

RESEARCH ARTICLE

Chinese parents' caregiving ability for children with haematological malignancies: A latent class analysis

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Abstract

Aim: The aim of this study was to identify unobserved subgroups of Chinese parents' caregiving ability for children with haematological malignancies and examine the associations of the latent class membership with individual characteristics.

Design: A multicentre cross-sectional survey study was conducted.

Methods: A total of 392 parents of children with haematological malignancies in China were surveyed with the Hematologic Malignancies' Family Caregiver Skills Scale and a study-specific demographic information questionnaire. Latent class analysis (LCA) and multinomial logistic regression model were applied in data analysis.

Results: LCA results suggested that there existed three distinct a priori unknown classes of parents of children with haematological malignancies in regard to caregiving ability: Class 1—"high caregiving ability" class ($n = 131$, 33.4%), Class 2—"medium caregiving ability" class ($n = 170$, 43.4%) and Class 3—"low caregiving ability" class ($n = 91$, 23.2%). Socio-demographics and clinical characteristics had significant associations with the latent class membership.

KEYWORDS

caregiving ability, children with haematological malignancies, latent class analysis, parents

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1 | INTRODUCTION

The incidence and mortality of childhood cancer have increased annually over the past decade, making it surpass accidental trauma as the leading cause of childhood death in 2016 (Bray et al., 2018; Kyu et al., 2018). The overall annual incidence of childhood cancer varied between 46 and 165 per million (Rodriguez-Galindo et al., 2015). Haematological malignancy is the most common cancer among children younger than 15 years old (Wild et al., 2020, Feb). However, with the advances in treatment over the past decade, the 5 years and 10 years survival rates for childhood cancer are more than 80% in high-income countries (Bhakta et al., 2019; Dixon et al., 2018; Ward et al., 2019). Based on current and long-term survival rates, the number of childhood cancer survivors in the United States is expected to reach 500,000 by 2020 (Robison & Hudson, 2014).

Despite the better survival rates, the diagnosis of haematological malignancy is undoubtedly a heavy blow to the children and their families. Due to the complexity and particularity of haematological malignancy, children are suffering from a series of discomforts caused by the disease and the long-term chemotherapy (Abedin & Altman, 2016; Berger et al., 2015). As the primary caregivers, the parents need to participate in children's physical and mental support and all-round care throughout the diagnosis and treatment (Wang et al., 2017). However, caring for children with haematological malignancies is a rare and challenging experience for parents without medical training, and most parents are seeking professional assistance to improve their caregiving ability (Wang et al., 2016, 2018).

1.1 | Background

Caregiving ability refers to the knowledge and skills that the caregiver has acquired to supply the patient what he or she needs (Clarke et al., 2014). Parents' caregiving ability directly affects the rehabilitation process and the prognosis of their children (Aburn & Gott, 2011). However, existing studies mostly focused on caregivers of adult patients with cancer and aimed at improving their caregiving ability (Mazanec et al., 2019; Potter et al., 2012). Studies on caregiving ability in parents of children newly diagnosed with leukaemia in China have showed that parent's caregiving ability was at a low level (Wu et al., 2020). However, the findings were based on average statistics and did not necessarily mean that all the parents of children with haematological malignancies have a low level of caregiving ability. Importantly, the statistical analyses conducted in those studies assumed the parents were a homogeneous population about caregiving abilities. Thus, the statistical results in the studies might be biased (Mao et al., 2018; Shen et al., 2018; Wu et al., 2020). In order to better understand the populations, the present study used latent class analysis (LCA) to test the heterogeneity of this special population, that is parents with children with haematological malignancies, identify the unobserved distinct subpopulations/latent classes in the target population and examine the characteristics of parents in different classes. The study aimed to provide useful implications

for development of a targeted and group-centred intervention for parents to improve their caregiving ability.

