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Latent profile analysis of anticipatory grief in family caregivers of patients with chronic heart failure and its influencing factors

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Abstract

Background Anticipatory grief has been shown to be highly prevalent among family caregivers of patients with advanced illness. However, there is less research on the anticipatory grief of family caregivers with chronic heart failure. Therefore, the purpose of this study was to explore the profile of anticipatory grief among family caregivers of patients with chronic heart failure and to analyze the influencing factors of different profiles.

Methods A convenience sampling method was adopted to select 205 family caregivers of chronic heart failure patients hospitalized in a tertiary general hospital in Nanchong, China as the research subjects. A general information questionnaire, Anticipatory Grief Scale (AGS), and Fear of Progression Questionnaire-Short Form (FoP-Q-SF) were used for the survey. Latent profile analysis was conducted on the anticipatory grief of family caregivers of chronic heart failure patients, and univariate analysis and multinomial logistic regression analysis were used to explore the influencing factors of anticipatory grief in each subgroup.

Results The anticipatory grief of family caregivers of chronic heart failure patients has been divided into three latent classes: low anticipatory grief class (16.4%), moderate anticipatory grief class (58.7%), and high anticipatory grief and loss class (24.8%). Gender, education, relationship with the patient, course of disease, and fear of progression were the influencing factors of the latent profile of anticipatory grief among family caregivers of chronic heart failure patients (all $P < 0.05$).

Conclusion There were differences in the level of anticipatory grief among different subgroups of family caregivers of chronic heart failure patients. Medical staff can develop personalized intervention measures on the basis of the influencing factors of different categories to alleviate anticipatory grief of family caregivers and promote physical and mental health of caregivers in chronic heart failure patients.

Keywords Chronic heart failure, Family caregivers, Anticipatory grief, Latent profile analysis

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Introduction

Chronic heart failure is a group of long-term, complex, and severe life-threatening clinical syndromes [1], which is a serious manifestation or terminal stage of the development of various cardiovascular diseases, and is characterized by high mortality rate, high hospitalization rate, and high medical burden [2–4]. According to the "Report on Cardiovascular Health and Diseases in China 2022" [5], there are 8.9 million heart failure patients in China, and with the development of the aging society in China, the number of CHF patients is increasing. The prevalence of heart failure among people over 35 years old is 1.3% in China, with a readmission rate of 30–40% within 30 ~ 90 days after discharge [6]. This disease remains incurable, and with a long course and poor prognosis, often trapping patients in a vicious cycle of recurrent episodes [7].

Family caregivers, who play a pivotal role in the home-based rehabilitation and care of CHF patients, shoulder heavy responsibilities in managing patients' daily lives and disease-related nursing. So they are prone to anxiety, depression, and other negative emotions. Additionally, when patients' conditions deteriorate, caregivers may experience anticipatory grief due to the uncertainty of the disease. Anticipatory grief (AG) refers to the psychological process whereby individuals perceive the potential loss of a loved one in the future and undergo psychosocial restructuring triggered by the impending loss [8]. Fear of progression (FoP) refers to an individual's psychological fear of all potentially life-threatening diseases, encompassing concerns and anxieties about the possible recurrence or progression of illnesses, which is prevalent among chronic patients and caregivers [9]. Studies have shown that 78% of family caregivers of CHF patients developed negative emotions such as anxiety, fear and sadness during the course of care [10]. Dirikkan et al. reported that 74% of caregivers felt sad and fear during the care process, and these negative psychological states can adversely affect caregivers' physical, psychological, social, and behavioral well-being, leading to diminished caregiving abilities and significantly impacting patients' quality of life and disease outcomes [11, 12]. Therefore, the psychological state of the caregiver is worth paying attention to. Current research often relies on total AG scale scores to assess the overall level of AG among participants, overlooking the heterogeneity among different subgroups. Latent profile analysis (LPA), a person-centered approach, identifies latent classes on the basis of patterns of exogenous variables and explores the heterogeneity among individuals with similar characteristics, thereby producing more accurate and objective results [13, 14]. This study used LPA to investigate whether there were distinct categories of AG among family caregivers of CHF patients and further analyzes the influencing factors within each subgroup, aiming to provide new insights for medical staff in developing tailored interventions for managing AG among family caregivers of CHF patients.

