inability to determine the meaning of illness-related events (Mishel, 1997a). Each item is scored on a scale of 1 (*strongly disagree*) to 5 (*strongly agree*). Total sum scores range from 31 to 155; higher scores indicate greater uncertainty. In our study, Cronbach's alpha was .92 at T1 and .95 at T2.

Stress.—Perceived stress was measured by the Perceived Stress Scale,²⁴ which includes 14 items designed to assess symptoms of stress and global measures of the degree of stress experienced in “the last month, including today.” In our study, the time parameter was modified to ask about stress experienced “in the past day” (24 hours) because at T1, “the last month” would have preceded the relative's stroke. Each item was scored from 0 (*never*) to 4 (*very often*) with total sum scores ranging from 0 to 56; higher scores indicated higher perceived stress. Cronbach's alpha in our study was .86 at T1 and .88 at T2.

Physiological stress was measured by salivary cortisol, which assesses the variation in endocrine activity and response to acute stress.²⁵ One advantage of using salivary cortisol is that one can measure the free unbound fraction of cortisol because it is the last output of the HPA axis that remains high in acute stress with a disruption of circadian rhythms.^{25, 26} Cortisol levels follow a circadian rhythm²⁷ and the concentration is higher in the early morning and lower at night.²⁸ To capture diurnal variations in cortisol concentration in this study, caregivers self-collected saliva using Salimetrics oral swabs on waking and again at 2100 h.²⁹ Caregivers were instructed not to eat food, drink liquid, or brush teeth for 30 minutes before collecting saliva, and not to smoke for 60 minutes before collecting saliva.

An inter-assay coefficient of variation was 6.56% and intra-assay coefficient of variation was 4.61%, indicating good precision, and the minimal detection limit distinguishable from 0 was 0.010 µg/dL.

Coping capacity.—We used a 13-item short-form version of the Sense of Coherence tool¹² to measure how well caregivers coped with stress associated with caregiving. Each item is scored from 1 (*never*) to 7 (*very often*), with total scores ranging from 13 to 91; higher scores indicate better coping capacity. Cronbach's alpha was .81 at T1 and .83 at T2.

Social support.—Social support was measured using the Multidimensional Scale of Perceived Social Support.³⁰ The scale includes 12 items designed to assess perceptions about support from family, friends, and a significant other. Responses range from 1 (*very strongly disagree*) to 7 (*very strongly agree*) and higher scores indicate better levels of perceived social support. Cronbach's alpha reliability scores were .94 at each time point.

Chronic illnesses.—We used a previously established modified version of the Cumulative Illness Rating Scale (CIRS)³¹ to measure the presence of coexisting chronic illnesses in caregivers. Total scores range from 0 (*no impairment*) to 56 (*maximal impairment*) across 14 systems. Scoring of each system followed the guidelines proposed by Hudon et al. (2005).³² A study interviewing patients in a family practice to evaluate multimorbidity reported intraclass correlation coefficients for estimating interrater reliability of 0.81 (95% CI, 0.70–0.89).³²

Sociodemographic characteristics.—These included age, sex, race/ethnicity, household income, and questions about relationships and other major life events (e.g., death, moving, retirement or marriage). We asked participants to rate their household income as (1) comfortable, have more than enough to make ends meet; (2) adequate, have enough to make ends meet; or (3) do not have enough to make ends meet.

Stroke-Survivor Characteristics

Functional status.—We measured caregiver perceptions of the survivor's ability to perform activities of daily living using the Barthel Index.³³ The scale has 10 items; each was scored from either 0 to 5, 0 to 10 or 0 to 15. Total scores range from 0 to 100 with higher scores indicating independence from any help. In our study, Cronbach's alpha was .94 at both T1 and T2.

Sociodemographic and Clinical Characteristics.—At T1, we collected sociodemographic characteristics. At T2, we identified the site of current placement (e.g., rehabilitation hospital) of the stroke survivor. Other clinical characteristics at T1 included severity of stroke (the NIH Stroke Scale, Cronbach's alpha: 0.88) and description of stroke (type, area, presence of communication disability, and days poststroke). As with caregivers, the CIRS measured chronic illnesses in stroke survivors at T1.