Latent class analysis (LCA) is a probabilistic modelling algorithm that allows clustering of data and statistical inference (Sinha et al., 2021). Using a set of observed indicators, LCA models identify solutions that best describe these latent classes in which the indicators follow the same distribution (Sinha et al., 2021). LCA is an appropriate method to classify parents according to their caregiving ability, considering population heterogeneity. Tillery et al used LCA to classify caregivers of childhood cancer survivors aged 10–18, based on the parent-child relationship functioning. Their findings would help to improve psychological and social outcomes in young survivors of childhood cancer (Tillery et al., 2020). However, no existing studies used LCA to analyse the caregiving ability in parents of children with haematological malignancies.

In the present study, we used LCA to identify a priori unknown latent classes of parents of children with haematological malignancies based on caregiving ability measures. Once latent classes were identified, the multinomial logistic model was used to examine the effects of socio-demographic and clinic characteristics on latent class membership. The findings of this study will be helpful for studying disparities in parents' caregiving ability and provide targeted interventions to parents in the different caregiving ability subgroups.

1.2 | Aims

This study aimed to identify unobserved subgroups of Chinese parents' caregiving ability for children with haematological malignancies and examine the associations of the latent class membership with individual characteristics.

2 | THE STUDY

2.1 | Design

A multicentre cross-sectional survey study was conducted. The study was prepared and is reported according to the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) checklists.

2.2 | Sample recruitment

Participants were 392 parents of children with haematological malignancies recruited from three children's hospitals in Shanghai, Jiangsu and Chongqing, China. The eligible criteria for parents and children were as follows: (1) the child met the diagnostic criteria for haematological malignancy (Zhang & Shen, 2007) by bone marrow cytology, immunohistochemical and genetic analysis, or histochemical staining, (2) the child was under treatment and was less than 15 years old,

(3) the child had no other serious or chronic diseases, (4) the parent had high school diplomas or higher education, and could communicate fluently in Mandarin, (5) the parent took the major responsibility for the daily caregiving of the child and (6) the parent volunteered for the survey.

2.3 | Data collection

Data collection took place in the selected three children's hospitals between May 2018 and April 2020. The printed questionnaires were handed to the parents by trained researchers. The researchers explained the research aims to the parents, and only after the consent form to participate in the study was signed, the questionnaires were given to the parents in sealed envelopes. In the same way, the answered questionnaires were collected back after the parents finished the questionnaires on the same day by researchers. The anonymous, voluntary participation and the right to withdraw from the study were assured in the consent form.

Information about the socio-demographic and clinical characteristics of parents and their children was collected in survey. Parents' caregiving ability was measured based on their last week's experience, using the Hematologic Malignancies' Family Caregiver Skills Scale (HMFCGSS) that was previously validated in haematologic malignancies' family caregivers in China (Cronbach's $\alpha = 0.920$) (Qian, 2016). HMFCGSS consists of 6 domains with a total of 23 items: disease cognitive ability (DCA) with 3 items, general approaches to caregiving (GAC) with 3 items, person-centred care skills (PCS) with 5 items, emotional management ability (EMA) with 4 items, appraising supportive resources (ASR) with 3 items, balancing caregiving needs and one's own needs (BCN) with 5 items (see Appendix). Each of the 23 items was measured on a Likert-point scale ranging from not difficult (1) to very difficult (5). In the present study, all the items were recoded as dichotomous indicator of parent's caregiving ability: 1—"no difficulty" (if item score ≤ 2) versus. 0—"at least some difficulty" (if item score ≥ 3).

2.4 | Ethics considerations

This survey received ethical review approval from the Naval Medical University (NO. HJEC-2018-YF-001). The participants were informed of the aim of this study before the survey was conducted. No procedures were performed until participants signed the informed consent.

2.5 | Data analysis

The 23 dichotomous caregiving ability indicators were used for Latent Class Analysis (LCA) (Collins & Lanza, 2010; Lazarsfeld & Henry, 1968; Muthén, 2002; Vermunt & Magidson, 2002; Wang & Wang, 2020). The LCA analysis was started with a single-class