Methods

Study design and participants

The present study used a cross-sectional design and followed a convenience sampling. After communication with the director of the department of cardiology of the Affiliated Hospital of North Sichuan Medical College, two uniformly trained members of the research team distributed the questionnaires to the patient caregivers in a one-to-one manner. Family caregivers of CHF admitted to the cardiology ward of the Affiliated Hospital of North Sichuan Medical College in Nanchong, China, from July 2023 to January 2024 were the study subjects. The inclusion criteria : ①patients who met the diagnostic criteria of the "Chinese Guidelines for the Diagnosis and Treatment of Heart Failure 2024" [15] and were diagnosed with chronic heart failure, with the New York Heart Association (NYHA) functional classification ranging from Class II to Class IV; ②Caregivers aged ≥ 18 years ; ③caregivers who are relatives of the patients and assume primary caregiving responsibilities; ④caregivers with clear consciousness, able to effectively communicate and understand the questionnaire content; ⑤caregivers gave informed consent and participated voluntarily. The exclusion criteria: ①patients with other end-stage diseases (such as chronic renal failure in the uremic stage, malignant tumors) or severe mental illnesses; ②caregivers with major mental or physical illnesses; ③caregivers who have experienced significant traumatic events within the past year.

Data collection

The questionnaire was distributed by members of the study team (TC and JJY) after admission of CHF patients. The questionnaire was completed independently by family caregivers of patients with CHF. Prior to completing the questionnaire, study team members used unified instructions to explain the purpose, significance, questionnaire content, and data confidentiality principles of the research to the research subjects and assisted participants who had difficulty reading the questionnaire. They had the right to leave the study at any time and were not required to answer any questions. Informed written consent was obtained from all participants prior to participation. The participants completed the questionnaires and collected by the research team members on the spot, and the participants were asked to complete any missing options. Ethical approval for this study was obtained from the Affiliated Hospital of North Sichuan Medical College Institutional Review Board (2023ER323-1). The sample size was calculated via Kendall's sample size estimation method, ensuring that it would be 5–10 times that of the number of variables [16]. The number of variables in this study was 14 and so the sample size was estimated to be 70–140. Considering the possibility of invalid questionnaires, the sample size was expanded by 20%, for a final sample size of 84–168. In total, 205 participants were included for final analysis and there were no missing and excluded data (response rate 100%).

Measures

Self-compiled general information questionnaire

Based on the extensive literature reading, our research group developed a general information questionnaire. The questionnaire includes two parts: ① demographic data of family caregivers: gender, age, education, religion, monthly income, relationship with patient, care time (months), etc. ② patients' clinical data which were obtained from medical records: course of disease, number of readmissions, payment pattern, NYHA classification.

Anticipatory grief scale (AGS)

This scale was developed by Theut et al. in 1991 [17]. It was originally used to measure the grief experienced by female spouses diagnosed with dementia. Cronbach's alpha was 0.840. In 2016, the Chinese scholar Xin Dajun translated it into Chinese [18]. This study used the Chinese version of the AGS scale. The scale is divided into 7 dimensions, including grief, anxiety, feelings of loss, irritability, anger, guilt, and decreased ability to function at usual tasks, with a total of 27 items. The items adopt the 5-point Likert scale, "strongly disagree" to "strongly agree" with scores ranging of 1 to 5. The total score ranges from 27 to 135, with higher scores being indicative of higher levels of AG. Cronbach's alpha in the current sample was 0.874.

Fear of progression questionnaire short form (FoP-Q-SF)

This scale was simplified by Mehnert et al. on the basis of the Fear of Progression Questionnaire, which includes two dimensions of social family and physiological health, with a total of 27 items [19]. A 5-point Likert scale ranging from "never" to "always" was used, with scores ranging from 1 to 5 points respectively, and a total score ranging of 12 to 60. The higher the score, the more severe the fear of disease progression. Cronbach's alpha in the current sample was 0.835.

