Influence of psychological responses of caregiving on the perceived health of family caregivers to acute stroke survivors

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Abstract

Family caregivers provide round-the-clock care to their family members who had a stroke. The detrimental effects of caregiving on caregiver's health would lead to the abandonment of caregiver role and institutionalization of stroke survivors. This study aims to determine the factors associated with the perceived health status of family caregivers to stroke survivors. This study conducted a secondary analysis of the baseline data of 142 family caregivers of stroke survivors nested within a longitudinal randomized controlled trial. Potential factors were identified according to the Pittsburgh Mind-Body Center model and were analyzed with hierarchical multiple regression models. The results indicated that stroke caregivers exhibited comparable perceived physical health with general population but poorer perceived mental health. Severity of depressive symptoms ($\beta = -0.37$, $P < .001$) remained the strongest and most significant factor associated with perceived mental health, followed by confidence in problem-solving ($\beta = -0.21$, $P < .05$). Moreover, caregiving competence ($\beta = 0.29$, $P < .001$) was the sole significant psychological factor associated with perceived physical health. Caregiving competence, problem-solving abilities, and severity of depressive symptoms are significant modifiable correlates of the perceived health of caregivers. Intervention for improving these psychological responses of caregivers is suggested incorporated in stroke rehabilitation programs.

Abbreviations: CES-D10 = 10-item Center for Epidemiologic Studies Depression Scale, FAD-GF = General Functioning subscale of McMaster Model of Family Assessment Device, MCS = Mental component score, PCS = Physical component score, PSI = Problem Solving Inventory, SF-12v2™ = Medical Outcomes Study 12-item Short Form Health Survey, version two.

Keywords: caregiver, caregiving competence, depressive symptoms, health, problem-solving abilities, stroke

1. Introduction

Stroke is a leading cause of chronic disability worldwide, specifically in Chinese populations.[1,2] With current medical advancements, family caregivers are expected to provide continuous care to stroke-afflicted family members who have exhibited complex stroke symptoms, increased functional dependency, cognitive impairments, and behavioral problems for years following the onset of the condition.[3,4] Caregiving is a public health issue[5] as family caregivers are the bedrock of long-term home care given their provision of unpaid care (economically valued at an estimated US$ 470 billion) to disabled family members.[6,7] However, studies suggest that caregiving-associated stressors may be detrimental to the psychosocial well-being of caregivers, thereby influencing the perceived health of caregivers. The perceived health not only affects the sustainability of home care for stroke survivors,[8,9] but also determine the recovery and hospital readmission of stroke survivors.[10] Thus, the modifiable factors that affect caregiver health should be identified to support these important healthcare partners.

The health of family caregivers undergoes complex and drastic changes as these family members assume caregiving responsibilities. According to a Pittsburgh Mind-Body Center model,[11,12] the presence of an acute stressor (being a caregiver to stroke survivors) triggers the changes in perceived health of family caregivers. The perceived health of family caregivers is influenced by the psychological responses, that is, changes in the cognitive and affective reactions of caregivers (depression, problem-solving abilities, and caregiving competence), and the socio-demographic characteristics of the caregivers and of stroke survivors, the clinical characteristics of stroke survivors, as well as caregiving resources (social support and family functioning).[12]

Previous studies report that caregiver health is independently related to either signs of psychological distress, such as depressive symptoms and caregiving burdens, or the physical dependency of stroke survivors.[13,14] Nevertheless, the capability of caregiving resources (social support and family functioning) to buffer the influence of caregiving-related stressors on the physical and psychological health of caregivers was rarely considered.[15,16] Regarding social support, immediate family members,

including spouses and children, have been identified as the most important individuals in the actual social networks of caregivers to stroke survivors.[17] The onset of stroke alters family functioning, as well as the equilibrium of the roles and affective responses of the family members involved. Subsequently, this shift affects the health of family caregivers.