solution, and then, models with increased number of classes (to four) were estimated and compared. Model fit statistics and indices include the Akaike information criterion (AIC), Bayesian information criterion (BIC), adjusted Bayesian information criterion (aBIC), bootstrapped likelihood ratio test (BLRT), Vuong-Lo-Mendell-Rubin likelihood ratio test (LMR), Lo-Mendell-Rubin adjusted LRT test (aLMR) and entropy score. Lower values on AIC, BIC and aBIC indicate better model fit; statistically significant p -values on the BLRT, LMR and aLMR indicate the k class model is more preferable than the $k-1$ class model (Wang & Wang, 2020). BIC and BLRT perform better than other fit statistics/indices in determining the number of latent classes. The entropy statistic measures the quality of class classification. The values of entropy range from 0 to 1, and a value closer to 1 indicating better classification. For a LCA model with entropy ≥ 0.80 , the latent class membership estimated from the model can be saved as "observed" categorical variables for further analysis (Clark, 2010). In the present study, we used a multinomial logistic regression model to examine the effects of demographic and clinical variables on the latent class membership. LCA was estimated using Mplus 7.0, and other analyses were conducted using SPSS 22.0. All tests of statistical significance were 2-sided at $\alpha = 0.05$ level.

2.6 | Validity, reliability and rigour

The HMFCGSS have been tested for validity and reliability for haematologic malignancies' family caregivers in China (Cronbach's $\alpha = 0.920$). In the present study, the Cronbach's alpha was 0.928 for the total scale and 0.698–0.864 for the 6 domains, indicating satisfactory internal consistency.

3 | RESULTS

3.1 | Socio-demographic characteristics

A total of 392 parents of children with haematological malignancies who completed the questionnaires were eligible for this survey. The socio-demographic characteristics of parents and children are described in Table 1.

3.2 | Latent class analysis

Model fit statistics/indices are shown in Table 2. The single-class model had the largest AIC, BIC and aBIC, compared with all other models. In addition, the LR tests of the two-class model were all statistically significant (LMR $p < .0001$, aLMR $p < .0001$ and BLRT $p < .0001$), indicating the population is not homogeneous, but heterogeneous. Comparing the two-class and three-class models, the latter had smaller information criterion indices (AIC, BIC and aBIC) and all statistically significant LR tests (LMR $p = .0021$, aLMR $p = .0021$ and BLRT $p < .0001$). We, therefore, rejected the

Variables	Categories	n	%
Gender	Male	111	28.3
	Female	281	71.7
Age	≤30	113	28.8
	31–40	231	58.9
	>40	48	12.3
Education	High school	185	47.2
	Junior college	98	25.0
	Bachelor's degree or above	109	27.8
Marital Status	Married	373	95.2
	Unmarried (Divorced or widowed or separated)	19	4.8
Residency area	City	180	45.9
	Country	212	54.1
Hospital near residency area	Yes	92	23.5
	No	300	76.5
Average monthly household income	2000–5000CNY (\$285–713)	220	56.1
	5000–8000CNY (\$713–1411)	76	19.4
	Over 8000CNY (over \$1411)	96	24.5
Type of medical payment	Self-pay	115	29.3
	Medical health insurance	96	24.5
	Rural cooperative health care insurance	181	46.2
Daily caregiving time	<12 hr	117	29.8
	12–18h	63	16.1
	18–24h	212	54.1
Number of co-caregivers	3 or more	34	8.7
	2	119	30.4
	1	219	55.9
	0	20	5.1
Gender of child	Boy	212	54.1
	Girl	180	45.9
Age of child	<3	127	32.4
	3–6	146	37.2
	7 or more	119	30.4
Disease Diagnosis	Leukaemia	369	94.1
	Other haematological malignancies	23	5.9
Single child	Yes	153	39.0
	No	239	61.0
Treatment Duration	1–3 months	234	59.7
	4–8 months	83	21.2
	9 months or more	75	19.1

TABLE 1 Characteristics of parents and their children with haematologic malignancies (n = 392)

two-class model in favour of three or more classes. Comparing the three-class and the four-class models, BIC (9705.262), LMR ($p = .0021$) and aLMR ($p = .0021$) favoured the three-class model, but AIC, aBIC and BLRT favoured the four-class model. On the balance of model fit, model parsimony and clinical interpretability of

the results, the three-class model was selected. Figure 1 displays the results of the three-class solution. The average latent class probabilities for the most probably latent class membership were 0.923, 0.948 and 0.958, respectively, and entropy=0.872 indicating good quality of class classification. The plot of item-response