Statistical Analysis

We described depressive symptoms, uncertainty, perceived stress, salivary cortisol, coping capacity, social support, chronic illnesses, and sociodemographic and stroke-related data (mean, standard deviation, and frequencies). We used paired *t*-tests (for continuous variables) and McNemar tests (for categorical variables) to explore any changes over time in study variables measured at both time points. We estimated correlations among caregiver of stroke-survivor characteristics and depressive symptoms at T1 and T2 using Spearman's correlation coefficients. Given the large number of variables available and limited sample size, we computed a separate unadjusted linear mixed model to examine the relationship between each caregiver or stroke-survivor characteristic and repeated measures of depressive symptoms (overall depressive symptoms) without adjustment for other variables, using full maximum likelihood with random intercept at Level 2. Each independent variable was either time-varying (values for variables measured at both time points, e.g., coping capacity) or fixed (values for variables measured only at baseline, e.g., gender). Each model included one independent variable (e.g., age or coping capacity) and time variable (time points T1 and T2) to determine which caregiver or stroke-survivor characteristic was independently associated with depressive symptoms. For all analyses, a *p*-value of less than 0.05 in a two-sided test was considered statistically significant. Analyses were done using SPSS 22 for Windows and Stata 13.

Results

We enrolled 63 caregivers and reviewed their stroke-survivor relatives' medical records for stroke severity and description. By T2, however, 13 stroke survivors had died; additionally, three caregivers withdrew from the study and seven more were lost to follow up. With the exception of social support and race, there were no statistically significant differences in baseline characteristics between participants who completed and those who did not complete the study. Participants who did not complete the study had more social support at baseline (*p* = 0.036) and were more likely to be of the non-Hispanic White race (*p* = 0.018 for caregivers, *p* = 0.009 for stroke survivors).

The main reason given for declining to participate in the study was "feeling overwhelmed with their current situation." A total of 40 caregivers completed the measures at T2. Table 1 summarizes caregiver and stroke-survivor sociodemographic and stroke-related characteristics. Ages of the caregivers ranged from 30 to 89; one third of caregivers were 65 or older. Only 8% of caregivers were taking antidepressant medications at T1. Ages of the stroke survivors ranged from 65 to 95 years. At T2, a large proportion (42.5%, *n*=17) of stroke survivors were at home (vs. 27.5% at a rehabilitation hospital, 12.5% at a nursing facility, and 17.5% at another place or still hospitalized).

Table 2 summarizes the descriptive analysis and comparison of variables measured at both time points. Depressive symptoms did not change between measurements at 2 weeks and 6 weeks poststroke. Overall, caregivers' depressive symptoms remained low: T1 (6.67 ± 5.55) and T2 (6.60 ± 5.96). More than half (57%) of the caregivers in this study had at least mild depressive symptoms during the early phases of initiating the caregiver role, and 6 weeks after stroke, 47% continued to have depressive symptoms. Notably, about 30% had at least

moderate depressive symptoms at both time points (moderate: 19% at T1 and 15% at T2, moderate-to-severe: 6% at T1 and 13% at T2, and severe depressive symptoms: 3% at T1 and 3% at T2). Functional status of stroke survivors was better at T2, and compared to T1, caregivers at T2 reported better coping capacity, less social support and higher levels of chronic illness.

The supplemental table reports correlations among caregiver of stroke-survivor characteristics and depressive symptoms at T1 and T2. At T1, depressive symptoms were not correlated with salivary cortisol levels on waking ($\rho = 0.125$, $p = 0.356$) or in the evening ($\rho = 0.008$, $p = 0.955$). At T2, however, greater depressive symptoms were correlated with elevated salivary-cortisol level in the evening ($\rho = 0.502$, $p = 0.001$) but not with the levels on waking ($\rho = -0.207$, $p = 0.213$).

Characteristics Associated with Depressive symptoms

Table 3 presents an unadjusted linear mixed model that examined the association between a caregiver or stroke-survivor characteristic and repeated measures of depressive symptoms. Since this is an exploratory study, we tested an unadjusted linear mixed model with 34 caregiver and stroke-survivor characteristics (e.g., age, coping capacity), but here we report only those with significant associations. In separate models, each of the following characteristics was independently associated with more depressive symptoms across the first 6 weeks poststroke: caregiver uncertainty ($p < 0.001$), perceived stress ($p < 0.001$) but not cortisol ($p = 0.858$ on waking, $p = 0.231$ evening), coping ($p < 0.001$), social support ($p = 0.006$), race ($p = 0.022$), income ($p = 0.001$), time spent in caregiving ($p = 0.039$), and stroke-survivor race ($p = 0.033$) and functional status ($p = 0.003$). The use of antidepressants was not associated with depressive symptoms ($p = 0.80$).