Statistical analysis

The sociodemographic characteristics of the participants were examined by computing frequencies, percentages, means, and standard deviations. All analyses were conducted in Mplus version 8.3 using robust maximum likelihood estimation [20]. The scores of seven dimensions of AG among family caregivers of CHF patients were used as manifest variables. Starting from an initial model with one class, the number of classes was increased sequentially, and the optimal latent profile model was selected on basis of evaluation metrics. Based on the guidelines for fit indices in the literature [21–23]: ① Akaike information criteria (AIC), Bayesian information criteria (BIC), and adjusted bayesian information criteria (aBIC), where smaller values for these three criteria indicate better model fit; ② Entropy, ranging from 0 to 1, with values closer to 1 indicating more precise classification by the model, with a value ≥ 0.80 representing good discriminability. ③ the significance of the Lo-Mendell-Rubin Likelihood Ratio Test (LMR) and Bootstrapped Likelihood Ratio Test (BLRT) at $P<0.05$ suggests that the k-class model is superior to the k-1 class model. After the optimal class model was determined, statistical analysis was performed using IBM SPSS Statistics version 26.0. The chi-square test and ANOVA were used for univariate analysis. Variables with statistical significance in univariate analysis were included in the multinomial logistic regression analysis to explore the influencing factors of different categories of AG. A two-tailed $P<0.05$ was considered as statistically significant.

Results

Latent profile analysis for AGS

The model fit statistics for 1 ~ 5 latent profile models were presented in Table 1. Model 3 had the highest entropy value of 0.892, and both the LMR ($P<0.001$) and BLRT ($P<0.001$) reached significant levels, indicating that this model had good goodness-of-fit and accuracy. The LMR P values of Models 2, 4, 5 did not reach significance

Table 1 Model fit indices for the compared latent profiles ($n=205$)

Model	AIC	BIC	aBIC	Entroy	*P*-value		Class Probability
					LMR	BLRT	
1-class	5978.794	6025.316	5980.959	-	-	-	-
2-class	5702.729	5775.835	5706.132	0.776	0.540	< 0.001	0.405/0.595
3-class	5529.574	5629.264	5534.214	0.892	< 0.001	< 0.001	0.164/0.587/0.248
4-class	5484.023	5610.297	5489.900	0.866	0.196	< 0.001	0.162/0.142/0.481/0.216
5-class	5459.755	5612.613	5466.870	0.850	0.698	< 0.001	0.143/0.164/0.416/0.239/0.038

Note: AIC = Akaike information criteria; BIC = Bayesian information criteria; aBIC = adjusted bayesian information criteria; LMR-LRT = Lo-Mendell-Rubin likelihood ratio test; BLRT = Bootstrapped likelihood ratio test; $P<0.05$

Table 2 The latent profile average attribution probability (%)

Category	Class1	Class2	Class3
Class1	93.6	6.4	0
Class2	1.6	97.1	1.3
Class3	0	6.8	93.2

($P>0.05$), indicating poor goodness-of-fit. In summary, Model 3 was selected as the optimal latent profile model, and the average probabilities of each category in Model 3 were 93.6%, 97.1% and 93.2%, indicating that the results of each category in this model had high reliability, as shown in Table 2.

According to the category characteristics in Fig. 1, class 1 had the lowest average score in the seven dimensions, thus named the "low anticipatory grief class", accounting for 16.4%. Class 2 was intermediate in the average score in the seven dimensions, so it was named "moderate anticipatory grief class", accounting for 58.7%. Class 3 had a high level in the seven dimensions, and had the highest score in the loss dimension, so it was named "high anticipatory grief and loss class", accounting for 24.8%.

Comparison of demographic variables in each latent profile

A total of 205 family caregivers of CHF patients were investigated, and the results of univariate analysis revealed that gender, education, monthly income, relationship with patient, course of disease, number of readmissions and fear of progression were different among the three AG classes (all $P<0.05$), as shown in Table 3.

Multinomial logistic regression analysis of AG among family caregivers of patients with CHF

The latent category of AG among family caregivers of CHF patients was used as the dependent variable, the variables with statistically significant differences in univariate analysis as independent variables, and the "high anticipatory grief and loss class" as the reference. The results revealed that gender, education, relationship with patient, course of disease and fear of progression were the factors influencing the potential category of anticipatory grief among family caregivers of patients with CHF (all $P<0.05$), as shown in Table 4.

