RESEARCH



Care dependence and caregiver fatigue in ischemic stroke survivors: a cross-sectional study

Shuangyan Tu¹, Zhiqiang Deng¹, Siqin Li², Jinyao Wang³, Rong Yang^{1*}, and Lihong Zhao^{4*}

Abstract

Background Care dependence among ischemic stroke survivors may be related to caregiver fatigue, but the current status and relationship between these factors have not been well studied. This study aimed to investigate the current status of care dependence and caregiver fatigue in ischemic stroke survivors and to analyze their influencing factors and relationship.

Methods A total of 380 pairs of inpatient ischemic stroke survivors and caregivers were included from July 2019 to April 2020 by convenience sample. Survivors demographic data and clinical variables were collected. The Chinese Care Dependency Scale and Fatigue Scale-14 were used to assess survivors' care dependence and caregiver fatigue.

Results The largest number of ischemic stroke survivors were mild care dependence (62.89%), followed by those who were severe dependence (19.47%). Caregiver fatigue was moderate (42.9%) or severe (40.5%). Survivors' care dependence was influenced by the age of survivors (P=0.005), total score of NIHSS (P<0.001), and number of comorbidities (P=0.006). Caregiver fatigue was positively correlated with survivors' care dependence (P<0.001), and was affected by total score of NIHSS (P=0.032), conscious health (P=0.024) or sleep status (P<0.001) of caregivers, and number of survivors cared for at the same time (P=0.002).

Conclusions The current status of ischemic stroke survivors' care dependence and caregiver fatigue was not optimistic. This study identified three influencing factors for IS survivors' care dependence and four influencing factors for caregiver fatigue, and identified the positive relationship between them. This provided new evidence and direction for future research to explore effective measures to reduce survivors' care dependence and caregiver fatigue. In clinical practice, we should focus on and actively help survivors and caregivers with these influencing factors to reduce their burden.

Trial registration This study was not registered prospectively and we would conduct retrospectively registered. **Clinical trial number** Not applicable.

Keywords Ischemic stroke, Care dependence, Caregiver fatigue

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Introduction

Ischemic stroke (IS) refers to various causes of brain blood supply disorders, resulting in brain tissue ischemia, hypoxic necrosis, and rapid emergence of the corresponding neurological deficits [1]. IS is characterized by a heavy disease burden, and is one of the most important neurovascular causes of death and disability [2, 3]. Care dependence is a common problem in IS stroke survivors. Care dependence refers to the process by which caregivers provide support and assistance to survivors with varying degrees of dependence due to reduced self-care ability or increased care needs [4]. Research reported that 85.3% of stroke survivors had different degrees of care dependence [5]. Care dependence was associated with mortality, hindered recovery and affected the entire family [6-8]. Some scholars have studied influencing factors of care dependence in IS survivors, but many of these factors are still unclear, and there is a lack of research on psychological factors. For example, previous study found that age, history of falls, physical dysfunction, chronic comorbidities, depression, nutritional status and cognitive dysfunction were influencing factors for care dependence [9]. Ferri et al. proved that comorbid dementia and depression were the main correlates of disability and dependence [10].

IS (Ischemic stroke) not only harms survivors, but also places a serious burden on caregivers. Many caregivers encounter caregiver fatigue, which reduces their quality of life and indirectly affects their recovery [11, 12]. Caregivers refers to family members of the survivor (spouse, parents, son, daughter, etc.), and they are informal caregivers. Caregiver fatigue refers to the caregiver's strong, lasting sense of fatigue and powerlessness in the process of caring for survivors, which is difficult to be relieved by rest [13]. In a qualitative study, caregivers' burden was considerable and they often had to oversee the poststroke fatigue management strategies used [11]. Tchokote used interpretative phenomenological analysis to explore family caregivers, and this research showed that throughout the whole care process, family caregivers had difficult experiences, painful affects and psychological fatigue [14]. However, previous studies have not focused on caregiver fatigue, which was mostly mentioned in the discussion of caregiver burden. We believe that there should be more studies on caregiver fatigue, especially quantitative studies, which might help caregivers reduce fatigue and improve quality of life.