Discussion

The major finding from this study was that depressive symptoms were evident in more than half of all caregivers and these symptoms changed little over the first 6 weeks following their relatives' stroke. In addition, approximately 30% had at least moderate depressive symptoms at baseline and follow-up. Further, the proportion of caregivers with depressive symptoms at 6 weeks may under-represent the extent of the problem, considering that some caregivers dropped out of the study. These may have been those experiencing the most problems in adjusting to the new caregiver role. Caregiver uncertainty, perceived stress but not cortisol, coping, social support, race, income, time spent in caregiving, and stroke-survivor functional status were independently associated with depressive symptoms. By 6 weeks poststroke, depressive symptoms were correlated with evening cortisol level.

Depressive symptoms in these caregivers were common, even in the early weeks of caregiving. The finding of at least modest levels of depressive symptoms in 30% of caregivers is notably higher than the 18% of caregivers with moderate, moderate-to-severe, or severe depressive symptoms at 1 and 4 months poststroke reported by Bakas et al. (2006).² The early days and weeks of caregiving may present the caregiver with new physical and emotional challenges.³⁴ Long-term health in caregivers of stroke survivors is related to caregivers' capacity for successful coping in their caregiving situation.^{6, 35} In chronic illness

such as heart failure and diabetes mellitus, depression is a risk factor for long term mortality.^{36, 37} Caregivers are also at high risk for developing depression¹ and chronic illnesses such as coronary heart disease.³⁸ Thus, assessing and treating caregivers' early poststroke period depressive symptoms are particularly important. In this study, about half of caregivers showed no depressive symptoms. Possibly these caregivers had coped well with their caregiving situation, as positive aspects of caregiving (e.g., sense of coherence) that protect against depression in caregivers of stroke survivors have also been reported.⁶

The finding of a significant effect of uncertainty on depressive symptoms is consistent with earlier findings of a correlation between uncertainty and depression in caregivers for people with Parkinson's disease.³⁹ In patients with multiple sclerosis, uncertainty about the illness was an important mediator of the relationship between the present state of the illness and depression.⁴⁰ We also found that caregiver coping capacity was associated with depressive symptoms and this finding supported others' previous findings.^{6, 41} Chumbler et al. (2008) reported that higher coping capacity was associated with lower levels of depression in caregivers of stroke survivors across 2 years of follow-up.⁴¹

Caregiver perceived stress, income, social support, and stroke-survivor functional status were each associated with depressive symptoms. Some of these variables -- uncertainty, caregiver income, coping capacity, social support, number of close friends and relatives, stroke survivor gender, income, insurance, and functional status -- are among those we previously reported as independently associated with perceived stress in caregivers of stroke survivors.⁴² Caregivers of stroke survivors may experience stress because they are uncertain of the extent to which stroke survivors will worsen or recover, how involved they will need to be in longer term care, and the commensurate impacts on employment, economics, family life, and so on.³⁴ It is notable that a large proportion of stroke survivors were at home by 6 weeks poststroke. By 6 weeks poststroke, however, stroke survivor placement location was not associated with depressive symptoms ($F = 1.611$, $p = 0.204$), despite the differences in survivor functional status (a characteristic associated with depressive symptoms) across post-discharge location. Caregivers for stroke survivors at home may have been more involved in direct care. In our study, better functional status of stroke survivors at home vs. other facilities ($F = 19.729$, $p < 0.001$) was revealed, which may have offset depressive symptoms in caregivers for stroke survivors at home.

Receptor-mediated actions of cortisol cause immunosuppressive and anti-inflammatory effects on target immune tissues and cells,⁴³ and the immune system is known to be suppressed in other caregiver groups, e.g. those of dementia patients.⁴⁴ In our study, physiological stress measured by salivary cortisol was not associated with repeated measures (overall) of depressive symptoms; at 6 weeks poststroke, however, having more depressive symptoms was correlated with elevated salivary-cortisol level in the evening, but not with the levels on waking at either time period. Saban et al. (2012) reported that salivary-cortisol levels were lower across the day in caregivers with higher depressive-symptom scores when compared to caregivers with lower scores.⁷ Another study reported that patients with relapsed major depression had higher cortisol levels than patients in stable remission.⁴⁵ The present study measured salivary-cortisol levels at two time points during the first 6 weeks of caregiving, whereas Saban et al. (2012)⁷ measured them at approximately 8 months of

caregiving. It is possible that when caregivers initially are exposed to stressors, e.g., within 2 weeks poststroke, their physiologic homeostasis may have been maintained, thus, explaining these differences. By 6 weeks poststroke, however, stressors may have induced an increase in hypothalamic-pituitary-adrenal (HPA)-axis activity, which may be related to the relationship between depressive symptoms and elevated salivary cortisol levels. By 8 months poststroke, however, HPA-axis activity may have decreased or over adjusted, resulting in lower levels of cortisol.^{46, 47} In a few of our study participants, salivary-cortisol levels were similar between waking and evening periods. A possible interpretation for these flatter salivary slope patterns could also be depression.⁴⁸ Further investigation is required to verify whether, over time, cortisol levels increase, similar to those in caregivers for patients with dementia,¹⁵⁻¹⁸ or diminish, similar to those in the previous study of caregivers for stroke survivors.⁷