Despite the negative psychological responses to caregiving, the positive changes observed in caregivers also attracted attention.[18,19] Pearlin et al[20] suggest that caregiving-related stressors and strains affect caregiving competence among family caregivers. According to a study that focused on family members providing care to dementia patients, caregiving competence protects the psychological well-being of caregivers.[21] Problem-solving abilities have also been postulated to protect the health of family caregivers from the negative influences of caregiving-related stressors in line with the relational or problem-solving model of stress.[22] Cumulative studies conducted on the caregivers of individuals suffering from various chronic illnesses have indicated that deficits in problem-solving abilities are associated with the poor psychological and physical health of caregivers.[23,24] Study on stroke populations have determined that problem-solving abilities are significantly correlated with depressive symptoms in caregivers.[25] Nonetheless, few studies have demonstrated the influence of problem-solving abilities on the perceived health of family caregivers.[26,27]

Limited attention was drawn in the previous studies on examination of the socio-demographic, clinical and psychological factors and caregiving resources simultaneously in predicting the health of family caregivers.[28,29] Family caregivers are particularly prone to becoming "hidden patients"[30] as stroke survivors transition from hospital- to home-based care. Therefore, the current study aims to identify the factors associated with the perceived health status of Chinese family caregivers to acute stroke survivors in one model and to determine whether the psychological responses are independently and uniquely associated with perceived health of family caregivers.

2. Method

2.1. Study design, sample, and setting

This study is a cross-sectional study on family caregivers to stroke survivors. This study is nested in a randomized controlled trial by conducting secondary analysis of an existing baseline data set. Ethical approval for the study was obtained from Clinical Research Ethics Committee of the study institution (CRE-2012.185-T). Participants were recruited upon the admission of patients to the hospitals following acute strokes. Eligible participants were approached by the researcher within the first week of admission. Upon obtaining written informed consent from eligible participants, the researcher collected baseline data within the first two weeks of stroke onset. Then, participants were randomized into intervention and control groups.

Family caregivers and stroke survivors were recruited through convenience sampling. Participants were sampled from the medical wards of a regional acute hospital and two rehabilitation hospitals in the Eastern New Territories of Hong Kong. This region is home to 1.32 million of 7.39 million residents in Hong Kong.[31,32] These family caregivers and stroke survivors were all Chinese, aged ≥ 18, Hong Kong residents and could communicate in Cantonese. The initial/recurrent strokes in the survivors, were either ischemic or hemorrhagic in nature, and were diagnosed and confirmed through either computer tomography or magnetic resonance imaging. Participating caregivers were composed of individuals who assumed the primary responsibility of caring for their stroke-afflicted family members. These survivors in turn planned to return home and live with their family caregivers. Pairs of family caregivers and stroke survivors were excluded from the study if either party reported a history of self-reported or physician-diagnosed psychiatric illnesses, were unable to understand the research procedure and refused to provide consent.

2.2. Outcome measures

2.2.1. Primary outcome: perceived health status of caregivers. The perceived health status of caregivers was assessed using the Chinese (Hong Kong) Medical Outcomes Study 12-item Short Form Health Survey, version two (SF-12v2™).[33] Two component summary scores were considered, namely, the physical component summary score (PCS) and the mental component summary score (MCS). These scores ranged from 0 to 100. High PCS and MCS scores indicated enhanced perceived physical and mental health, respectively. The internal consistency, conceptual equivalence, construct validity and sensitivity of PCS and MCS of the Chinese (HK) SF-12v2™ has been established.[34]

2.2.2. Demographic and clinical variables. Socio-demographic and clinical characteristics were determined in relation to family caregivers, including age, gender, relationships with stroke survivors, educational background, employment status, marital status, living arrangement and family income. The caregiving characteristics of the participants included stroke-related caregiving experience, participation in support programs for caregivers to stroke survivors and the availability of domestic help. Stroke-related caregiving experience was assessed by the question, "do you have any experience in providing care to a stroke survivor?" Clinical data, including the nature of strokes and the functional levels of stroke survivors, were collected by reviewing pertinent medical records. The functional levels of stroke survivors were measured by the Modified Barthel Index.[35]

2.2.3. Caregiving resources: social support and family functioning. The social support provided to caregivers was determined using the Chinese version of a six-item Social Support Questionnaire,[36] which was translated and validated by Chang.[36] This scale evaluates the quantity of social support and the satisfaction of an individual with the support received. Caregivers were asked to specify the number of support persons (from 0 to 9) who supported them in six situations. The same caregivers were also asked to rate their overall satisfaction with the support they received. This satisfaction was rated on a six-point Likert scale. A high total score corresponds to a high satisfaction level. The Chinese version of the six-item Social Support Questionnaire demonstrated good internal consistency (Cronbach's alpha = 0.94 for the number of support person; 0.95 for satisfaction of support) when used with stroke survivors.[37]