What is the connection between care dependence in IS (ischemic stroke) survivors and caregiver fatigue? To our knowledge, previous studies have provided few relevant results and lack explicit conclusions. This might result in clinicians missing important strategies to solve the current worrying problems of survivors' care dependence and caregiver fatigue. Some scholars found that determinants of caregiving burden included stroke survivors' physical dependence, and caregivers' burnout was associated with the degree of dependence [15, 16]. We hope to solve this problem and perhaps find new ideas to help relieve the burden on IS survivors and caregivers.

In summary, this study focused on care dependence and caregiver fatigue in IS (ischemic stroke) survivors, and analyzed their current status and influencing factors to complement the findings of previous studies. In addition, we wanted to determine the connection between IS survivors' care dependence and caregiver fatigue. This study might provide new ideas for reducing caregiver fatigue and promoting the rehabilitation of survivors.

Methods

From July 2019 to April 2020, two investigators (TSY and DZQ) collected data on IS (ischemic stroke) survivors and caregivers in the Department of Neurology, West China Hospital, Sichuan University. The hospital had one of the best neurology departments in China and treated a large number of IS survivors every year. Researchers could conduct study conveniently in this hospital. A convenience sample was enrolled in the study. Inclusion criteria for IS survivors were as follows: (1) principal diagnosis of IS (ICD-10 code: I63); (2) older than 18 years; (3) were able to communicate effectively in language or writing; (4) complied with informed consent. Exclusion criteria for IS Survivors were survivors with malignant tumors, depression, serious diseases of the heart, liver or other organs who could not participant in the complete research process. Inclusion criteria for caregivers were as follows: (1) undertook primary care work during the survivors' hospitalization and were family members of the survivor (spouse, parents, son, daughter, etc.); (2) were able to communicate effectively in language or writing; (3) complied with informed consent. Exclusion criteria for caregivers were as follows: (1) severe psychological stress.; (2) charged fees from the survivors. Before the formal investigation, we conducted a preliminary survey to improve the scale guidance and data collection methods. In the inpatient ward, the researcher communicated face-to-face with the survivors and caregivers and asked them to fill out all scales on-site. As survivors and caregivers filled out scales, we answered all their questions timely. After they filled out scales, we checked whether there were missing or wrong items, and timely modified or checked with the respondents to ensure that the data was correct, true and complete.

According to the methods of multivariate analysis and experience, the sample size should be 5–10 times the number of variables [17]. Since the maximum number of variables in this study was 52, at least 260 cases had to be included. Moreover, considering a drop-out rate of 20%, the sample had to include at least 312 survivors.

This study was approved by the ethics committee of the survivors' hospital. All IS survivors and caregivers participated voluntarily and were informed about the study aims and procedures as well as their right to participate and withdraw from the study at any time.

Basic information

Basic information on survivors included 13 items: gender, age, marital status, education, monthly household income, medical expense payers, working status, Body Mass Index (BMI), stroke severity as assessed by the National Institute of Health Stroke Scale (NIHSS), duration of disease, number of strokes, number of comorbidities, and dysfunction. The basic information of caregivers included 11 items: gender, age, marital status, education, monthly household income, working status, conscious health status, conscious sleep status, relationship with survivors, number of survivors cared for at the same time and daily care time.

Chinese care dependency scale

The Care Dependency Scale (CDS) is a widely used scale for assessing care dependence of IS survivors, contains 2 dimensions and 15 items [18, 19]. Physical functional dimension includes 9 items, and psychological functional dimension includes 6 items. To better reflect the situation of survivors in China, we used the Chinese version of CDS (CCDS). CCDS had satisfactory reliability with a Cronbach's alpha coefficient of 0.967, inter-rater reliability with kappa value of 0.84~0.89, and test-retest reliability with kappa value of 0.83 ~ 0.92 [20]. CCDS adopts a five-level scoring method of $1 \sim 5$ points, with points ranging from 1, representing "totally dependent," to 5, representing "almost independent." The scale scores are the sum of the scores for all the items and range from 14 to 70 points. The lower the scores are, the worse the care dependence. Scores below 40 points indicate severe dependence, 40~47 points indicate moderate dependence, 48~69 points indicate mild dependence, and 70 points indicate almost independence.

Compared with the original scale, CCDS added instructions and deleted an item [20]. It must be assessed by a registered nurse who cared survivor at least one day, with informed consent from the survivor. CCDS is closely ralated to the clinical situation and can be used to assess physical and psychological outcomes in IS survivors.