Implications for Clinical Practice

It is important for health care providers to assess caregiver depressive symptoms in the early period of caregiving and provide additional support for at-risk caregivers. Initiating caregiver interventions, such as psychoeducation,⁴⁹ in the early period of caregiving may lead to decreased depressive symptoms. Spousal caregivers of stroke survivors who reframed their situation and prepared for caregiving had lower stress throughout the year after discharge.¹³ Involvement in discharge planning, especially for stroke survivors who will be discharged directly home, could immeasurably help caregivers adjust to their new caregiver role, increase preparedness for caregiving and reduce their depressive symptoms.

Study Strengths and Limitations

Strengths include a prospective longitudinal design that captured depressive symptoms at two time points: within 2 weeks poststroke and again at 6 weeks poststroke, the early time period when little is known about caregiving. As there was no intervention for caregivers between baseline and 6 weeks poststroke, we observed the “natural history” of depressive symptoms over time. Limitations of this study include limited generalizability due to convenience sampling from a single geographic region. Additionally, caregivers in this study were generally well educated and the majority of both caregivers and stroke survivors had health insurance. These factors limit the application of the findings to the general population. Caregivers who withdrew from the study or were lost to follow up at 6 weeks poststroke, however, may have had more caregiving responsibilities and depressive symptoms. The sample size in our study was relatively small, and caregiver or stroke-survivor characteristics were not controlled in a single linear mixed model. Instead, we computed multiple unadjusted linear mixed models; thus, there is a possibility of type 1 error in this study. As a first step, however, exploring changes in depression over time and related factors influencing depressive symptoms adds to the current literature. Replication studies are required that use a larger sample size in which caregiver or stroke survivor characteristics can be successfully controlled. The time period for follow up was limited. Extending the follow-up period to include multiple time points over a longer period of time after caregivers assume their caregiver role is required to determine its effect on long-term health outcomes. Our findings are also based on associations rather than demonstrating causal relationships.

Importantly, approximately half of these caregivers of stroke survivors reported at least mild levels of depressive symptoms within the first 6 weeks following their relatives' stroke. Caregiver and stroke-survivor characteristics confirmed in our study may help identify caregivers at highest risk for early depressive symptoms, likely those who may benefit from early detection and intervention. Given their high prevalence in caregivers of stroke survivors, timely intervention aimed at resolving depressive symptoms early in the caregiving period may prevent related negative health sequelae and improve quality of life in caregivers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Loh AZ, Tan JS, Zhang MW, Ho RC. The Global Prevalence of Anxiety and Depressive Symptoms Among Caregivers of Stroke Survivors. *J Am Med Dir Assoc.* 2017;18(2):111–6. [PubMed: 27742585]
2. Bakas T, Kroenke K, Plue LD, Perkins SM, Williams LS. Outcomes among family caregivers of aphasic versus nonaphasic stroke survivors. *Rehabil Nurs.* 2006;31(1):33–42. [PubMed: 16422043]
3. Opara JA, Jaracz K. Quality of life of post-stroke patients and their caregivers. *J Med Life.* 2010;3(3):216–20. [PubMed: 20945810]
4. McLennon SM, Bakas T, Jessup NM, Habermann B, Weaver MT. Task difficulty and life changes among stroke family caregivers: relationship to depressive symptoms. *Arch Phys Med Rehabil.* 2014;95(12):2484–90. [PubMed: 24858447]
5. Berg A, Palomaki H, Lonnqvist J, Lehtihalmes M, Kaste M. Depression among caregivers of stroke survivors. *Stroke.* 2005;36(3):639–43. [PubMed: 15677575]
6. Van Puymbroeck M, Hinojosa MS, Rittman MR. Influence of sense of coherence on caregiver burden and depressive symptoms at 12 months poststroke. *Top Stroke Rehabil.* 2008;15(3):272–82. [PubMed: 18647731]
7. Saban KL, Mathews HL, Bryant FB, O'Brien TE, Janusek LW. Depressive symptoms and diurnal salivary cortisol patterns among female caregivers of stroke survivors. *Biol Res Nurs.* 2012;14(4):396–404. [PubMed: 22531368]
8. Grant JS, Elliott TR, Weaver M, Glandon GL, Raper JL, Giger JN. Social support, social problem-solving abilities, and adjustment of family caregivers of stroke survivors. *Arch Phys Med Rehabil.* 2006;87(3):343–50. [PubMed: 16500167]
9. Grant JS, Bartolucci AA, Elliot TR, Giger JN. Sociodemographic, physical, and psychosocial characteristics of depressed and non-depressed family caregivers of stroke survivors. *Brain Inj.* 2000;14(12):1089–100. [PubMed: 11147581]
10. Guo Y, Liu Y. Family functioning and depression in primary caregivers of stroke patients in China. *Int J Nurs Sci.* 2015;2(2):184–9.
11. Pucciarelli G, Ausili D, Galbusera AA, Rebora P, Savini S, Simeone S, Alvaro R, Vellone E. Quality of life, anxiety, depression and burden among stroke caregivers: A longitudinal, observational multicentre study. *J Adv Nurs.* 2018.

