



Sequential mediation model of social support, care burden, and internalized stigma among family function and depression in caregivers of patients with schizophrenia: evidence from a cross-sectional study in southwest China

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Abstract

Purpose There is a lack of comprehensive measurements and systematic evaluations of the depression in caregivers of patients with psychiatric disorders and the factors influencing them in China. This study aims to explore the relationship between family function and depression in caregivers of patients with schizophrenia at the individual, family, and social levels according to the ecological system theory and attachment theory.

Methods In this study, multi-stage, stratified cluster sampling was adopted to sample caregivers of patients with schizophrenia as subjects from one to three counties of four counties in Yunnan, from September 2022 to March 2023. Collecting the current caregiver's demographic data, family functions, social support, care burden, depression and internalized stigma.

Results The results of single-factor analysis show that age, education level, relationship with patients, and the degree of self-care of patients are the influencing factors of depression of people living with schizophrenia ($p < 0.05$). The scores of self-rating depression scale are higher for caregivers who have not received formal education, caregivers who cannot take care of themselves and the parents, spouses and children of patients. The results of Pearson correlation analysis show that depression is positively associated with internalized stigma and care burden, and negatively associated with social support and family function ($p < 0.05$). The results of multiple linear regression show that after controlling age, education level, the patient's self-care capacity, and relationship with patient, the internalized stigma ($\beta = 0.184$, $p = 0.01$) is positively correlated with depression. The mediation effect route of family function \rightarrow social support \rightarrow care burden \rightarrow internalized stigma \rightarrow depression was significant with 95% confidence interval $[-0.150, -0.01]$, and the chained mediation effect was 5.904%.

Conclusions To reduce the depression level in family caregivers of schizophrenia, apart from taking measures to improve the caregiver's family function, enhancing social support, decreasing care burden, and reducing internalized stigma are suggested.

Keywords Care burden · Depression social support · Family function · Internalized stigma

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Introduction

Schizophrenia is a chronic and severe mental disorder [1] that affects approximately 21 million people worldwide [2, 3], leading to significant impairments in cognitive, emotional, and social functioning [1]. The burden of this disorder extends beyond the patients themselves to their families, who often take on the role of primary caregivers. This article aims to explore the intricate relationships between family function, social support, caregiver burden, internalized stigma, and depressive symptoms among the family members of patients with schizophrenia.

Family function plays a crucial role in the management of schizophrenia. Effective family functioning can provide a stable and supportive environment, which is essential for the patient's recovery and overall well-being. Studies have shown that poor family function is associated with worse outcomes for patients, including higher relapse rates and more severe symptoms [4]. On the other hand, strong family support can mitigate the negative impacts of the disorder, improving both the patient's and the caregiver's quality of life.

Social support is another critical factor that influences the well-being of both patients and their caregivers. Social support can come from various sources, including family, friends, and community services. It has been found to reduce caregiver burden and depressive symptoms, thereby enhancing the overall mental health of caregivers [5]. Moreover, social support can act as a buffer against the stress associated with caregiving, making it easier for caregivers to manage their responsibilities [6].

Caregiver burden is a significant issue for families of patients with schizophrenia. The demands of caregiving can lead to physical, emotional, and financial strain, which in turn can affect the caregiver's mental health. High levels of caregiver burden are associated with increased depressive symptoms and lower quality of life [7]. Interventions aimed at reducing caregiver burden, such as respite care and support groups, have been shown to be effective in improving caregiver well-being [8].

Internalized stigma is another factor that can exacerbate the challenges faced by both patients and caregivers. Stigma associated with mental illness can lead to feelings of shame, guilt, and isolation, which can worsen depressive symptoms and reduce the effectiveness of social support [9]. Addressing internalized stigma through psychoeducation and anti-stigma campaigns can help improve the mental health of both patients and caregivers [10].

Depressive symptoms are common among both patients with schizophrenia and their caregivers [11]. The chronic nature of the disorder, coupled with the high levels of stress and burden associated with caregiving, can lead to

significant depressive symptoms. These symptoms can further impair the ability of caregivers to provide effective support, creating a vicious cycle that negatively impacts both the patient and the caregiver [12]. Effective management of depressive symptoms through pharmacological and non-pharmacological interventions is essential for improving the overall well-being of both patients and caregivers [13].

Family members usually play the role of care for patients with schizophrenia for free and these care experiences may damage the physical and mental health of caregivers. From the perspective of family system theory, the burden of disease caused by schizophrenia can be regarded as external pressure on the family system, which may have an impact on a stable family system. Therefore, we will focus on the family level of schizophrenia and conduct a comprehensive investigation of the depression status and influencing factors of People living with schizophrenia (PLWS)¹ in underdeveloped multi-ethnic areas of southwest China, especially to further explore the path and intermediary effect of social support, care burden and internal stigma in family function and depression. Verifying the accessibility and effectiveness of the family care model for schizophrenia from the family level, aims to strengthen the public's attention to the group of PLWS in the underdeveloped multi-ethnic areas of southwest China, and to provide targeted interventions to improve the mental health of PLWS. Based on the research purpose, we propose the intermediary model shown in Fig. 1 and put forward the following five assumptions: family function is positively related to social support (hypothesis 1), negatively correlated with depression (hypothesis 2), social support is negatively correlated with the care burden (hypothesis 3), care burden is positively correlated with the internalized stigma (hypothesis 4), the positive correlation between the internalized stigma and depression (hypothesis 5), social support, care burden, and the chain intermediary effect of internal stigma between family function and depression is significant (hypothesis 6). The specific research subjects of this study are the primary caregivers of patients with schizophrenia, with a focus on analyzing their family functioning, social support, caregiving burden, internalized stigma, and depression, as well as the interrelationships among these aspects. Previous research in this field has yielded some findings, such as the significant impact of caregivers' social support and mental health on patient recovery. However, these studies have predominantly concentrated on developed regions, lacking systematic research on multi-ethnic, less-developed areas. The direct relevance of these research subjects to the issues addressed in this study underscores the potential of this research to reveal the unique needs and challenges faced by caregivers of patients with schizophrenia

¹ PLWS: People living with schizophrenia.