Fatigue scale-14

The Fatigue Scale-14 (FS-14) was developed in 1993 by the British scholar Chalder et al., and we used this scale to assess caregiver fatigue [21]. The Cronbach's alpha coefficient of the FS-14 was determined to be 0.90. Receiver operating characteristic curve analysis revealed that the sensitivity of FS-14 was 75.5 and the specificity was 74.5. The scale has 2 dimensions and 14 items, including physical fatigue and psychological fatigue. The points for items No.1 ~ 8 are added to the physical fatigue scores, the points for items No.9 ~ 14 are added to the psychological fatigue scores, and the scores for all items are added to the total fatigue scores. The scale scores range from 0 to 14 points, and the higher the scores are, the worse the fatigue. Caregiver fatigue is divided into three levels according to the scores of each dimension: mild, moderate, and severe [22].

Data analysis

Two investigators (TSY and DZQ) entered the data and checked it. Basic information on IS survivors and caregivers were expressed as frequencies and percentages. The scores for each dimension and item on CCDS and FS-14 were recorded as mean and standard deviation. The t-test of two independent samples or the ANOVA test of multiple independent samples were used to analyze the basic information of participants, survivors' care dependence, and caregiver fatigue. Then, we used a multiple linear regression analysis model to analyze the influencing factors of survivors' care dependence and caregiver fatigue. Moreover, the Mantel-Haenszel chisquare test was used for orderly classified data. Finally, the correlation between survivors' care dependence and caregiver fatigue was evaluated by using Pearson correlation analysis and Kendall Tau b correlation analysis. Excel 2019 was used for data input and validation, while SPSS 25.0 was used for statistical analyses. Statistical significance was set at P < 0.05 (two-tailed).

Results

We surveyed 413 pairs of IS (ischemic stroke) survivors and caregivers, and excluded 33 pairs of participants. Ultimately, we included 380 IS survivors, 257 males (67.63%) and 123 females (32.37%), with an age range of $18 \sim 88$ years and a mean age of 64.07(12.62) years, as shown in Table 1. Among the 380 caregivers included, 124 (32.63%) were males and 256 (67.37%) were females, with an age range of $22 \sim 88$ years and an average age of 63.41(12.87) years, as shown in Table 2.

Current status and influencing factors of care dependence Total score on the Chinese care dependency scale

The total score of care dependence in the IS (ischemic stroke) survivors was 53.91(15.95), that of the physical function dimension was 30.45(9.47), and that of the psychological function dimension was 23.46(6.91). There were 74 survivors (19.47%) with severe care dependence, 27 survivors (7.11%) with moderate care dependence, 239 survivors (62.89%) with mild care dependence, and 40 survivors (10.53%) with almost independence. See Table 3 for details.

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$\begin{array}{c} {\rm Critical} & {\rm finite} & {2.7} & {\rm or} .57 \\ {\rm female} & {123} & {32.37} \\ {\rm Age} ({\rm years}) & \leq 44 & {21} & {5.53} \\ {\rm 4565} & {156} & {41.05} \\ {\rm \geq} 66 & {203} & {53.42} \\ {\rm Marital status} & {\rm have a spouse} & {333} & {87.63} \\ {\rm no spouse} & {47} & {12.37} \\ {\rm Education} & {\rm elementary education} & {153} & {40.26} \\ {\rm secondary education} & {179} & {47.11} \\ {\rm higher education} & {48} & {12.63} \\ {\rm Monthly house-} & \leq 1000 & {4} & {1.05} \\ {\rm hold income} ({\rm *}) & {1001-3000} & {167} & {43.95} \\ 3001-6000 & {171} & {45.00} \\ {\rm \geq} 6001 & {38} & {10.00} \\ {\rm Nedical expense} & {\rm self-paying medical} & {95} & {25.00} \\ {\rm Payers} & {\rm service} & {\rm health insurance} & {285} & {75.00} \\ {\rm Working status} & {\rm no incumbency} & {273} & {71.84} \\ {\rm incumbency} & {107} & {28.16} \\ {\rm BMI} & <{18.5} & {19} & {5.00} \\ {\rm 18.5-23.9} & {193} & {50.79} \\ {\rm 24-27.9} & {125} & {32.89} \\ {\rm > 28} & {43} & {11.32} \\ {\rm NIHSS} ({\rm points}) & {\rm 1-4} & {129} & {33.95} \\ {\rm 5-14} & {216} & {56.84} \\ {\rm 15-42} & {35} & {9.21} \\ {\rm Duration of dis-} & <3 & {262} & {68.95} \\ {\rm ease} ({\rm months}) & {3-6} & {36} & {9.47} \\ {\rm 6-12} & {31} & {8.16} \\ {\rm more than 12} & {51} & {13.42} \\ {\rm Number of} & {\rm first} & {282} & {74.21} \\ {\rm strokes} & {2} times and more} & {98} & {25.79} \\ {\rm Number of} & {\rm o-1} & {183} & {48.16} \\ {\rm comorbidities} & {\sim}4 & {34} & {8.95} \\ {\rm > 4} & {34} & {8.95} \\ \end{array} $	Gender	male	257	67.63
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no 55 14.47		no	55	14.47