Discussion

To the best of our knowledge, the present study may be the first to investigate the potential profile categories and the influencing factors of AG among family caregivers of patients with CHF. The present study has shown heterogeneity in AG among family caregivers of patients with CHF. According to the model fit evaluation index, the AG of the family caregivers were divided into three profiles: "low anticipatory grief " class, "moderate anticipatory grief " class and "high anticipatory grief and loss " class. Among them, 16.4% of the caregivers tend to be in

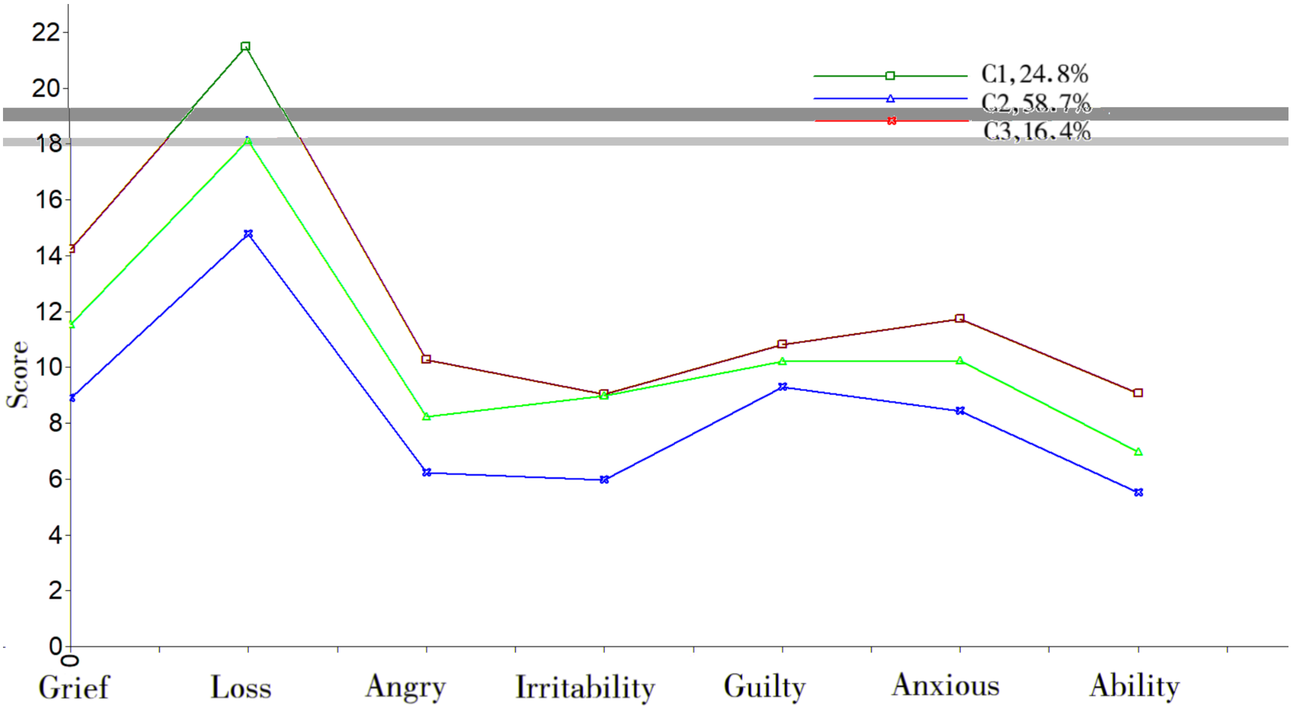

Fig. 1 Characteristic distribution of 3 latent categories of AG among family caregivers of patients with CHF. Note: Loss = feelings of loss; Ability = decreased ability to function at usual tasks. C1 = low anticipatory grief class; C2 = moderate anticipatory grief class; C3 = high anticipatory grief and loss class