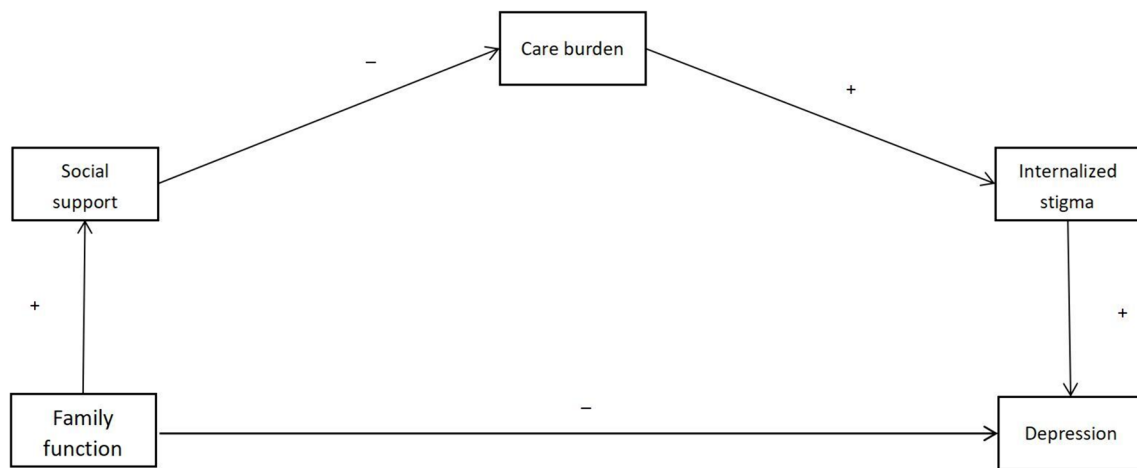


Fig. 1 The theoretical model and hypothesis

in multi-ethnic, less-developed regions, thereby providing a scientific basis for the development of more effective intervention measures.

In summary, this article will delve into the complex interplay between family function, social support, caregiver burden, internalized stigma, and depressive symptoms in the context of schizophrenia. By understanding these relationships, we can develop more effective strategies to support both patients and their families, ultimately improving their quality of life.

Materials and methods

Participants

This cross-sectional study was based on the Schizophrenia-specific cohort in the Less-developed Multi-ethnic Region of Southwestern China (SCZC-LMSWC)² created from 2010 to 2020. Multi-stage, stratified cluster sampling was adopted to sample caregivers of patients with schizophrenia as subjects from one to three counties of four counties in Yunnan, respectively: (1) Longyang, Baoshan, (2) Tengchong, (3) Shidian, and (4) Changning, nine townships in all, from September 2022 to March 2023.

Inclusion criteria were as follows: (1) those who take primary care responsibility; (2) those who take care of patients for more than 3 months; (3) those who voluntarily signed informed consent; (4) those who aged greater than 18 years; (5) those who do not have history of mental illness; (6) those who did not report serious cognitive dysfunction. Exclusion

criteria were as follows: (1) those who denied to sign the informed consent or reject to participate in this study; (2) those who suffered from severe physical diseases.

The study included 211 participants at last. The investigators were trained in standardized data collection methods before the formal investigation; on the day of the investigation, the investigators explained the purpose of this study in detail to the participants, and after obtaining informed consent from the participants, the face-to-face survey was conducted by electronic questionnaires. The demographic information collected in this study included gender, ethnicity, age, marital status, education, occupational status, the monthly average income of family members, relationship with the patient, daily caregiving time, and the number of relapses and self-care capacity of schizophrenia patients.

Measurements

Family function

The Family APGAR³ developed by Smilkstein et al. [14] was used to measure the family function of participants. The scale is divided into five attributes: Adaptation, Partnership, Growth, Affection, and Resolve, with each dimension evaluated by one 3-point scale ranging from 0 to 2. The scale has a total scale score of 0 to 10, with a higher total score indicating better family function. The Cronbach's α of the scale in this study was 0.914.

² SCZC-LMSWC: Schizophrenia-specific cohort in the Less-developed Multi-ethnic Region of Southwestern China.

³ APGAR: Adaptation, Partnership, Growth, Affection and Resolve.

Social support

The Social Support Rate Scale (SSRS)⁴ developed in 1986 and revised in 1990 by Chinese scholar Xiao Shuiyuan [15] was adopted to evaluate the social support of participants. The scale consists of 10 items, including three attributes: subjective support, objective support, and support utilization. Items 1 to 4 and items 8 to 10 were evaluated by a 4-point scale ranging from 1 to 4 (none, few, normal, and adequate support). The total score for the subitem is the score for entry 5; for items 6 and 7, if *without any source* is selected, the score is 0, if *with the following sources* is selected, the total number of sources is the score of the item. The higher the score, the higher the level of social support. The Cronbach's α for this instrument was 0.780 in this study.