Variable	Category	Frequence	Per-
Table 1	Basic information of	fischemic stroke survivors	(N = 380)

BMI=Body Mass Index, NIHSS=National Institute of Health Stroke Scale, Comorbidities include hypertension, diabetes, hyperlipidemia, coronary heart disease, atrial fibrillation, etc

Scores for each item on the Chinese care dependency scale Of the 15 items, the lowest score was item 4: Mobility, and the highest score was item 11: Sense of rules and values. The five items with the highest scores were: Item 11, Item 6, Item 2, Item 1, and Item 10. The three items with the lowest scores were: Item 4, Item 8, and Item 3. See Table 3 for details.

Variable	Category	Frequence	Per- cent- age (%)
Gender	male	124	32.63
	female	256	67.37
Age (years)	≤44	25	6.58
	45~64	160	42.11
	≥65	195	51.32
Marital status	have a spouse	370	97.37
	no spouse	10	2.63
Education	elementary education	130	34.21
	secondary education	205	53.95
	higher education	45	11.84
Monthly house-	≤1000	18	4.74
hold income (¥)	1001~3000	171	45.00
	3001~6000	161	42.37
	≥6001	30	7.89
Working status	no incumbency	314	82.63
	incumbency	66	17.37
Conscious health	good	334	87.89
status	not bad	45	11.84
	bad	1	0.26
Conscious sleep	good	286	75.26
status	not bad	82	21.58
	bad	12	3.16
Relationship with	spouse	213	56.05
survivors	children	130	34.21
	parents	9	2.37
	sibling	2	0.53
	other	26	6.84
Number of survi-	0	246	64.74
vors cared for at	1	78	20.53
the same time	≥2	56	14.74
Daily care time	<6	13	3.42
(hours)	6~12	299	78.68
	>12	68	17.89

Number of survivors cared for at the same time: 0 means care for 1 IS survivor, 1 means care for 1 IS survivor and another patient, and \geq 2 means care for 1 IS survivor and at least 2 patients

Influencing factors of care dependence

Multiple linear regression analysis showed that the influencing factors of care dependence of IS survivors were age of survivors (β =-9.606, *P*=0.005), total score of NIHSS (β =-12.755, *P*<0.001), and number of comorbidities (β =-2.868, *P*=0.006). See Table 4 for details.

Current status and influencing factors of caregiver fatigue Total score on the fatigue scale-14

The total score of caregivers' FS-14 was 8.34(3.58). The physical fatigue dimension was 5.47(2.20), and the psychological fatigue dimension was 2.87(1.79). Caregiver fatigue was severe in 154 caregivers (40.53%), moderate

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Table 3Scores of items on the Chinese care dependency scalefor ischemic stroke survivors

Items	Mean±stan- dard deviation or Frequence (Percentage)
11. Sense of rules and values	4.40±1.118
6. Body temperature	4.34 ± 1.206
2. Incontinence	4.16±1.209
1. Eating and drinking	4.14±1.319
10. Contact with others	4.06 ± 1.331
9. Communication	3.97 ± 1.355
14. Learning ability	3.88 ± 1.301
5. Getting dressed and undressed	3.84 ± 1.386
7. Hygiene	3.83 ± 1.363
13. Recreational activities	3.61±1.322
12. Daily activities	3.55 ± 1.357
3.Body posture	3.54 ± 1.403
8. Avoidance of danger	3.37±1.183
4. Mobility	3.23±1.379
Total score of care dependence	53.91 ± 15.95
Total score of physical function dimension	30.45 ± 9.47
Total score of psychological function dimension	23.46 ± 6.91
Severe care dependence	74 (19.47%)
Moderate care dependence	27 (7.11%)
Almost independence	40 (10.53%)

in 163 caregivers (42.89%) and mild in 63 caregivers (16.58%), as detailed in Table 5.