The family functioning of caregivers was assessed using a 12-item General Functioning subscale (GF) of the McMaster Model of Family Assessment Device (FAD), which was developed by Epstein and colleagues.[38] The FAD-GF effectively estimates overall family functioning.[39] The Chinese version of the scale used in the current study[40] follows a four-point Likert scale (1 = strongly disagree, 4 = strongly agree). A high score indicates low level of family functioning. The Chinese version of the FAD-GF demonstrates good internal consistency (Cronbach's alpha = 0.86) and is substantially correlated with other measures of family functioning (0.84–0.92), including the Chinese Family Assessment Device.[41] As in previous studies, the current study considered the mean score of the FAD-GF subscale in data analysis.[42,43] A mean score >2 indicates unhealthy family functioning.[38]

2.2.4. Caregivers' psychological responses: depressive symptoms, caregiving competence and problem-solving abilities Depressive symptoms were identified in

caregivers using the Chinese version of the 10-item Center for Epidemiologic Studies Depression Scale (CES-D10).[44] Family caregivers were asked about their depressive symptoms in the previous week and responded through a dichotomous format (0 = no; 1 = yes, most of the time). An optimal cutoff score of four indicated good sensitivity and specificity, as well as positive predictive values related to the onset of depression in the older population.[45] The Chinese version of the CES-D10 shows good internal consistency (Cronbach's alpha = 0.76) and adequate construct validity.[44]

Caregiving competence refers to the self-perceived adequacy of an individual as a caregiver. This factor was measured in the current study through the Caregiving Competence Scale.[20] Family caregivers were asked to rate their self-perceived caregiving competence on a four-point Likert scale ranging from 1 (not at all) to 4 (very much). Total scores ranged from 4 to 16, and high scores corresponded to a strong sense of caregiving competence. The Chinese version of the Caregiving Competence Scale demonstrated good internal consistency (Cronbach's alpha = 0.81), stability (1-week retest weighted kappa statistics: 0.67–0.78) and adequate construct validities.[46]

The self-appraised problem-solving abilities of caregivers were assessed using the Chinese version of the Problem Solving Inventory (PSI), which was translated by Cheng and Lam.[47] The PSI is composed of 33 items with three subscales, namely, the problem-solving confidence, approach-avoidance style, and personal control subscales. The items in the PSI are rated on a six-point Likert scale ranging from 1 (strongly agree) to 6 (strongly disagree). A low score indicates a highly positive self-appraisal of problem-solving abilities. Low scores in the problem-solving confidence, personal control, and approach-avoidance subscales indicate strong self-confidence in problem-solving, a high sense of personal control and a tendency to approach rather than to avoid a problem, respectively. The Chinese version of the PSI demonstrated an adequate internal consistency (Cronbach's alpha = 0.82) in terms of its results among Chinese family caregivers of stroke survivors in Hong Kong.[27]

2.3. Data analysis

Socio-demographic and clinical data were summarized with the appropriate descriptive statistics, as were the caregiving resources and psychological responses of the participants. The normality of each variable was tested through skewness and kurtosis statistics. The correlations of these variables with the PCS and the MCS of the Chinese (HK) SF-12v2™ were examined using Pearson Product-Moment Correlation tests for interval variables, Eta for categorical variables and point biserial r for dichotomous variables.

Multiple regression analysis was performed to determine the associations between the socio-demographic and clinical variables, caregiving responses, psychological variables and the perceived health status of family caregivers. The predictor variables that were encoded in the multiple regression models were identified according to the Pittsburgh Mind-Body Center model,[11,12] as were the significant associations of these predictor values with the outcome variables (MCS or PCS). A liberal significance level of 0.2 was applied to reduce the probability of excluding an important variable from the model.[48] Potential predictors with either a high co-variability ($R > 0.7$) or low correlation with the outcome variables were excluded from the model to reduce over-parameterization. According to Khamis and Kepler,[49] the minimum sample size in the multiple regression was 20 + 5m (m = number of independent variables). The number of observations (N = 142) in the study exceeded the minimal requirement of 100 and 120 for PCS and MCS, respectively. All statistical analyses were conducted using IBM SPSS version 25. The level of statistical significance was set at 0.05 (two-sided).