Care burden

The Chinese version of the Zarit burden interview (ZBI)⁵ [16] was used to assess the care burden of participants. The scale has 22 items, including two attributes: personal burden and role burden. Each item was evaluated by a 5-point scale (never, occasionally, sometimes, usually, and always) ranging from 0 to 4, with a total score of 0 to 88. The higher the total score, the heavier the care burden. A total score of 0 to 19 indicates no or few burdens, a score of 20 to 39 indicates mild burdens; a score of 40 to 59 indicates moderate burdens; and a score greater than 60 indicates severe burdens. The Cronbach's α for this scale was 0.907 in this study.

Internalized stigma

The Internalized Stigma of Mental Illness (ISMI)⁶ [17] was adopted to measure the internalized stigma of participants. The scale consists of 29 items, including five attributes: Alienation, Stereotype Endorsement, Perceived Discrimination, Social Withdrawal, and Stigma Resistance. Each item was coded by a 4-point scale (1 refers to Strongly Disagree and 4 refers to Strongly Agree), but the five items in attribute Stigma Resistance were reverse-coded items. The score for each attribute was divided by the number of items to calculate the standardized score. A standardized score of less than 2 represents stigma, a score of 2.1 to 2.5 represents mild stigma, a score of 2.6 to 3.0 represents moderate stigma, and a score greater than 3.0 represents severe stigma. The Cronbach's α for this scale was 0.930 in this study.

Depression

The Self-Rating Depression Scale (SDS)⁷ [18] was used to assess participants' depression. The scale consists of 20 items that reflect the subjective feelings of depressed patients by assessing the frequency of symptoms by a 4-point scale, with items 2, 5, 6, 11, 12, 14, 16, 17, 18, and 20 being reverse-coded. In this study, the standardized score was used as the measurement, and the standardized score equals the sum of the scores multiplied by 1.25, with a total score ranging from 25 to 100. A standardized score greater than 53 represents subjects suffering from depression symptoms. The higher the score, the severer the depressive state. The Cronbach's α of the scale was 0.821 in this study.

Date analysis

Data were analyzed using R studio. The reliability of the scales was evaluated by *psych*; the scores of APGAR, SSRS, ZBI, and ISMI scales were grouped demonstrated (mean \pm standard deviation) by *doBy*; two independent samples t-test and one-way ANOVA were performed by *car*; correlation analysis and heat map were performed by *corrplot*; chain multiple mediation was analyzed by PROCESS, which was activated by *devtools*.

Findings

Demographic characteristics

A total of 211 SCZ⁸ caregivers completed the investigation. The mean age of the participants was 57.2 ± 14.7 years. The participants spent 10.807 ± 7.6297 h per day with the patients. There were 41.71% ($n=88$) of the participants had a standardized score of SDS greater than 53 (Table 1).

Comparison of crucial variable scores between groups of demographic characteristics

In the investigation, the mean (SD)⁹ of APGAR score was 6.16 (3.26). The mean (SD) of SSRS score was 32.39 (8.43). The mean (SD) of ZBI score was 26.18 (14.84). The mean (SD) of ISMI score was 67.61(13.73). The mean (SD) of SDS score was 49.88 (11.31). APGAR score by relationship with patient and number of relapses were significantly different ($p < 0.05$). SSRS score by age, education level, relationship with patient and number of relapses were significantly

⁴ SSRS: Social Support Rate Scale.

⁵ ZBI: Zarit Burden Interview.

⁶ ISMI: Internalized Stigma of Mental Illness.

⁷ SDS: Self-rating Depression Scale.

⁸ SCZ: schizophrenia.

⁹ SD: Standard Deviation.

Table 1 Comparison of crucial variable scores between the demographic variables of caregivers [Mean (SD)]