Scores for each item on the fatigue scale-14

The lowest score on the FS-14 was item 11; The highest score was item 1. The five items with the highest scores were: Items 1 to 5, and the three items with the lowest scores were: Item 11, Item 14, Item 12 and Item 7 (the latter three items were equally scored), as detailed in Table 5.

Influencing factors of caregiver fatigue

Multiple linear regression analysis revealed that influencing factors of caregiver fatigue were as follows: total score of CCDS (β = -0.03, *P*=0.011), total score of NIHSS (β =0.56, *P*=0.032), conscious health status of caregivers (β =1.36, *P*=0.024), conscious sleep status of caregivers

Table 5	Scores	of items	on the	fatique	scale-	14

Items	Mean±stan- dard deviation or Frequence
1. Have you over been plaqued by fatigue?	(Percentage)
2. De vev peed mere rest?	0.92±0.27
2. Do you need more rest?	0.89±0.32
3. Do you feel sleepy or lethargic?	0.80 ± 0.40
4. Do you struggle to get started?	0.69 ± 0.46
5. Are you feeling overwhelmed by what to do?	0.63 ± 0.48
6. Do you feel that you don't have enough stamina?	0.58 ± 0.49
10. Are you as clear and agile as usual when thinking about problems?	0.52 ± 0.50
8. Do you feel weak?	0.51 ± 0.50
9. Do you have difficulty concentrating?	0.51 ± 0.50
13. Is your memory going on as usual now?	0.49 ± 0.50
7. Do you have less strength in your muscles?	0.46 ± 0.50
12. Do you find it difficult to find the right word when speaking?	0.46 ± 0.50
14. Do you still enjoy doing what you used to do?	0.46 ± 0.50
11. Do you experience verbal disadvantage when you speak?	0.43 ± 0.50
Total score of caregiver fatigue	8.34 ± 3.58
Total score of physical fatigue dimension	5.47 ± 2.20
Total score of psychological fatigue dimension	2.87±1.79
Severe caregiver fatigue	154 (40.53%)
Moderate caregiver fatigue	163 (42.89%)
Mild caregiver fatigue	63 (16.58%)

(β = 2.29, *P* < 0.001), and number of survivors cared for at the same time (β = 0.74, *P* = 0.002). See Table 6 for details.

Correlation analysis between care dependence and caregiver fatigue

Kendall Tau b correlation analysis showed that IS (ischemic stroke) survivors' care dependence was positively correlated with caregiver fatigue(P < 0.001), and caregiver fatigue increased with increasing care dependence. Pearson correlation analysis revealed that physical(r= -0.28, P < 0.001) or psychological(r= -0.21, P < 0.001) care dependence of IS survivors all positively correlated with caregiver fatigue. See Table 7 for details.

Table 4 Multiple linear regression analysis of care dependence for ischemic stroke survivors

Variable	Non-standardized		Normalize	t	Р	95% Confidence interval	
	Partial regression coefficient	Standard coefficient	regression coefficient			Lower limit	Upper limit
Constant	91.45	8.514	0	10.74	< 0.001	74.707	108.192
Age of survivors	-9.606	3.425	-0.362	-2.80	0.005	-16.341	-2.871
Total score of NIHSS	-12.755	1.112	-0.487	-11.47	< 0.001	-14.942	-10.568
Number of comorbidities	-2.868	1.041	-0.116	-2.76	0.006	-4.915	-0.822

NIHSS = National Institute of Health Stroke Scale

Variable	Non-standardized		Normalize regression	t	Ρ	95% Confidence interval	
	Partial regression coefficient	Standard coefficient	coefficient			Lower limit	Upper limit
Constant	3.69	2.205	0	1.67	0.095	-0.646	8.026
Total score of CCDS	-0.03	0.013	-0.146	-2.57	0.011	-0.058	-0.008
Total score of NIHSS	0.56	0.321	0.095	1.74	0.032	-0.072	1.191
Conscious health status of caregivers	1.36	0.599	0.124	2.27	0.024	0.183	2.538
Conscious sleep status of caregivers	2.29	0.461	0.276	4.96	< 0.001	1.381	3.193
Number of survivors cared for at the same time	0.74	0.237	0.153	3.12	0.002	0.274	1.206