3. Results

3.1. Characteristics of family caregivers and stroke survivors

Among the 178 caregiver–survivor dyads who were approached by the researcher and satisfied the inclusion criteria, only 142 (80%) of these pairs consented to participate in the study. The demographic and psychosocial characteristics of the family caregivers are shown in Table 1. The majority of family caregivers (71.8%) were female, and a quarter of the participants had experience in providing care to a stroke survivor. More than half of the participants were children of the stroke survivors and had received more than 6 years of formal education. Among adult-children caregivers, 41 (48.8%) were married and 34 (40.1%) were male. Hypertension was the most common ailment among the caregivers who suffered from at least one chronic illness (n = 54, 38.0%). With

Table 1

Demographic and psychosocial characteristics of family caregivers (N = 142).

Characteristics	Mean ± SD or n (%)
Age (range: 18–80)	48.94 ± 12.76
Gender (female)	102 (71.8)
Being married	96 (67.6)
Relationship with stroke survivor	
Spouse	46 (32.4)
Children	84 (59.2)
Relative/sibling	12 (8.4)
Educational level	
Primary or less	25 (17.6)
Secondary	77 (54.2)
Tertiary or above	40 (28.2)
Having full-time/part-time job	76 (53.5)
Family income (US dollar)	
<1282	37 (26.1)
1282 to 2563	44 (31.0)
≥2564	61 (42.9)
Household size (range 2–7)	3.41 ± 1.19
Living with stroke survivors only	38 (26.8)
Caregiving conditions	
Experienced in caregiving of stroke survivors	36 (25.4)
Attended support program for caregivers	4 (2.8)
Hired a domestic helper	20 (14.1)
Number of physical illnesses (range: 0–5)	
1	37 (26.0)
>1	17 (12.0)
Perceived heath (SF-12v2™)	
Physical health (PCS: range: 19.99–67.70)	51.82 ± 8.96
Mental health (MCS: range: 19.45–65.34)	46.96 ± 10.48
Psychological responses	
Caregiving competence (CCS: range: 5–16)	10.49 ± 2.33
Severity of depressive symptoms (CES-D10: range: 0–10)	2.37 ± 2.10
Problem-solving abilities	
Overall (range: 51 -141)	104.25 ± 17.06
Approach-avoidance style subscale (range: 26–75)	53.47 ± 9.68
Personal control subscale (range: 9–29)	17.91 ± 3.97
Problem-solving confidence (range: 11–47)	32.87 ± 6.29
Caregiving resources	
Social support (SSQ-6)	
Number of support (range: 0–7)	1.78 ± 1.41
Satisfaction of support (range: 3.33–6.00)	5.06 ± 0.68
Family functioning (FAD-GF: range: 1.08–3.25)	1.08 ± 0.34

CCS = Caregiving Competence Scale, CES-D10 = 10-item Center for Epidemiologic Studies Depression Scale, FAD-GF = General Functioning subscale of McMaster Model of Family Assessment Device, MBI = Modified Barthel Index, MCS = mental component score, PCS = physical component score, SD = Standard deviation, SF-12v2™ = Medical Outcomes Study 12-item Short Form Health Survey, version two, SSQ-6 = six-item Social Support Questionnaire.

regard to psychological characteristics, 33 family caregivers (23.0%) displayed potential depression (CES-D10 ≥ 4). The self-perceived problem-solving ability scores reported by the family caregivers were fair because the subscale scores were generally in the upper range. With respect to caregiving resources, family caregivers identified an average of two people who provided them with social support. These caregivers were quite satisfied with the support they received. However, 82 family caregivers (57.7%) reported unhealthy family functioning.

Table 2 shows that most of the stroke survivors (73.2%) suffered from ischemic stroke and were recovering from their initial stroke episode (78.2%). The majority of stroke survivors exhibited hemiparesis (n = 127, 89.4%) and were moderately to severely dependent on others when performing daily activities (n = 111, 78.2%) as measured by the Modified Barthel Index.[50] The stroke survivors suffered from an average of three other chronic illnesses; among these illnesses, hypertension was the most prevalent.

3.2. Bivariate correlations of the MCS and PCS of caregivers

Bivariate relationships between the potential predictors ($P < .2$) and the PCS and MCS scores of the caregivers are presented in Table 3. The correlations between the MCS and PCS was –0.15 ($P = .77$).