Characteristic	N (%)	APGAR score	P-value	SSRS score	P-value	ZBI score	P-value	ISMI score	P-value	SDS score	P-value
Sex											
Male	98(46.4)	6.16(3.25)	0.977	32.37(8.55)	0.967	24.92(14.71)	0.253	65.95(14.39)	0.101	48.61(10.50)	0.055
Female	113(53.6)	6.15(3.29)		32.42(8.37)		27.27(14.92)		69.05(13.01)		51.23(11.77)	
Age											
19 ~	36(17.1)	6.64(2.94)	0.565	35.33(9.12)	0.014*	21.72(13.6)	0.015*	59.89(12.71)	<0.001***	47.64(10.14) ^a	0.002**
45 ~	73(34.6)	6.14(3.49)		33.45(8.62)		27.81(14.32) ^a		66.11(13.67) ^e		47.19(11.21) ^a	
60 ~	83(39.3)	5.84(3.11)		30.36(7.51) ^e		28.31(15.28) ^a		72.23(12.96) ^e		53.03(11.55)	
75 ~	19(9.0)	6.68(3.67)		31.63(8.46)		19.00(14.07)		67.84(12.00) ^e		54.34(7.96)	
Marital status											
Married	179(84.8)	6.27(3.27)	0.24	32.70(8.42)	0.215	26.31(14.84)	0.761	67.99(13.51)	0.339	49.83(11.26)	0.253
Else	32(15.2)	5.53(3.18)		30.69(8.41)		25.44(15.05)		65.47(14.94)		52.30(11.18)	
Education level											
Non-formal schooling	35(16.6)	5.83(3.42)	0.745	29.74(8.78)	0.015*	29.49(15.59)	0.073	73.34(13.16)	0.015*	56.43(10.29)	0.001**
Primary	83(39.3)	5.99(3.45)		31.35(7.60)		26.40(14.33)		68.30(13.67)		50.51(10.81) ^b	
Junior high school	68(32.2)	6.46(3.09)		34.78(8.97) ^b		26.66(16.03)		65.24(13.51) ^b		47.37(11.24) ^b	
High school/technical secondary and above	25(11.8)	6.36(2.97)		33.08(7.77)		19.48(9.96)		63.76(13.19) ^b		48.2(11.12) ^b	
Occupation											
Farmer	95(45.0)	5.84(3.44)	0.206	31.81(8.96)	0.365	27.00(15.29)	0.466	70.61(13.93)	0.004**	51.11(11.41)	0.296
Else	116(55.0)	6.41(3.11)		32.87(7.98)		25.5(14.48)		65.16(13.11)		49.47(11.12)	
Personal monthly income											
< 3000 RMB	172(81.5)	6.07(3.31)	0.42	31.95(8.62)	0.112	27.7(14.74)	0.002**	68.77(13.75)	0.009**	50.6(11.63)	0.224
≥ 3000 RMB	39(18.5)	6.54(3.09)		34.33(7.36)		19.46(13.47)		62.49(12.53)		48.46(9.38)	
Relationship with patient											
Parents	74(35.1)	5.95(3.48) ^c	0.005**	31.27(8.39)	0.041*	29.04(16.90) ^c	<0.001***	69.18(16.00) ^c	0.001**	52.16(11.98) ^c	0.019*
Spouse	66(31.3)	5.48(3.03) ^c		31.15(8.11)		28.18(12.26) ^c		71.38(11.26) ^c		50.64(10.68) ^c	
Children	38(18.0)	6.21(3.26) ^c		34.95(9.42)		25.92(14.83) ^c		63.11(11.72)		50.3(11.33) ^c	
Else	33(15.6)	7.91(2.69)		34.45(7.20)		16.03(10.00)		61.76(11.90)		44.85(9.24)	

^ameans that the difference is statistically significant compared with ≥ 75 years old in age

^bmeans that the difference is statistically significant compared with illiteracy in education level

^cmeans that the difference is statistically significant compared with other relatives in the relationship with patient

*P < 0.05, **P < 0.01, ***P < 0.001

different ($p < 0.05$). ZBI scores by age, personal monthly income, relationship with the patient, number of relapses and self-care capacity were significantly different ($p < 0.05$). ISMI scores by age, education level, occupation, personal monthly income, relationship with the patient and number of relapses were significantly different ($p < 0.05$). SDS scores by age, education level, relationship with the patient and the self-care capacity ($p < 0.05$), the results of single-factor analysis show that age, education level, relationship with patients, and the degree of self-care of patients are the influencing factors of the SDS scale score of PLWS. The two comparison results show that compared with PLWS who are ≥ 75 years old, the score of SDS scale of 19 to 59 years old is lower. Compared with PLWS who have not received formal education, the score of SDS scale with education level of primary school or above is lower. Consistent with the conjecture, the SDS score of parents, spouse and children of patients is higher than other relatives, and the score of SDS scale of PLWS, which is completely self-care, is lower than unable to care himself (Tables 1 and 2).

Pearson correlation analysis between crucial variables

Pearson correlation analysis demonstrated that ISMI scores were significantly associated with ZBI scores ($r = 0.65$, $p < 0.001$) and SDS scores ($r = 0.43$, $p < 0.001$) positively, and significantly associated with SSRS scores ($r = -0.40$, $p < 0.001$), and APGAR scores ($r = -0.35$, $p < 0.001$) negatively. ZBI scores were significantly associated with SDS scores ($r = 0.38$, $p < 0.001$) positively and significantly associated with SSRS scores ($r = -0.37$, $p < 0.001$) and APGAR scores ($r = -0.40$, $p < 0.001$) negatively. SDS scores were significantly correlated with SSRS scores ($r = -0.36$, $p < 0.001$) and APGAR scores ($r = -0.32$, $p < 0.001$) negatively. SSRS score was significantly correlated with APGAR score ($r = 0.61$, $P < 0.001$) positively (Fig. 2 and Table 3).

Multiple linear regression of SDS

The results of single-factor analysis show that the score of SDS is statistically significant in terms of age, education level, the patient’s self-care capacity, and relationship with patient ($p < 0.05$). Relevant analysis results show that there is a correlation between the score of ZBI, SSRS, APGAR and ISMI and SDS score. Therefore, the score of SDS is used as the dependent variable, and the age, education level, the patient’s self-care capacity, the relationship with patient, ZBI, SSRS, ISMI, APGAR score as the independent variable for multiple linear regression analysis. First of all, the age, education level, the patient’s self-care capacity, and the relationship with patient are included in the analysis to obtain model 1. The results of model 1 show that $R^2 = 0.183$, the

Table 2 Comparison of crucial variable scores between the demographic variables of patients [Mean (SD)]

Characteristic	N (%)	APGAR score	P-value	SSRS score	P-value	ZBI score	P-value	ISMI score	P-value	SDS score	P-value
Number of relapses											
0	63(29.8)	7.22(3.08)	0.018*	35.17(8.58)	0.007**	20.86(16.03)	0.002**	62.59(13.45)	<0.001***	49.78(10.77)	0.519
1~5	91(43.1)	5.66(3.34)		32.03(7.51)		26.73(13.23)		67.31(12.89)		49.37(11.42)	
6~10	21(10)	5.48(3.36)		29.81(9.88) ^f		31.43(15.12) ^f		77.90(14.44) ^f		52.92(11.13)	
> 10	36(17.1)	5.94(2.99)		29.94(8.41) ^f		31.03(13.87) ^f		71.17(11.88) ^f		51.49(11.86)	
Self-care capacity											
Unable	27(12.8)	5.81(3.23)	0.811	32.19(8.79)	0.066	31.89(14.67)	0.004**	70.04(13.17)	0.411	53.84(9.56)	0.009**
Partial	89(42.2)	6.13(3.37)		30.93(8.55)		28.19(15.68)		68.2(13.94)		51.78(10.75)	
Total	95(45.0)	6.27(3.20)		33.82(8.06)		22.66(13.28) ^d		66.37(13.69)		47.7(11.71) ^d	