the "low anticipated grief" class, with low scores for both anger and irritability. An analysis of their characteristics revealed that this group of people tends to have a higher education level, is able to better accept the role transition brought about by the disease, and has better social support, thus they have low levels of AG. A total of 58.7% of family caregivers belong to the "moderate anticipated grief" class, with scores in all dimensions falling in the middle range among the three profiles, indicating that the majority of family caregivers of CHF patients have medium levels of AG. This may be due to the irreversibility of the disease and the higher mortality rate, leading caregivers to still feel anxious about the prognosis and long-term care of the disease [7]. For the 24.8% of family caregivers belonging to the "high anticipatory grief and loss" class, their scores in all dimensions are higher than those of the other two categories, indicating an overall higher level of AG in this group. The reason for this may be that most of these family caregivers are females with a lower education level and the patient had a shorter disease duration. When facing the uncertainty of the disease and various pressures from society and family, they are more prone to negative emotions such as anxiety, depression and grief [24]. Medical staff should pay close attention to this group and take targeted interventions.

Gender

The results of this study indicate that gender was an influential factor for the potential category of AG among family caregivers of CHF patients. Compared with females, males are more likely to fall into low anticipatory grief class and moderate anticipated grief class, whereas females generally have a higher level of AG than males do. This finding is similar to the results of relevant studies by Nielsen and others both domestically and internationally [25, 26]. The reasons for this may be that females often have a unique and profound emotional experience, especially when witnessing the progression of the patient's disease, they are more likely to fall into multiple thoughts [27, 28]. Moreover, females usually play multiple roles in the family structure, which may cause them to more easily feel the pressure and burden of their role [29]. In contrast, males may exhibit a tendency for calmness and composure in the face of major stress events, they usually have better resistance to pressure, and so the AG is relatively low. Therefore, medical staff should pay more attention to the psychological state of female caregivers. They can provide interventions such as dignity-based family interventions and expressive writing to alleviate their psychological stress and reduce their levels of AG [30, 31] .

Education

The results of this study indicated that education had an effect on both low anticipatory grief class and moderate anticipated grief class, with a higher educational level correlating with a lower level of AG. Caregivers with a higher educational level tend to be more easily able to access and understand information about the disease, including its causes, treatment methods, and prognosis [32]. They have a higher level of acceptance of the disease, can adapt to role changes more quickly, and may possess more caregiving skills and coping strategies to better address the patient's symptoms and needs, thereby reducing their own anxiety, sadness, and other emotions. In contrast, caregivers with a lower educational level may have limited abilities to access and process information. A qualitative interview study indicated that medical staff provided caregivers with neither knowledge about heart failure nor information about the city's support group [33]. Therefore, caregivers with a low education level will face more confusion and uncertainty, which can easily lead to increased emotional stress and thus experience greater AG. These findings suggest that medical staff should focus on caregivers with lower educational levels and provide easily understandable education and training related to the disease to improve their knowledge of the disease, caregiving abilities, and abilities for self-adjustment and stress management. This can help reduce their AG and facilitate effective management of the patient's condition.

Relationship with patient

The results of this study showed that patient's children were more inclined to moderate anticipatory grief class, which was inconsistent with related studies [34]. The possible reason was that more than 1/3 of the caregivers in this study were middle-young-aged people, who are often at an important stage of life development and shoulder many social responsibilities. They not only had to undertake the responsibility of taking care of patients' daily lives and disease care, but also faced the pressure of occupation, the economy, family life and other aspects, they were prone to facing problems such as poor role adaptation and heavy care burdens [35]. Therefore, middle-young-aged caregivers were prone to negative psychology such as fatigue, anxiety, depression and grief. Therefore, it is necessary to start from multiple aspects, such as strengthening relevant chronic disease policy support, improving the social support system, and raising public awareness of chronic diseases and their caregivers, so as to effectively alleviate the pressure of middle-young-aged caregivers and reduce their AG [36].

Table 3 Profiles of AGS in demographic characteristics among family caregivers of patients with CHF ($n=205$)