TABLE 2 Model fit comparisons and latent class prevalence by model ($n = 392$)

	one-class model	two-class model	three-class model	four-class model
AIC	11,414.072	9755.259	9423.303	9339.797
BIC	11,505.411	9941.909	9705.262	9717.067
aBIC	11,432.433	9792.779	9479.982	9415.635
Entropy	n/a	0.919	0.872	0.860
LMR	n/a	<0.0001	0.0021	0.6972
aLMR	n/a	<0.0001	0.0021	0.6978
BLRT	n/a	<0.0001	<0.0001	<0.0001
Relative class size	n/a	0.63/0.37	0.34/0.43/0.23	0.27/0.13/0.39/0.21

Note: Best-fitting model in bold

Abbreviation: aBIC, adjusted Bayesian information criterion; AIC, Akaike information criterion; aLMR, Lo-Mendell-Rubin adjusted LRT test; BIC, Bayesian information criterion; BLRT, bootstrapped likelihood ratio test; LMR, Vuong-Lo-Mendell-Rubin likelihood ratio test

FIGURE 1 Class prevalence and patterns of item-response probability by latent class

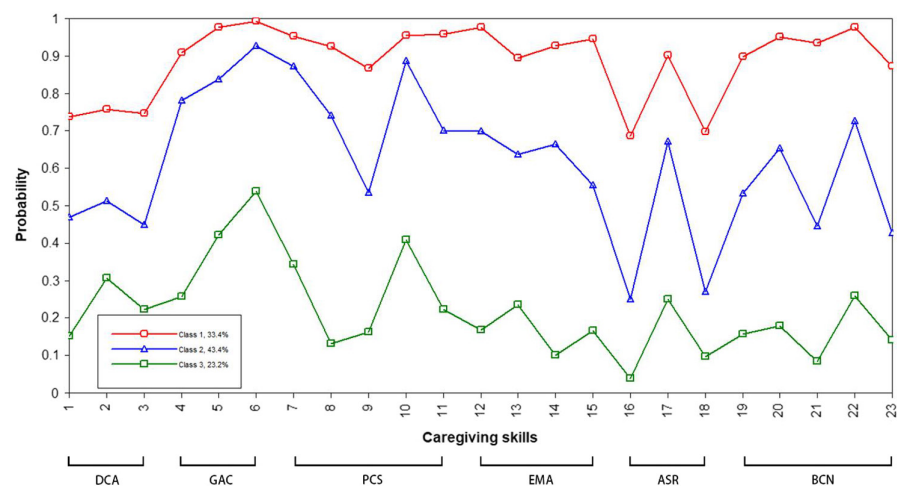


TABLE 3 Sores of six domains of caregiving ability ($n = 392$)

	"high caregiving ability" class ($\bar{x} \pm sd$)	"medium caregiving ability" class ($\bar{x} \pm sd$)	"low caregiving ability" class ($\bar{x} \pm sd$)
DCA	2.04 ± 0.68	2.64 ± 0.81	3.22 ± 0.78
GAC	1.38 ± 0.47	1.78 ± 0.63	2.82 ± 0.82
PCS	1.49 ± 0.43	1.94 ± 0.49	3.16 ± 0.74
EMA	1.60 ± 0.45	2.23 ± 0.66	3.26 ± 0.60
ASR	1.96 ± 0.63	2.81 ± 0.82	3.59 ± 0.72
BCN	1.59 ± 0.44	2.46 ± 0.68	3.38 ± 0.74

Abbreviations: ASR, appraising supportive resources; BCN, balancing caregiving needs and one's own needs; DCA, disease cognitive ability; EMA, emotional management ability; GAC, general approaches to caregiving; PCS, person-centred care skills; sd, standard deviation.

probabilities endorsing "no difficulty" for the 23 caregiving ability indicators in each of the classes shows explicit patterns of caregiving ability in the parents of children. The probabilities of endorsing "no difficulty" in Class 1 ($n = 131$, 33.4%) are all high across six domains. We, therefore, labelled this class as "high caregiving ability" class. The other two classes (Classes 2 and 3) were labelled "medium caregiving ability" ($n = 170$, 43.4%) and "low caregiving ability" ($n = 91$, 23.2%) classes, respectively, based on the item-response probabilities in the classes.