Table 6 Multiple linear regression analysis of caregiver fatigue

CCDS = Chinese Care Dependency Scale, NIHSS = National Institute of Health Stroke Scale

Table 7 Correlation analysis of care dependence and caregiver fatigue in ischemic stroke survivors

Correlation		Physical fatigue	Psycho- logical fatigue	Total score of FS-14
Kendall Tau b correlation coefficient		0.23	0.07	0.18
	Ρ	< 0.001	0.126	< 0.001
Pearson correlation analysis				
physical care dependence	r	-0.34	-0.13	-0.28
	Ρ	< 0.001	0.010	< 0.001
psychological care dependence	r	-0.28	-0.09	-0.21
	Ρ	< 0.001	0.088	< 0.001
total score of CCDS	r	-0.32	-0.12	-0.26
	Р	< 0.001	0.023	< 0.001

FS-14 = Fatigue Scale-14, CCDS = Chinese Care Dependency Scale

Discussion

We completed a cross-sectional survey of 380 pairs of participants on care dependence and caregiver fatigue in IS survivors. Notably, we not only considered the physical factors explored in previous studies, but also analyzed psychological factors. This would effectively complement previous results and might help IS survivors recover. Furthermore, what is innovative is that we identified a positive correlation between survivors' care dependence and caregiver fatigue. This research was of great significance in improving the health outcomes of IS survivors and helping caregivers reduce their burden.

The results of survivors' care dependence showed that it was influenced by the age of survivors, total score of NIHSS and number of comorbidities. We found that both physical function dimension and psychological function dimension, the older the survivors were, the worse the care dependence, which was similar to the findings of Grimby et al. [23]. This could be because, as we age, survivors' body functions, such as vision, hearing and memory, gradually decline, as does their inner motivation and initiative. In clinical work, we should develop targeted nursing measures according to the age of IS survivors, with a greater focus on elderly survivors. The total score of NIHSS and number of comorbidities reflect the severity of survivors' condition from different aspects, which can affect care dependence [9, 24]. However, for a more specific analysis, number of comorbidities did not have a substantial effect on care dependence. In this study, there was little difference in the CCDS scores between groups with different number of comorbidities. In contrast, the impact of total score of NIHSS may be more critical. This may be because in long-term disease, survivors adapted to the impact of chronic comorbidities, however IS was a sudden disease, and survivors would be affected quickly and severely, so that total score of NIHSS could better reflect the survivors' illness and care dependence at this time. What's more, gender, education and occupation of survivors may also affect care dependence, but this study ultimately did not confirm these factors, and more research is needed in the future [25, 26].

Caregiver fatigue is also a problem that deserves our attention. Our results showed that moderate fatigue accounted for the highest proportion (42.9%), followed by severe fatigue (40.5%). These results provided us with a strong sense of urgency and mission to help them. A study showed that, if survivors' self-care ability was further reduced, the situation of caregivers may worsen [27]. From the perspective of different dimensions, the physical fatigue of caregivers was severe, and the psychological fatigue is moderate, which was consistent with the research results of Sun [28]. On the one hand, such a result may be because caregivers need to take care of IS survivors for 24 h to understand the illness and treatment of survivors, and the noisy environment in the ward also prevent caregivers from resting well. On the other hand, the average age of the caregivers included in this study was relatively high, with elderly caregivers accounting for 51.3% and female caregivers accounting for the majority (67.4%). They had less physical strength, which may increase the incidence of physical fatigue. In addition, we investigated survivors during hospitalization, which may not have been studied long enough, and the psychological fatigue of caregivers was not fully manifested [16].

Caregiver fatigue is affected by many factors. our research revealed that there were 5 most likely factors: survivors' care dependence, total NIHSS score of survivors, caregivers' conscious health or sleep status, and number of survivors cared for at the same time. We divided total NIHSS score of survivors into three groups: $1 \sim 4$ points, $5 \sim 14$ points and $15 \sim 42$ points. We considered previous research results and related clinical criteria: total NIHSS score \geq 15 was the criterion for severe stroke [29]. Different grouping methods may result in more detailed results. Total NIHSS score were assessed by healthcare professionals, but survivors may not agree with these results. A research showed that when 32 survivors and caregivers were surveyed at 3 and 7 months after stroke, the survivors all deemed their memory and thinking better than their caregivers assessed them [30]. Survivors' assessment of their own illness conditions were inconsistent with those of caregivers, which exacerbated caregiver fatigue to some extent.