12. Antonovsky A *Unraveling the mystery of health: How people manage stress and stay well*: San Francisco, CA: Jossey-Bass.; 1987.
13. Ostwald SK, Bernal MP, Cron SG, Godwin KM. Stress experienced by stroke survivors and spousal caregivers during the first year after discharge from inpatient rehabilitation. *Top Stroke Rehabil.* 2009;16(2):93–104. [PubMed: 19581196]
14. Draper B, Bowring G, Thompson C, Van Heyst J, Conroy P, Thompson J. Stress in caregivers of aphasic stroke patients: a randomized controlled trial. *Clin Rehabil.* 2007;21(2):122–30. [PubMed: 17264106]
15. Bauer ME, Vedhara K, Perks P, Wilcock GK, Lightman SL, Shanks N. Chronic stress in caregivers of dementia patients is associated with reduced lymphocyte sensitivity to glucocorticoids. *J Neuroimmunol.* 2000;103(1):84–92. [PubMed: 10674993]
16. Da Roza Davis JM, Cowen PJ. Biochemical stress of caring.[Erratum appears in *Psychol Med* 2002 Oct;32(7):1327]. *Psychol Med.* 2001;31(8):1475–8. [PubMed: 11722162]
17. de Vugt ME, Nicolson NA, Aalten P, Lousberg R, Jolle J, Verhey FRJ. Behavioral problems in dementia patients and salivary cortisol patterns in caregivers. *J Neuropsychiatry Clin Neurosci.* 2005;17(2):201–7. [PubMed: 15939974]
18. Vedhara K, Cox NK, Wilcock GK, Perks P, Hunt M, Anderson S, Lightman SL, Shanks NM. Chronic stress in elderly carers of dementia patients and antibody response to influenza vaccination. *Lancet.* 1999;353(9153):627–31. [PubMed: 10030328]
19. Schulz R, Tompkins CA, Rau MT. A longitudinal study of the psychosocial impact of stroke on primary support persons. *Psychol Aging.* 1988;3(2):131–41. [PubMed: 3268251]
20. Mishel MH. Uncertainty in illness. *J Nurs Sch.* 1988;20(4):225–32.
21. Mishel MH. The measurement of uncertainty in illness. *Nurs Res.* 1981;30(5):258–63. [PubMed: 6912987]
22. Kroenke K, Spitzer RL. The PHQ-9: A new depression diagnostic and severity measure. *Psychiatr Ann.* 2002;32(9):509–15.
23. Mishel MH. *Uncertainty in illness scales manual*. Chapel Hill, NJ: University of North Carolina; 1997.
24. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* 1983;24(4):385–96. [PubMed: 6668417]
25. Feve-Montange M, Van Cauter E, Refetoff S, Desir D, Tourniaire J, Copinschi G. Effects of “jet lag” on hormonal patterns. II. Adaptation of melatonin circadian periodicity. *J Clin Endocrinol Metab.* 1981;52(4):642–9. [PubMed: 7204537]
26. Hellhammer DH, Wust S, Kudielka BM. Salivary cortisol as a biomarker in stress research. *Psychoneuroendocrinology.* 2009;34(2):163–71. [PubMed: 19095358]
27. Preville M, Zarit S, Susman E, Boulenger P, Lehoux R. Response variability of salivary cortisol among older adults under psychological stress. *Aging Ment Health.* 2008;12(2):249–57. [PubMed: 18389406]
28. Chernow B, Alexander HR, Smallridge RC, Thompson WR, Cook D, Beardsley D, Fink MP, Lake CR, Fletcher JR. Hormonal responses to graded surgical stress. *Arch Intern Med.* 1987;147(7):1273–8. [PubMed: 3606284]
29. McCallum TJ, Sorocco KH, Fritsch T, Sorocco KH, Fritsch T. Mental health and diurnal salivary cortisol patterns among African American and European American female dementia family caregivers. *Am J Geriatr Psychiatry.* 2006;14(8):684–93. [PubMed: 16861373]
30. Zimet GD, Dahlem NW, Zimet SG, Farley GK. The Multidimensional Scale of Perceived Social Support. *J Pers Assess.* 1988;52(1):30–41.
31. Miller MD, Paradis CF, Houck PR, Mazumdar S, Stack JA, Rifai AH, Mulsant B, Reynolds CF 3rd. Rating chronic medical illness burden in geropsychiatric practice and research: application of the Cumulative Illness Rating Scale. *Psychiatr Res.* 1992;41(3):237–48.
32. Hudon C, Fortin M, Vanasse A. Cumulative Illness Rating Scale was a reliable and valid index in a family practice context. *J Clin Epidemiol.* 2005;58(6):603–8. [PubMed: 15878474]
33. Mahoney FI, Barthel DW. FUNCTIONAL EVALUATION: THE BARTHEL INDEX. *Md State Med J.* 1965;14:61–5.