Variables	**Total number ($n=205$)**	**Class1(n/%)**	**Class2(n/%)**	**Class3(n/%)**	**χ2/F**	***P***
Gender					34.175	< 0.001
Male	81(39.5)	22(64.7)	55(46.6)	4(7.5)		
Female	124(60.5)	12(35.3)	63(53.4)	49(92.5)		
Age(years)					8.957	0.062
< 45	35(17.1)	10(29.4)	16(13.6)	9(17.0)		
45 ~ 60	96(46.8)	15(44.1)	62(52.5)	19(35.8)		
> 60	74(36.1)	9(26.5)	40(33.9)	25(47.2)		
Education					21.510	< 0.001
Elementary school and under	76(37.1)	5(14.7)	43(36.4)	28(52.8)		
Middle school	56(27.3)	9(26.5)	34(28.9)	13(24.5)		
High school	45(22.0)	10(29.4)	30(25.4)	5(9.5)		
College and above	28(13.6)	10(29.4)	11(9.3)	7(13.2)		
Religion					2.526	0.283
yes	68(33.2)	9(26.5)	37(31.4)	22(41.5)		
no	137(66.8)	25(73.5)	81(68.6)	31(58.5)		
Monthly income(RMB)					10.433	0.034
< 3000	62(30.2)	9(26.5)	34(28.8)	19(35.8)		
3000 ~ 5000	86(42.0)	15(44.1)	43(36.4)	28(52.8)		
> 5000	57(27.8)	10(29.4)	41(34.8)	6(11.4)		
Self-conscious health					4.692	0.320
good	125(61.0)	21(61.8)	76(64.4)	28(52.8)		
commonly	55(26.9)	7(20.6)	32(27.1)	16(30.2)		
bad	25(12.1)	6(17.6)	10(8.5)	9(17.0)		
Relationship					33.276	< 0.001
spouse	107(52.2)	9(26.5)	55(46.6)	43(81.1)		
children	76(37.1)	19(55.9)	53(44.9)	4(7.5)		
other	22(10.7)	6(17.6)	10(8.5)	6(11.4)		
Care time (months)					4.907	0.297
< 1	106(51.7)	18(52.9)	67(56.8)	21(39.6)		
1 ~ 4	36(17.6)	7(20.6)	17(14.4)	12(22.6)		
> 4	63(30.7)	9(26.5)	34(28.8)	20(37.7)		
Bereavement experience					3.548	0.170
yes	122(59.5)	16(47.1)	76(64.4)	30(56.6)		
no	83(40.5)	18(52.9)	42(35.6)	23(43.4)		
Payment pattern					8.339	0.080
Slef-expense	29(14.1)	7(20.6)	12(10.2)	10(18.9)		
Medical insurance for urban workers	41(20.0)	6(17.6)	30(25.4)	5(9.4)		
Medical insurance for rural residents	135(65.9)	21(61.8)	76(64.4)	38(71.7)		
course of disease (years)					14.430	0.006
< 1	56(27.3)	5(14.7)	27(22.9)	24(45.3)		
1 ~ 2	28(13.7)	6(17.6)	14(11.9)	8(15.1)		
> 2	121(59.0)	23(67.6)	77(65.2)	21(39.6)		
NYHA classification					2.625	0.622
II-class	57(27.8)	10(29.4)	35(29.7)	12(22.6)		
III-class	94(45.9)	17(50.0)	49(41.5)	28(52.8)		
IV-class	54(26.3)	7(20.6)	34(28.8)	13(24.5)		
Number of readmissions					15.327	0.004
< 3	112(54.6)	12(35.3)	66(55.9)	34(64.2)		
3 ~ 5	45(22.0)	8(23.5)	22(18.6)	15(28.3)		
> 5	48(23.4)	14(41.2)	30(25.4)	4(7.5)		
FoP-Q-SF (score, mean ± SD)	205	30.32 ± 2.85	36.12 ± 5.15	42.28 ± 3.19	79.519	< 0.001

Note: RMB = Renminbi; Class1 = low anticipatory grief class; Class2 = moderate anticipatory grief class; Class3 = high anticipatory grief and loss class; $P<0.05$

Table 4 Multinomial logistic regression analysis of the latent categories of AG among family caregivers of patients with CHF