For family caregivers, the factors significantly associated with a better perceived mental health were being either the spouse or the child of the stroke survivor, having a high level of education, being satisfied with the available social support, displaying high confidence on and perceived control of problem-solving abilities, reporting a better family function and experiencing few depressive symptoms. The factors

associated with a better perceived physical health included youth, few physical illnesses, enhanced self-perceived caregiving competence, few depressive symptoms and improved self-appraised problem-solving abilities.

Stroke survivors exhibiting difficulty in communication, particularly dysphasia, was a factor that was significantly associated with poor mental health perceived by caregivers. By contrast, the enhanced perceived mental health of caregivers was associated with stroke survivors who experienced dysarthria. The recurrence of stroke among stroke survivors was associated with the poor perceived physical health of caregivers. The recovery of stroke survivors from ischemic stroke with hemorrhagic transformation was associated with the enhanced perceived physical health of caregivers.

Table 2

Demographic and clinical characteristics of stroke survivors (N = 142).

Characteristics	Mean ± SD or n (%)
Age (range: 43–94)	71.30 ± 11.47
Gender (male)	76 (53.5)
Marital status	
Married	89 (62.7)
Single/separated/divorced/ widowed	53 (37.3)
Educational level	
Less than primary (<6 yr)	49 (34.5)
Primary (6–12 yr)	46 (31.0)
Secondary or above (>12 yr)	49 (34.5)
Have a full-time/part-time job before stroke	29 (20.4)
Type of stroke	
Ischemic	104 (73.2)
Hemorrhagic	15 (10.6)
Ischemic with hemorrhagic transformation	13 (9.2)
Unspecific	10 (7.0)
With history of stroke	31 (21.8)
Major presenting characteristics	
Hemiparesis (either side/ both side)	122 (85.2)/5 (3.5)
Dysphagia	103 (72.5)
Dysphasia/Aphasia	38 (26.8)/24 (16.9)
Dysarthria	91 (64.1)
Comorbidities (range: 0–9)	3.51 ± 1.92
Hypertension	107 (75.4)
Hyperlipidemia	62 (43.7)
Diabetes mellitus	53 (37.3)
Atrial fibrillation	36 (25.4)
Physical functioning (MBI: range: 0–89)	45.92 ± 27.54

MBI = Modified Barthel Index, SD = standard deviation.

Table 3

The bivariate relationship between the potential correlates ($P < .2$) and the perceived health status (MCS and PCS scores).

	MCS	PCS
1. Psychological responses of caregivers		
a) Approach-avoidance style (PSI-AA)	–	−0.15
b) Problem-solving confidence (PSI-PSC)	−0.30**	−0.20*
c) Personal control (PSI-PC)	−0.25*	−0.18*
d) Caregiving competence (CCS)	–	0.22**
e) Depressive symptoms (CES-D10)	−0.55*	−0.18*
2. Socio-demographic characteristic Caregivers		
a) Age	–	−0.30**
b) Being married†	0.14	–
c) Relationship with stroke survivor†,§	0.22*	–
d) Educational level‡,‖	0.22*	–
e) Being employed†	–	0.13
f) Attended caregiving training†	–	0.11
g) Had experience in caring a stroke survivor†	–	−0.13
h) Number of physical illness (0 vs 1 vs >1)‡,¶	–	0.56**
i) Family income‡,#	0.18	0.18
j) Household size	–	−0.14
Stroke survivors		
l) Gender (male)†	–	0.11
m) Educational level‡,‖	0.20	0.18
2. Clinical characteristic of stroke survivors		
a) Number of comorbidities	−0.12	–
b) With history of stroke†	–	−0.24**
c) Presented with aphasia†	−0.17*	–
d) Presented with dysarthria†	0.24*	–
e) Suffering from ischemic stroke with hemorrhagic transformation	–	0.20*
f) Physical functioning (MBI)	–	−0.11
3. Caregiving resources		
a) SSQ-6_percieved number of support	0.25**	–
b) SSQ-6_satisfaction of the perceived support	0.35**	0.15
c) Family functioning (GF-FAD)	−0.26*	−0.12
d) Having a domestic helper†	0.13	–