34. Byun E, Riegel B, Sommers M, Tkacs N, Evans L. Caregiving Immediately After Stroke: A Study of Uncertainty in Caregivers of Older Adults. *J Neurosci Nurs*. 2016;48(6):343–51. [PubMed: 27824803]
35. Haley WE, Roth DL, Hovater M, Clay OJ. Long-term impact of stroke on family caregiver well-being: a population-based case-control study. *Neurology*. 2015;84(13):1323–9. [PubMed: 25740862]
36. Martin-Subero M, Kroenke K, Diez-Quevedo C, Rangil T, de Antonio M, Morillas RM, Loran ME, Mateu C, Lupon J, Planas R, Navarro R. Depression as Measured by PHQ-9 Versus Clinical Diagnosis as an Independent Predictor of Long-Term Mortality in a Prospective Cohort of Medical Inpatients. *Psychosom Med*. 2017;79(3):273–82. [PubMed: 27606795]
37. Fan H, Yu W, Zhang Q, Cao H, Li J, Wang J, Shao Y, Hu X. Depression after heart failure and risk of cardiovascular and all-cause mortality: a meta-analysis. *Prev Med*. 2014;63:36–42. [PubMed: 24632228]
38. Lee S, Colditz GA, Berkman LF, Kawachi I. Caregiving and risk of coronary heart disease in U.S. women: a prospective study. *Am J Prev Med*. 2003;24(2):113–9. [PubMed: 12568816]
39. Sanders-Dewey NEJ, Mullins LL, Chaney JM. Coping style, perceived uncertainty in illness, and distress in individuals with Parkinson's disease and their caregivers. *Rehabil Psychol*. 2001;46(4):363–81.
40. Kroencke DC, Denney DR, Lynch SG. Depression during exacerbations in multiple sclerosis: the importance of uncertainty. *Mult Scler*. 2001;7(4):237–42. [PubMed: 11548983]
41. Chumbler NR, Rittman MR, Wu SS. Associations in sense of coherence and depression in caregivers of stroke survivors across 2 years. *J Behav Health Serv Res*. 2008;35(2):226–34. [PubMed: 17849188]
42. Byun E, Riegel B, Sommers M, Tkacs N, Evans L. Effects of Uncertainty on Perceived and Physiological Stress in Caregivers of Stroke Survivors: A 6-Week Longitudinal Study. *J Gerontol Nurs*. 2017;43(11):30–40. [PubMed: 28661542]
43. Elenkov IJ, Webster EL, Torpy DJ, Chrousos GP. Stress, corticotropin-releasing hormone, glucocorticoids, and the immune/inflammatory response: acute and chronic effects. *Ann N Y Acad Sci*. 1999;876:1–11. [PubMed: 10415589]
44. Vitaliano PP, Zhang J, Scanlan JM. Is caregiving hazardous to one's physical health? A meta-analysis. *Psychol Bull*. 2003;129(6):946–72. [PubMed: 14599289]
45. Zobel AW, Nickel T, Sonntag A, Uhr M, Holsboer F, Ising M. Cortisol response in the combined dexamethasone/CRH test as predictor of relapse in patients with remitted depression. a prospective study. *J Psychiatr Res*. 2001;35(2):83–94. [PubMed: 11377437]
46. Fries E, Hesse J, Hellhammer J, Hellhammer DH. A new view on hypocortisolism. *Psychoneuroendocrinology*. 2005;30(10):1010–6. [PubMed: 15950390]
47. Sabban EL. Catecholamines in stress: molecular mechanisms of gene expression. *Endocr Regul*. 2007;41(2–3):61–73. [PubMed: 18257649]
48. Adam EK, Quinn ME, Tavernier R, McQuillan MT, Dahlke KA, Gilbert KE. Diurnal cortisol slopes and mental and physical health outcomes: A systematic review and meta-analysis. *Psychoneuroendocrinology*. 2017;83:25–41. [PubMed: 28578301]
49. Smith GC, Egbert N, Dellman-Jenkins M, Nanna K, Palmieri PA. Reducing depression in stroke survivors and their informal caregivers: a randomized clinical trial of a Web-based intervention. *Rehabil Psychol*. 2012;57(3):196–206. [PubMed: 22946607]