Variables	β	SE	Waldχ2	OR(95%CI)	*P*
C1[a]					
Intercept	21.686	4.013	29.203		< 0.001
FoP-Q-SF	-0.639	0.108	35.114	0.528(0.427,0.652)	< 0.001
Gender					
male	2.495	0.968	6.639	12.124(1.817,80.904)	0.010
Education					
High school	2.919	1.466	3.966	18.516(1.047,327.336)	0.046
C2[a]					
Intercept	11.416	3.172	12.955		< 0.001
FoP-Q-SF	-0.325	0.083	15.239	0.723(0.614,0.851)	< 0.001
Gender					
male	2.594	0.804	10.410	13.382(2.768,64.689)	0.001
Education					
High school	3.318	1.310	6.420	27.604(2.120,359.438)	0.011
Relationship					
children	3.074	1.173	6.870	21.632(2.172,215.503)	0.009
Course of disease (years)					
< 1	-1.667	0.674	6.110	0.189(0.050,0.708)	0.013

Note: C1 = low anticipatory grief type; C2 = moderate anticipatory grief type; a = C3 as a refer

OR = odds ratio; CI = confidence interval; $P < 0.05$

Course of disease

The results of this study showed that family caregivers of CHF patients with course of disease of less than 1 year were more likely to experience high anticipatory grief and loss class. It may be that in the face of a sudden illness, the caregiver was unable to adapt to the role change in the short term, lacked understanding of the disease-related knowledge and care experience, which made them more prone to feelings of frustration and helplessness. Some studies have shown that 99.0% of family caregivers indicated that they had not received any relevant training or psychosocial support programs for heart failure management, and 59.5% of family caregivers said that they did not obtain sufficient information on disease care and management from medical staff [11]. Therefore, it is suggested that medical staff could provide targeted health education and training and continuous care guidance through the "Internet + platform" pattern in the early stage of the disease to help caregivers improve their disease awareness, promote the orderly implementation of caregiving tasks, and reduce anxiety and AG [37, 38].

Fear of progression

The results of this study indicated that FoP serves as an influential factor for family caregivers of CHF patients and that caregivers with higher FoP are more likely to experience high anticipatory grief and loss class, suggesting that the severity of caregiver's FoP is positively correlated with the level of their AG, which is consistent with the findings of Liu Jingjing et al. [39]. On the one hand, CHF cannot be cured, with the progression of CHF patients, patients face progressive deterioration of cardiac function, appearance of complications and higher readmission rate, due to the uncertainty of the disease, caregivers are prone to anticipatory sadness. On the other hand, CHF has a long course of disease and requires continuous medical care, family caregivers often need to spend a lot of time, energy, and money to take care of patients [40]. This long-term stress can cause caregivers to feel fear and anxiety about the future. It is suggested that medical staff could strengthen their attention to the negative psychological states of caregivers, identify high-risk groups at an early stage, understand the reasons of their fear and grief, and implement targeted multidimensional interventions (including physical, psychological, and social) to alleviate their psychological pressure and AG, ultimately helping caregivers maintain a positive mindset.

Limitations

This study has certain limitations that should be considered and addressed in future research. Firstly, a cross-sectional design was used, meaning that the results can only identify associations between the different constructs. Secondly, owing to objective constraints, data were collected only from a single tertiary hospital in Sichuan Province, resulting in a limited sample size and representativeness, limiting the ability to generalize these results to other geographical areas. Future research with larger samples, multicenter designs, and longitudinal studies are needed to further explore the trajectories of AG among family caregivers of chronic heart failure patients.

Conclusion

In this study, family caregivers of CHF patients presented moderate to high levels of AG, with three potential categories characterized by a low anticipatory grief class, moderate anticipatory grief class, and high anticipatory grief and loss class. Gender, education, relationship with the patient, course of disease, and FoP were identified as predictors for these three subgroups. Our findings offer new insights into improving the AG among family caregivers of CHF patients. Our findings may help medical staff to implement individualized interventions tailored to the characteristics and influencing factors of different categories of AG, and reduce AG among family caregivers of CHF patients, promote their physical and mental well-being.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12904-024-01621-1.

Supplementary Material 1

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Author contributions

TC and JJY contributed to the conceptualization and design of the study, data collection, data analysis, and original manuscript draft and revise; LS and HMZ developed the methodology and analytical plan; HRX contributed to the data analysis; YLW contributed to the supervision and reviewed/edited the the manuscript; All authors have read and approved the final manuscript.

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Data availability

All the data and materials are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was granted ethical approval by the Affiliated Hospital of North Sichuan Medical College Ethics Committee. Informed written consent was obtained from all participants prior to participation. All methods were performed in accordance with the relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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