CCS = Caregiving Competence Scale, CES-D10 = 10-item Center for Epidemiologic Studies Depression Scale, FAD-GF = General Functioning subscale of McMaster Model of Family Assessment Device, MBI = Modified Barthel Index, MCS = Mental component score,
PCS = Physical component score, PSI-AA = Approach-avoidance style subscale of Problem Solving Inventory, PSI-PC = Personal control subscale of Problem Solving Inventory, PSI-PSC = Problem-solving confidence subscale of Problem Solving Inventory, SSQ-6 = six-item Social Support Questionnaire.
†Point biserial r.
‡Eta, otherwise Pearson correlation coefficient.
Reference group:
§not being the spouse nor the child of the stroke survivors;
‖receiving less than 6 years of education;
¶without any physical illness;
#family income is USD < 1282.
*$P < .05$.
**$P < .01$.

3.3. Regression analyses of the perceived health of caregivers

Hierarchical regression analyses were conducted to determine whether or not psychological responses remain significant factors associated with perceived health after controlling for relevant socio-demographic and clinical characteristics, as well as for the caregiving resources. The first set of variables entered into the hierarchical regression analysis included the psychological responses/resources, followed by the socio-demographic characteristics, the clinical characteristics and the caregiving resources.

Caregiving competence, problem-solving abilities and severity of depressive symptoms in caregivers accounted for 34% of the variance in perceived mental health. Severity of depressive symptoms ($\beta = -0.37$, $P < .001$) remained the strongest and most significant factor in the perceived mental health of family caregivers, followed by confidence in problem-solving ($\beta = -0.21$, $P < .05$) after controlling for other relevant socio-demographic and clinical factors and for caregiving resources (Table 4). In addition, the clinical characteristics of stroke [F change (3, 124) = 3.06, $P < .05$] alone constituted the sole significant contributing factor to the perceived mental health of caregivers with an additional 4% variance explained.

Caregiving competence, problem-solving abilities and severity of depressive symptoms accounted for 8% of the variance with respect to the perceived physical health of caregivers. Among all of the psychological variables, caregiving competence was the sole significant factor associated with perceived physical health ($\beta = 0.29$, $P < .001$) after controlling for other relevant socio-demographic and clinical characteristics, as well as for caregiving resources (Table 5). The socio-demographic [F change (10, 126) = 3.20, $P < .05$] and clinical characteristics [F change (5, 121) = 7.95, $P < .001$] of caregivers and stroke survivors accounted for an additional 19% and 18% of the variance in caregivers' perceived physical health, respectively. Among these characteristics, caregiver age ($\beta = -0.25$, $P < .05$), caregivers who suffered from >1 physical illness ($\beta = -0.38$, $P < .001$) and household size ($\beta = -0.25$, $P < .05$) were the significant factors associated with the perceived physical health of family caregivers.

4. Discussion

The abrupt onset of stroke imposes heavy demands on the psychosocial condition of caregivers.[3,50] In the current study, family caregivers exhibited poorer perceived mental health (MCS: 46.96 ± 10.48) than the general Hong Kong population (MCS: 49.99 ± 9.12).[34] Nonetheless, the perceived physical health score of these caregivers (PCS: 51.82 ± 8.96) was similar to that of the general population (PCS: 50.02 ± 8.93)[34] because physically demanding tasks, such as the carrying and transfer of stroke survivors, were performed by healthcare providers during the hospital stay of stroke survivors. A study on family caregivers of dementia patients who were newly referred to geriatric services has also revealed that caregiving exerts a limited influence on the physical health of these caregivers during the initial phase of this chronic illness.[51] Our finding that caregiving was less detrimental to the physical health of caregivers than to their mental health is consistent with the result presented in previous studies on family caregivers to stroke survivors in Hong Kong,[26,52] the United States,[53] and Sweden.[54]

Table 4

The hierarchical multiple regression analysis examining the association between caregivers' perceived mental health (SF-12v2™ MCS) and their psychological responses (caregiving competence, depressive symptoms and problem-solving abilities).