In addition to the survivors' factor, caregiver fatigue was also affected by themselves. Our research showed that the worse the caregivers' conscious health status, sleep status, and number of survivors cared for at the same time \geq 2, the worse the caregiver fatigue, which was similar to the findings of Lu et al. [31]. The most noteworthy point was the third one. We all knew that China was a populous country with many family members, and it seemed that caregivers would not take on such a large workload. However, the reality was that young families needed to go out to work, children needed to go to school, and middle-aged or elderly people without jobs assumed the main role of caregivers [27]. Therefore, we called on the families of survivors, especially young people, to take the initiative to help caregivers during breaks to reduce caregiver fatigue. In addition, although our study results were not similar to those of some scholars reported the influence of caregiver age and gender on fatigue [32, 33]. These results may be influenced by the region of the study population, sample size, ratio of men to women, or ratio by age group, and needed to be further explored in future studies.

Last but not least, we found that survivors' care dependence was positively correlated with caregiver fatigue. This correlation was strong and widely observed for various combinations of survivors and caregivers (regardless of age, gender, kinship, etc.). We thought that the more severe the survivors' care dependence was, the more the caregivers had to do and worked longer hours, which aggravated caregiver fatigue [16]. Theoretically, caregivers should have enough knowledge and skills in stroke rehabilitation if they want to be competent in care work, but the reality was completely unable to meet these requirements [14]. Clinicians and nurses should know more about the demands of survivors and caregivers, and patiently explain how to take care of survivors, so that they can benefit more. More importantly, we need to recognize the positive connections between survivors and caregivers, while also paying attention to their circumstances and adopting collaborative measures that may help reduce their burden.

Our study also had some limitations. First, the study participants were from only one general hospital, so the results may be biased. Expanding the sample size and conducting multi-institutional and multi-regional studies may better verify the results. Second, the study was a cross-sectional study and could not reflect the dynamic changes in care dependence and caregiver fatigue. Some factors, such as stroke duration and length of hospital stay, may be supplemented by longitudinal studies. Third, research tools we used were the CCDS and FS-14. Research results may be biased due to different research tools, but we tried our best to obtain the most authentic thoughts of participants to ensure the reliability of data.

Conclusions

In conclusion, care dependence in IS (ischemic stroke) survivors was mainly mild or severe, and the main influencing factors were age of survivors, total score of NIHSS, and number of comorbidities. Caregiver fatigue was mainly moderate and severe, and the worse the care dependence of survivors was, the worse the physical and psychological fatigue of caregivers was. We needed to focus on helping caregivers with the following characteristics: conscious health or sleep status was bad, number of survivors cared for at the same time ≥ 2 , and total NIHSS score of survivors were high. Clinicians and nurses should timely assess their needs and adopt collaborative measures to assist them, for example, care courses are conducted during hospitalization and regular telephone follow-up after discharge, so that survivors and caregivers can benefit more.

Abbreviations

- NIHSS National Institute of Health Stroke Scale
- IS Ischemic stroke
- ICD International Classification of diseases
- BMI Body Mass Index
- CDS Care Dependency Scale
- CCDS Chinese version of CDS
- FS-14 Fatigue Scale-14
- SPSS Statistical Package for the Social Sciences

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Author contributions

TSY and DZQ collected and analysed the data; DZQ and TSY wrote paper; LSQ and WJY assisted in collecting the data; YR provided the main study ideas; YR and ZLH help deal with various problems in the study.

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Data availability

The data that support the findings of this study are available in the supplementary material of this article and are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of West China Hospital, Sichuan University (No.2018 – 496). All methods were performed in accordance with the relevant guidelines and regulations. Based on the principle of informed consent, all potential participants received a study introduction, which outlined the purpose of the study, the risks and benefits of participation, confirmed participation was entirely voluntary and the likely time commitment. The procedure included the assurance of anonymity and the possibility to withdraw from the study at any stage without explanation and without consequences. All authors and participants gave consent for participation. This study adhered to the Declaration of Helsinki.

Consent for publication

All the authors read and agreed to publish it.

Competing interests

The authors declare no competing interests.

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