^dmeans that the difference is statistically significant compared with unable in self-care capacity

^fmeans that the difference is statistically significant compared with 0 in number of relapses

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

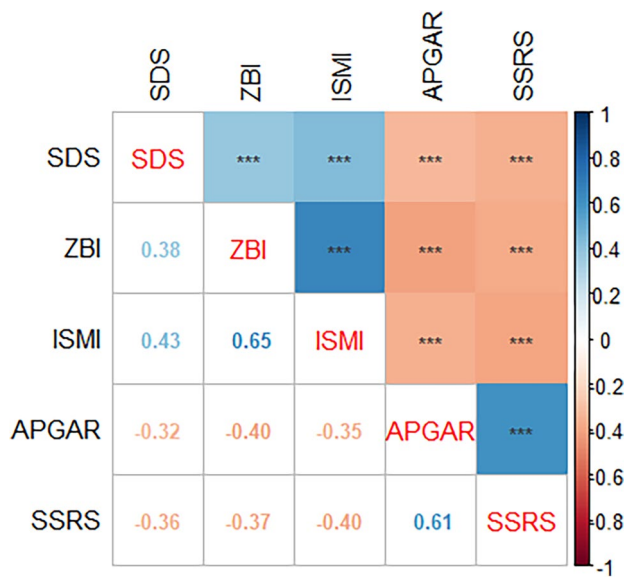


Fig. 2 Correlation heat map of key variables

Table 3 Pearson correlation analysis between crucial variables

	ISMI	ZBI	SDS	SSRS	APGAR
ISMI	1.00				
ZBI	0.65***	1.00			
SDS	0.43***	0.38***	1.00		
SSRS	-0.40***	-0.37***	-0.36***	1.00	
APGAR	-0.35***	-0.40***	-0.32***	0.61***	1.00

*** $P < 0.001$

education level, the patient’s self-care capacity and the relationship with the patient are the influencing factors of SDS score. On the basis of model 1, ZBI score, SSRS score, ISMI and APGAR score are added for hierarchical regression analysis to obtain model 2. The results show that $R^2 = 0.331$, ISMI score ($\beta = 0.184, p = 0.01$) is positively correlated with SDS score (Table 4 and supplementary material 2).

Chain multiple mediation effect of SSRS, ISMI, and ZBI between APGAR and SDS

Model 6 of PROCESS was used to test the chain multiple mediation effect of SSRS, ISMI, and ZBI between APGAR and SDS. Regression analyses showed that before the integration of the mediators, APGAR scores could positively predict SSRS scores ($\beta = 1.57, p < 0.001$) and negatively predict ZBI scores ($\beta = -1.27, p < 0.001$). SSRS scores could negatively predict ZBI scores ($\beta = -0.35, p < 0.05$), ISMI scores ($\beta = -0.28, p < 0.01$), and SDS scores ($\beta = -0.22, p < 0.05$). ZBI scores could positively predict ISMI scores

($\beta = 0.54, p < 0.001$). ISMI scores could positively predict SDS scores ($\beta = 0.22, p < 0.01$) (Table 5).

By using PROCESS, the 10,000-sample bootstrap verified the bias-corrected 95% CI, which did not contain 0, representing the indirect effect was significant. The results showed a significant 95% CI $[-0.150, -0.01]$ for the mediation effect of $APGAR \rightarrow SSRS \rightarrow ZBI \rightarrow ISMI \rightarrow SDS$ (Table 6, Fig. 3).

Discussion

Schizophrenia is a severe mental disorder characterized by profound disruptions in thought processes, perceptions, emotional responsiveness, and social interactions. Patients with schizophrenia often require long-term care and support, which places significant psychological and social burdens on their caregivers. Understanding the multifaceted pressures faced by these caregivers, including family dynamics, social support, caregiving burden, internalized stigma, and depression, is crucial for developing effective interventions aimed at alleviating their stress and improving the quality of care provided to patients.

This study employed a cross-sectional design with multi-stage, stratified cluster sampling to collect data from 211 caregivers of schizophrenia patients in a multi-ethnic, less-developed region. Utilizing standardized scales such as the Family APGAR, SSRS, ZBI, ISMI, and SDS, and analyzing the data through R studio, the research provides comprehensive empirical evidence on the interrelationships among family function, social support, caregiving burden, internalized stigma, and depression. The findings reveal significant correlations among these variables, highlighting the unique challenges faced by caregivers in this demographic. This study’s robust methodology and focus on an under-researched population underscore its potential to inform targeted interventions and improve caregiver well-being.