Steps and variables	B	β	sr²	R²	Adjusted R²	Δ R²	ΔF
Step 1				0.34**	0.31	0.34	13.79**
Caregiving competence	−0.07	−0.02	0.00				
Depressive symptoms	−2.33	−0.47**	0.19				
Approach-avoidance style	0.18	0.17	0.02				
Problem-solving confidence	−0.32	−0.19	0.02				
Personal control	−0.29	−0.11	0.01				
Step 2†				0.41**	0.35	0.08	1.85
Caregiving competence	−0.12	−0.03	0.00				
Depressive symptoms	−2.08	−0.42**	0.13				
Approach-avoidance style	0.18	0.17	0.01				
Problem-solving confidence	−0.38	−0.23*	0.02				
Personal control	−0.12	−0.05	0.00				
Step 3‡				0.45**	0.38	0.04	3.06*
Caregiving competence	−0.25	−0.06	0.00				
Depressive symptoms	−2.04	−0.41**	0.12				
Approach-avoidance style	0.11	0.10	0.01				
Problem-solving confidence	−0.37	−0.22*	0.02				
Personal control	−0.10	−0.04	0.00				
Step 4§				0.47**	0.38	0.14	0.81
Caregiving competence	−0.27	−0.06	0.00				
Depressive symptoms	−1.82	−0.37**	0.09				
Approach-avoidance style	0.13	0.12	0.01				
Problem-solving confidence	−0.34	−0.21*	0.02				
Personal control	−0.12	−0.01	0.00				

SF-12v2™ MCS = Mental component score of Medical Outcomes Study 12-item Short Form Health Survey, version two, sr² = semi-partial correlation.

†Socio-demographic characteristic (caregivers' marital status, relationship with stroke survivors, educational level of both caregivers and stroke survivors and family income) were entered in the model

‡In addition to socio-demographic characteristics, clinical characteristics of stroke survivors (number of comorbidities, presence of aphasia, and presence of dysarthria) were also entered in the model.

§In addition to socio-demographic characteristics and clinical characteristics, caregiving resources for caregivers (family functioning, social support [number and satisfaction] and domestic helper supporting family care) were also entered in the model.

*P < .05.

**P < .001.

Table 5

The hierarchical multiple regression analysis examining the association between caregivers' perceived physical health (SF-12v2 PCS) and their psychological responses (caregiving competence, depressive symptoms and problem-solving coping).

Steps and variables	B	β	sr²	R²	Adjusted R²	Δ R²	ΔF
Step 1				0.08*	0.05	0.08	2.49*
Caregiving competence	0.59	0.15	0.02				
Depressive symptoms	−0.56	−0.13	0.01				
Approach-avoidance style	−0.06	−0.06	0.00				
Problem-solving confidence	−0.08	−0.06	0.00				
Personal control	−0.08	−0.03	0.00				
Step 2†				0.27**	0.18	0.19	3.20*
Caregiving competence	1.03	0.27*	0.05				
Depressive symptoms	−0.58	−0.14	0.02				
Approach-avoidance style	0.04	0.04	0.00				
Problem-solving confidence	−0.09	−0.06	0.00				
Personal control	−0.10	−0.05	0.00				
Step 3‡				0.45**	0.36	0.18	7.95*
Caregiving competence	1.12	0.29**	0.06				
Depressive symptoms	−0.17	−0.04	0.00				
Approach-avoidance style	0.07	0.08	0.00				
Problem-solving confidence	−0.14	−0.10	0.00				
Personal control	−0.10	−0.04	0.00				
Step 4§				0.45**	0.35	0.00	0.10
Caregiving competence	1.12	0.29**	0.06				
Depressive symptoms	−0.17	−0.04	0.00				
Approach-avoidance style	0.07	0.07	0.00				
Problem-solving confidence	−0.14	−0.10	0.00				
Personal control	−0.10	−0.05	0.00				

SF-12v2TM PCS = Physical component score of Medical Outcomes Study 12-item Short Form Health Survey, version two, sr² = semi-partial correlation.

†Socio-demographic characteristic (caregivers' marital status, relationship with stroke survivors, educational level of both caregivers and stroke survivors and family income) were entered in the model

‡In addition to socio-demographic characteristics, clinical characteristics of stroke survivors (number of comorbidities, presence of aphasia, and presence of dysarthria) were also entered in the model.

§In addition to socio-demographic characteristics and clinical characteristics, caregiving resources for caregivers (family functioning, social support [number and satisfaction] and domestic helper supporting family care) were also entered in the model.

*P < .05.