Table 1.Characteristics of Caregivers and Stroke-Survivors ($N = 63$)

Variable	$M \pm SD$ or N (%)	
	Caregivers	Stroke Survivors
Caregiver and Stroke-Survivor Socio-demographic Characteristics		
Age (years)	56.92 \pm 13.81	75.92 \pm 7.82
Gender		
Female	42 (67%)	37 (59%)
Male	21 (33%)	26 (41%)
Race/Ethnicity		
White	46 (73%)	45 (71%)
African American	14 (22%)	15 (24%)
Other	3 (5%)	3 (5%)
Health Insurance		
Private/Medicare/Medicare + Supplemental Health Insurance Plans	55 (87%)	53 (84%)
Medicare + Medicaid/Medicaid/No Insurance	8 (13%)	10 (16%)
Education		
Less than High School	0 (0%)	9 (14%)
High School	20 (32%)	22 (35%)
Vocational Training	6 (9.5%)	6 (10%)
College	23 (36.5%)	19 (30%)
Postgraduate	14 (22%)	7 (11%)
Employment		
Full Time	27 (43%)	6 (9.5%)
Part Time	7 (11%)	1 (2%)
Homemaker	2 (3%)	7 (11%)
Unemployed	5 (8%)	2 (3%)
Retired	18 (29%)	47 (75%)
Leave of Absence	6 (6%)	0 (0%)
Income		
Comfortable	30 (48%)	27 (43%)
Adequate	26 (41%)	27 (43%)
Insufficient	7 (11%)	9 (14%)
Relationship to the Stroke Survivor		
Spouse	22 (35%)	
Child	38 (60%)	
Grandchild	1(2%)	
Sibling	2 (3%)	
Number of Close Friends and Relatives	18.37 \pm 17.34	
Antidepressant Medication	5 (8%)	
Stroke Survivors' Stroke-Related Health Characteristics		
Days poststroke at T1 caregiver interview		4.22 \pm 3.37

Variable	<i>M</i> ± <i>SD</i> or <i>N</i> (%)	
	Caregivers	Stroke Survivors
Stroke Experience		
First Stroke		50 (79%)
Recurrent Stroke		13 (21%)
Type of Stroke		
Ischemic		32 (51%)
Intra-cerebral Hemorrhage		21 (33%)
Subarachnoid Hemorrhage		10 (16%)
Area of Stroke		
Right		27 (43%)
Left		28 (44%)
Right and Left or Other		8 (13%)
Communication Disability		
Yes		27 (42.9%)
No		30 (47.6%)
Unclassified		6 (9.5%)
Severity of Stroke [†] [0–42]		12.98 ± 9.92
Chronic Illness [†] [0–56]		8.37 ± 4.37

Note. *M* = mean; *SD* = standard deviation. This information was collected only at T1.

[†]Higher scores = greater severity of stroke or more chronic illnesses.

Table 2.

Study Variables between T1 and T2.