Depression degree in caregivers of patients with schizophrenia

The results of this study showed that the depression score of family caregivers of patients with schizophrenia was (49.88 ± 11.31) , which was higher than the results of the research of Pasquale et al. [19] on caregivers of patients with dementia (43.16 ± 14.36) , and it may be attributed to the following reason: the complexity of the mental state of PLWS is variable, which puts the family caregivers under great psychological stress. In addition, this study found significant differences in depression scores among caregivers of different ages, educational levels, relationships with the patient, and self-care capacity ($p < 0.05$). The findings of Luppá et al. [20] on depression in populations indicate that

Table 4 Multiple linear regression of SDS

Independent variables		Model 1			Model 2		
		β	<i>t</i>	<i>P</i>	β	<i>t</i>	<i>P</i>
Education level	Non-formal schooling						
	Primary	-3.826	-1.712	0.088	-3.28	-1.603	0.11
	Junior high school	-6.19	-2.603	0.01*	-4.957	-2.248	0.026*
	High school/technical secondary and above	-7.44	-2.534	0.012*	-5.638	-2.083	0.039*
Self-care capacity	Unable						
	Partial	-1.359	-0.584	0.56	-0.922	-0.431	0.667
	Total	-5.427	-2.343	0.02*	-3.666	-1.681	0.094
Relationship with patient	Else						
	Parents	5.851	2.575	0.011*	2.674	1.207	0.229
	Spouse	6.054	2.627	0.009**	2.247	1.012	0.313
	Children	6.073	2.378	0.018*	3.963	1.601	0.111
Age	19~44						
	45~59	-2.574	-1.048	0.296	-3.285	-1.456	0.147
	60~74	1.654	0.667	0.506	-0.389	-0.168	0.867
	≥75	3.728	1.14	0.256	3.441	1.122	0.263
ZBI				0.08	1.168	0.244	
SSRS				-0.142	-1.32	0.188	
APGAR				-0.357	-1.322	0.188	
ISMI				0.184	2.607	0.01*	

All variables' VIF < 5, there is no multicollinearity problem

* $P < 0.05$, ** $P < 0.01$

Table 5 Regression analysis among variables in the chain intermediary model

Outcome variable	Predictor variable	R	R ²	<i>F</i>	β	<i>t</i>
SSRS	APGAR	0.61	0.37	122.55	1.57	11.07***
ZBI	APGAR	0.433	0.19	23.94	-1.27	-3.56***
	SSRS				-0.35	-2.55*
ISMI	APGAR	0.67	0.45	57.24	-0.04	-0.16
	SSRS				-0.28	-2.64**
	ZBI				0.54	10.24***
SDS	APGAR	0.49	0.24	16.5	-0.26	-0.96
	SSRS				-0.22	-2.11*
	ZBI				0.09	1.42
	ISMI				0.22	3.22*

** $P < 0.05$, *** $P < 0.01$, **** $P < 0.001$

older adults were more prone to depression, and the SDS scores of caregivers older than 60 years were significantly higher in this study, which may be related to the fact that older caregivers are more concerned about the prognosis of patients with schizophrenia. Research held by Demenescu et al. [21] demonstrated that education level would affect the process and regulation of emotions, and individual with poorer education level was prone to suffer from anxiety and depression. In our study, the level of depression was higher in caregivers who reported non-formal schooling.

Furthermore, the relationship to patients with schizophrenia was associated with the depression level in caregivers. It was found that when the caregiver was non-relative to patients with schizophrenia, the depression level in caregivers was lower. We assumed that caregivers closer to the patient with schizophrenia looked out for patients emotionally. Therefore, it is crucial to focus on older caregivers, less educated caregivers, and caregivers who are closer to the patient and to provide them with regular psychological support to mitigate the depression level.

Table 6 Analysis of the mediating effect of perceived social support, care burden and Internalized Stigma

	Effect size	Boot SE	Boot LL CI	Boot UL CI	Relative mediation effect (%)
Total effect	-1.101	0.226	-1.537	-0.645	-
Direct effect	-0.26	0.271	-0.795	0.275	-
Ind1	-0.349	0.171	-0.697	-0.034	31.698
Ind2	-0.113	0.094	-0.331	0.042	10.263
Ind3	-0.01	0.063	-0.145	0.116	0.908
Ind4	-0.049	0.042	-0.146	0.022	4.45
Ind5	-0.096	0.049	-0.204	-0.016	8.719
Ind6	-0.149	0.063	-0.283	-0.041	13.533
Ind7	-0.065	0.037	-0.15	-0.01	5.904

Ind1: APGAR → SSRS → SDS
 Ind2: APGAR → ZBI → SDS
 Ind3: APGAR → ISMI → SDS
 Ind4: APGAR → SSRS → ZBI → SDS
 Ind5: APGAR → SSRS → ISMI → SDS
 Ind6: APGAR → ZBI → ISMI → SDS
 Ind7: APGAR → SSRS → ZBI → ISMI → SDS