**P < .001.

In the current study, severity of depressive symptoms and confidence in problem-solving was significantly associated with the perceived mental health of caregivers after all other variables were adjusted. This study concurs with previous studies in arguing that the self-confidence of caregivers in their problem-solving abilities is a significant predictor of perceived mental health, as is the severity of depressive symptoms.[26,55] Despite cultural differences, the severity of depressive symptoms also serves as an important determinant of the health status of caregivers in Caucasians.[53,55] To the best of our knowledge, the present study is the first to identify the importance of caregiving competence in protecting the perceived health of Chinese caregivers of stroke survivors. The perceived competence of family caregivers accounted for 6% of the variance in perceived physical health, as reflected by the semi-partial correlation coefficient. Caregiving competence, problem-solving abilities and severity of depressive symptoms are significant modifiable factors which can influence the perceived health of family caregivers of stroke survivors. Interventions aimed at enhancing the problem-solving coping ability of caregivers should be conducted to support stroke caregivers.[56]

Problem-solving coping integrates cognitive appraisal and coping activities with respect to a daily problem within the social problem-solving framework.[57] This ability protects the psychological and physical health of individuals from the negative effects of daily stress.[58] Problem-solving coping exerts dual effects, namely, changing the situation and one's reaction to the situation. Therefore, this coping includes the goal of emotion-focused coping when a situation is perceived to be either uncontrollable or unchangeable.[58] As indicated by D'Zurilla and Nezu,[58] people who apply problem-solving coping strategies tend to appraise stressful situations as problems to be solved, are confident in their problem-solving abilities, generate alternative solutions and implement the solutions as outcomes

evolve. Considerable empirical evidence has demonstrated the mediating and moderating effects of problem-solving coping on the relationship between stress and psychosocial functioning.[59,60] The provision of informal caregiving to a family member who has suffered a stroke is stressful for the caregiver.[61,62] Thus, enhancing the problem-solving coping ability of caregivers can protect caregivers' health from the negative influence of caregiving-related stress.

Unlike previous studies,[52,63] the present study indicates that female caregivers did not report low perceived mental health. The sons of stroke survivors are expected to assume caregiving responsibilities in Chinese culture; therefore, the influence of caregiving on male caregivers should not be neglected given their increased participation in the caregiving arena.[64,65] Furthermore, the Confucian notion of filial piety in Chinese culture influences how caregivers appraise caregiving and buffers the negative effects of caregiving-related stressors and burdens.[3,66,67] This notion runs deep in Hong Kong. However, high filial expectations related to caregiving duties and obligations were negatively associated with the perceived health of caregivers.[67] As a result of the cultural expectation to provide care, perceived physical health can be viewed as either a benefit or a burden to caregivers with limited interfamilial support.[68,69] Therefore, the influence of filial piety on the perceived health status of family caregivers warrants further study.

This study has several limitations. There is a risk of harm to the health of caregivers during the transition of stroke survivors from hospital care to home care. Therefore, this study was conducted during the acute phase of stroke recovery to determine how support to caregivers can be improved over time. Although this study was the first to identify caregiving competence as a significant predictor of the perceived physical health of caregivers of stroke survivors, the study data were collected during a single period. Thus, the applicability

of these data may be insufficient to explore the causality between the perceived health of caregivers and the variables associated with stroke survivors and caregivers. In addition, the study only tested a main effect model of psychological response and perceived health. Future study on examination of the moderating effects of the sociodemographic and clinical characteristics of caregiver-survivor dyads, as well as the caregiving resource on psychological responses is suggested. Furthermore, this research involved the secondary data analysis of an intervention study on family caregivers to stroke survivors. As such, the use of strict inclusion criteria in this randomized controlled trial study limits the generalisability of the findings to the entire population of such caregivers. These limitations should be considered to enhance future studies on the perceived health of caregivers in the immediate aftermath of stroke onset.

5. Conclusions

Caregiving competence, problem-solving abilities and severity of depressive symptoms in caregivers are significantly associated with perceived health when the effects of socio-demographic and clinical characteristics are controlled for, as is that of caregiving resources. Furthermore, older caregivers with more coexisting physical illnesses and fewer cohabiting family members were at greater risk of reporting poor perceived physical health than others. Thus, interventions should be conducted to enhance the problem-solving coping strategies of caregivers to stroke survivors. In this way, providing care to stroke survivors may not deteriorate the health of family caregivers.

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Author contributions

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