Variable [Range]	<i>M</i> ± <i>SD</i> or <i>N</i> (%) at T1 (N= 63)	<i>M</i> ± <i>SD</i> or <i>N</i> (%) at T2 (N=40)	<i>t</i> statistic	<i>p</i> value
Depressive Symptoms				
Mean	6.67 ± 5.55	6.60 ± 5.96	0.891	0.379
None [1–4]	27 (43%)	21 (53%)		0.321
Mild [5–9]	18 (29%)	7 (18%)		
Moderate [10–14]	12 (19%)	6 (15%)		
Moderate to Severe [15–19]	4 (6%)	5 (13%)		
Severe [20–27]	2 (3%)	1 (3%)		
Caregiver centeracteristics				
Uncertainty [†] [31–155]	84.13 ± 19.93	85.23 ± 23.94	0.713	0.480
Perceived Stress [†] [0–56]	24.21 ± 9.55	24.48 ± 10.74	0.080	0.936
Salivary Cortisol AM [µg/dL]	0.41 ± 0.37 (N= 57)	0.33 ± 0.21 (N=38)	1.308	0.199
Salivary Cortisol PM [µg/dL]	0.13 ± 0.11 (N=54)	0.12 ± 0.10 (N= 38)	0.061	0.952
Coping Capacity [†] [13–91]	65.75 ± 11.71	67.25 ± 15.46	2.061	0.046
Social Support [†] [7–84]	73.57 ± 12.16	63.88 ± 18.18	2.560	0.014
Chronic Illness [†] [0–56]	4.90 ± 4.20	6.20 ± 4.69	2.054	0.047
Duration of Caregiving (days)	4.19 ± 3.37	36.03 ± 6.96		
Time Spent Caring per Day (hours)	8.59 ± 6.64	7.60 ± 6.59	0.954	0.346
Other Life Event	25 (40%)	9 (23%)		0.057
Stroke-Survivor centeracteristic				
Functional Status [†] [0–100]	23.17 ± 28.71	43.75 ± 36.56	3.266	0.002

Note. *M* = mean; *SD* = standard deviation. Paired *t*-test was used for all variables except categories of depressive symptoms (none, mild, moderate, moderate to severe, and severe) and other life event (e.g., death, moving, retirement or marriage) for which McNemar test was calculated;

[†] Higher scores = greater uncertainty, higher perceived stress, better coping capacity, better social support, more chronic illnesses, or better functional status.

Table 3.

Each Caregiver and Stroke-Survivor Characteristic Associated with Depressive Symptoms based on Unadjusted Linear Mixed Models ($N = 63$)

Predictors	B	SE	z statistic	p value	95% CI
Caregiver leftacteristics					
Model 1					
Uncertainty	0.12	0.03	4.77	< 0.001	[0.07, 0.17]
Time	-0.58	0.68	-0.85	0.395	[-1.90, 0.75]
Model 2					
Perceived Stress	0.35	0.04	7.92	< 0.001	[0.27, 0.44]
Time	-0.37	0.69	-0.53	0.597	[-1.71, 0.99]
Model 3					
Coping Capacity	-0.24	0.04	-6.65	< 0.001	[0.01, 0.29]
Time	0.23	0.69	0.33	0.631	[-1.62, 0.79]
Model 4					
Social Support	-0.09	0.03	-2.77	0.006	[-0.15, -0.03]
Time	-1.16	0.71	-1.64	0.102	[-2.25, 0.23]
Model 5					
Non-White	Reference				
White	3.27	1.42	2.30	0.022	[0.48, 6.06]
Time	-0.57	0.69	-0.82	0.413	[-1.92, 0.79]
Model 6					
Comfortable Income Adequate Income	Reference 0.86	1.31	0.66	0.511	[-1.71, 3.43]
Insufficient income	6.5	2.03	2.20	0.001	[2.52, 10.48]
Time	-0.44	0.69	-0.64	0.522	[-1.80, 0.91]
Model 7					
Time Spent Care	0.15	0.07	2.06	0.039	[0.01, 0.29]
Time	-0.32	0.66	-0.48	0.631	[-1.62, 0.79]
Stroke-Survivor leftacteristics					
Model 8					
Non-White	Reference				
White	3.01	1.41	2.13	0.033	[0.24, 5.77]
Time	-0.57	0.69	-0.82	0.413	[-1.92, 0.79]
Model 9					
Functional Status	-0.05	0.02	-2.95	0.003	[-0.08, -0.02]
Time	0.39	0.74	0.53	0.594	[-1.05, 1.84]

Note. B = unstandardized slope coefficient; SE = standard error; CI = confidence interval; Time-varying variables: uncertainty, perceived stress, coping capacity, social support, time spent providing care and stroke survivor functional stats; Fixed variables: race and income