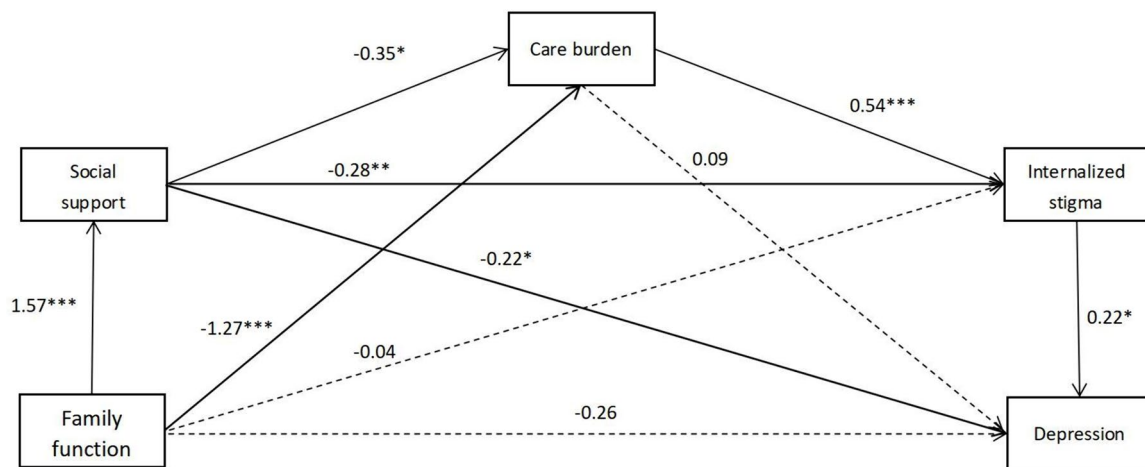


Fig. 3 Chain mediation effects of social support, care burden, and social support. ** $P < 0.05$, * $P < 0.01$, *** $P < 0.001$

Social support and internalized stigma as predictors of depression levels in caregivers of patients with schizophrenia

Social support

In this study, most of the caregivers had satisfactory social support with an overall social support score of 32.39 ± 8.43 . A study in Ethiopian [22] showed that insufficient social support in caregivers of patients with severe psychiatric disorders was associated with depression. In addition, Jensen et al. [23] found that a higher sense of social support could reduce the level of depression in caregivers.

In contrast, a lack of social support increased caregivers' care burden, affecting caregivers' psychological flexibility [24]. Satisfactory social support promotes and maintains an individual's mental health and prevents the emergence and development of depression. The correlation analysis of this study indicated that social support in PLWS was associated with depression negatively ($r = -0.36, p < 0.01$), which was similar to the findings of Jensen et al. [23], which may be related to the fact that the more social support received by the caregivers relieves the stress of caring. It was found [25] that the perceived social support of caregivers of patients with schizophrenia had a direct impact on the level of psychological well-being of the individual. Intervention on the

social support in caregivers of patients with schizophrenia could significantly improve the mental health of caregivers [26]. The results of structural equation modeling analysis in this study showed that social support could directly affect the depression level of family caregivers ($\beta = -0.22, p < 0.05$). When the caregiver felt exhausted, the other family members involved in the caregiving would have similar emotional distress [23]. As a result, the caregiver was more inclined to seek support, shifting from internal to external when social support would play a crucial role. Therefore, it is recommended to adopt policy lurches for patients with schizophrenia by increasing the reimbursement ratio of medical insurance and strengthening caregiver employment assistance to improve the practical social support system of caregivers of patients with schizophrenia and increase the sense of social support in caregivers.

Internalized stigma

In this study, the ISMI score of the caregivers was (67.61 ± 13.73). A study [27] found that caregivers of patients with schizophrenia were more likely to experience internalized stigma compared to patients with depression because the public usually believes that patients with schizophrenia are more dangerous than patients with depression, while the public's cognitive biases lead to higher internalized stigma as caregivers of patients with schizophrenia are more prone to internalize the external misinformation [28]. In all, the results of our study were generally consistent with the findings of other studies that caregivers of patients with schizophrenia dealt with a higher risk of internalized stigma. In this study, we also found that the occupation and relationship to the patient caregivers were associated with the internalized stigma. Non-farmer caregivers had lower internalized stigma scores, which may be related to their richer range of social circles and more perceived social support; meanwhile, close-relative caregivers had higher scores, which may be related to the influence of Confucianism that close-relative caregivers were more concerned about the perceptions to the patient and the family from the outside. In contrast, non-close-relative caregivers did not bear this burden. In addition, results showed that ISMI scores were significantly associated with SDS scores positively ($r = 0.43, p < 0.001$), and ISMI scores could positively predict SDS scores ($\beta = 0.22, p < 0.05$). Caregivers with a strong sense of internalized stigma may strongly recognize the public discrimination against them, which may feel shame and embarrassment, consequently leading to negative emotions and even withdrawal from social relations [29], and such behaviors may reduce social support necessary to care and to address difficulties in daily living. These adverse effects may lead to or exacerbate depression in caregivers. Therefore,

interventions are needed to reduce caregivers' internalized stigma and depression.

Mediation effect of social support, care burden, and internalized stigma among family function and depression in caregivers of patients with schizophrenia

The family function score (6.16 ± 3.26) in this study showed good family function. This study provides a more comprehensive understanding of the interactions between family function and depression to improve the physical and mental health and quality of life in caregivers of patients with schizophrenia. The results of the correlation analysis in this study showed that family function was negatively associated with internalized stigma, care burden, and depression and positively associated with social support ($p < 0.01$), which met the prerequisites for conducting the mediation effects. The results of the analysis of mediation effects in this study showed that social support, care burden, and internalized stigma had mediating effects on family function provided by caregivers of patients with schizophrenia and anxiety levels, the relative mediating effect of care burden through the internalized stigma between family functioning and anxiety levels. The relative mediating effect of social support amounted to 31.698%. Meanwhile, social support played a mediating role through internalized stigma, in which the relative mediating effect of social support through intrinsic disease shame amounted to 8.719%, and through care burden and internalized stigma amounted to 5.904%. It suggests that family function provided by caregivers indirectly affected depression levels in caregivers mainly through social support, care burden, and internalized stigma. The results of this study suggested that poor family function increased depression in caregivers, which in turn may increase the risk of poor life quality for caregivers. The mechanisms underlying the relationship between family function and caregiver depression had not been determined before this study. Family is an essential source of support for family members and a potential stressor [30]. Chronic illness in family members may disrupt the existing family order and may lead to family dysfunction [31, 32]. Poor family function in specific populations with chronic disease (e.g., stroke, Alzheimer's disease, and dementia) has been found to affect caregiver depression in several studies [33, 34]. Our study also suggested that poor family function could affect caregiver depression. Numerous studies have demonstrated that normal family function plays a vital role in the onset and development of caregiver depression [35, 36]. Poor family function interfered with the ability to regulate emotions, distress, and unhealthy emotions in caregivers, and unhealthy emotions often caused depression in caregivers [37]; among which it was found through our study that family function influenced caregiver depression through

social support, care burden, and internalized stigma. A low degree of social support can be emotionally disruptive for caregivers [24]. Social support is fundamental for caregivers in the care of patients with schizophrenia in the long term [38], and a poor sense of social support made it difficult to help themselves to regulate their unpleasant emotions, which in turn could exacerbate negative cognition and pessimism. Poor family function could also decrease social support in caregivers, and well family function played a critical role in the caregiving process.

Care burden ZBI score (26.18 ± 14.84) in this study indicated a high level of caregiver burden. Our findings are consistent to the study conducted by Sherien et al. [39], which also found that most patients with schizophrenia suffer from severe care burden. One study found [40] that family function was significantly associated with care burden. Lower levels of family function were associated with higher caregiver burden specifically. Family function was correlated with care burden negatively in our study ($r = -0.40$, $P < 0.01$). Although the causal relationship between family function and care burden could not be drawn in this study, we could hypothesize that poor family function (e.g., poor communication, hostile interactions) will exacerbate the burden perceived by caregivers. Other studies [41–43] have also demonstrated that dissatisfaction with family support was associated with care burden and relapses of schizophrenia.

The innovative aspect of this study lies in its focus on the caregivers of schizophrenia patients in a multi-ethnic, less-developed region, which has been underrepresented in previous research. While prior studies have explored the burden and psychological health of caregivers, they have predominantly concentrated on developed regions. For instance, a study by Liu et al. [44] examined caregiver burden in urban settings but did not account for the unique socio-cultural dynamics present in less-developed, multi-ethnic areas. Our study fills this gap by systematically analyzing the interrelationships between family function, social support, caregiving burden, internalized stigma, and depression among caregivers in such regions. The use of standardized scales like the Family APGAR, Social Support Rate Scale (SSRS), Zarit Burden Interview (ZBI), Internalized Stigma of Mental Illness (ISMI), and Self-Rating Depression Scale (SDS) provides a comprehensive and reliable dataset, which is further strengthened by advanced statistical analyses using R studio. This approach not only corroborates findings from developed regions but also uncovers unique challenges and needs specific to caregivers in less-developed, multi-ethnic settings.

The findings of this study have significant implications for clinical practice and policy-making. Understanding the intricate relationships between family function, social support, caregiving burden, internalized stigma, and depression can inform the development of targeted interventions aimed

at alleviating caregiver burden and improving their psychological well-being. For example, enhancing social support networks and family function could potentially reduce caregiving burden and internalized stigma, thereby mitigating depressive symptoms among caregivers. These insights are crucial for healthcare providers and policymakers in less-developed, multi-ethnic regions, where resources are often limited, and the socio-cultural context can significantly impact the effectiveness of interventions. By addressing the specific needs of caregivers in these regions, it is possible to improve the overall quality of care for schizophrenia patients, thereby enhancing their recovery and quality of life.

Limitations and strengths

Based on the ecological system theory and attachment theory, this study adopted five scales, APGAR, SSRS, ZBI, ISMI, and SDS, to comprehensively and systematically explore the sequential mediation effects of social support, care burden, and internalized stigma among family function and depression in caregivers of patients with schizophrenia at the individual, family, and social levels. For the first time, a comprehensive and systematic measurement and evaluation of depression in caregivers of patients with schizophrenic and its influencing factors from microlevel to macrolevel was conducted in the underdeveloped multi-ethnic region of Southwest China using the epidemiological survey methodology.

In this study, the age of the study participants was large (57.2 years old on average), and 55.92% of the participants reported an education level of elementary school or below, who were unable to complete the questionnaire survey independently. For this group, a question-and-answer interview was used to conduct the survey, and despite strict quality control, measurement bias may exist. Secondly, this study was a cross-sectional study. Hence, causal relationship could not be drawn. Thirdly, this study was based on the Schizophrenia-specific cohort in the Less-developed Multi-ethnic Region of Southwestern China (SCZC-LMSWC), where monthly income of family members was generally less than 3,000 yuan. Thus, extrapolation of the results to developed regions was limited.

Conclusions

In summary, this study suggests that to reduce levels of depression in caregivers of patients with schizophrenia, apart from improve the family function of caregivers, increasing the social support, decreasing the care burden, and reducing internalized stigma in caregivers are suggested.

Relevance for clinical practice

The results show that the family functions can indirectly affect the caregivers' depression level through social support, care burden and internal stigma. Therefore, in addition to taking measures to improve the caregiver's family function, we can also do a good job in the popularization of diseases and care for family members in clinical practice, so as to improve the level of social support for caregivers and reduce the internal sense of stigma of the family members, thus reducing the depression level of schizophrenia family caregivers.

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Data availability No datasets were generated or analysed during the current study.

Declarations

Conflict of interest The authors declare no competing interests.

Ethical approval Research program and informed consent are examined and approved by the Ethics Committee.

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