3.3 | Analysis of caregiving ability by latent class

Table 3 shows the mean scores of the 6 caregiving ability domains by latent classes. In each class, the GAC mean score was the lowest, compared with other domain scores. This indicated that parents all had higher level of ability of general caregiving on average. In Class 3 (the "low caregiving ability" class) and Class 2 (the "medium caregiving ability" class), the ASR score was higher than other domain

scores, indicating that parents had lower ability of appraising supportive resources in the two classes. Although the DCA mean score in Class 1 (the "high caregiving ability" class) was lower than those in the other two classes, this score was much higher than other domain scores in Class 1, indicating that parents in this class also had some difficulty in disease cognitive.

3.4 | The multinomial logistic regression model

Selected results of the multinomial logistic regression model are shown in Table 4. Parents with lower education (e.g. high school or junior college) and married status were more probably to be classified in the "high caregiving ability" class than in the "low caregiving ability" class. The corresponding adjusted ORs are OR = 2.679 (95% CI 1.116, 6.430) for high school; OR = 3.734 (95% CI 1.473, 9.463) for junior college; and OR = 4.298 (95% CI 1.070, 17.256) for married parents (see the second column of Table 4). On the contrast, parents with the following characteristics were less probably to be in the "high caregiving ability" class, but in the low caregiving ability class: parents with average monthly household income of 2000-5000CNY (\$285-713) (OR = 0.245, 95% CI 0.087, 0.691) or 5000-8000CNY (\$713-1411) (OR = 0.207, 95% CI 0.071, 0.608), daily caregiving time of less than 12h (OR = 0.308, 95% CI 0.140, 0.675) or 12 to 18h (OR = 0.293, 95% CI 0.115, 0.750), children aged less than 3 years old (OR = 0.137, 95% CI 0.053, 0.355) and with a diagnosis of leukaemia (OR = 0.056, 95% CI 0.006, 0.520).

Model results for comparing "medium caregiving ability" class with the "low caregiving ability" class are shown in Table 4. Parents who were married (OR = 5.447, 95% CI 1.588, 18.687), fathers (OR = 2.399, 95% CI 1.162, 4.956), had high school education (OR = 3.032, 95% CI 1.348, 6.818) or junior college (OR = 5.416, 95% CI 2.269, 12.930) were more probably to be classified in the "medium caregiving ability" class than in the "low caregiving ability" class. Parents with average monthly household income of 2000-5000CNY (\$285-713) (OR 0.245, 95% CI 0.087, 0.691) or 5000-8000CNY (\$713-1411) (OR 0.207, 95% CI 0.071, 0.608), daily caregiving time less than 12h (OR 0.237, 95% CI 0.113, 0.499) or 12 to 18h (OR 0.422, 95% CI 0.185, 0.965), and children younger than 3 years old (OR 0.420, 95% CI 0.180, 0.981) were more probably to be in the "low caregiving ability" class than in the "medium caregiving ability" class.

4 | DISCUSSIONS

4.1 | The latent classes of Chinese parents of children with haematological malignancies

To the best of our knowledge, this is the first study that used the LCA to identify unobserved subpopulations/classes of Chinese parents of children with haematological malignancies with respect to caregiving ability. Parents in the study were classified into three

distinct a priori unknown classes about to caregiving ability measured by HMFCGSS: Class 1—"high caregiving ability" class; Class 2—"medium caregiving ability" class; and Class 3—"low caregiving ability class," Class 1 accounted for 33.4% ($n = 131$) of the sample. The members in Class 1 had a medium level of DCA and high levels of the other five domains. Class 2 accounted for 43.4% ($n = 170$) of the sample. Overall, the parents in Class 2 had a medium level of DCA, EMA, ASR and BCN, and relatively high levels of GAC and PCS. Class 3 accounted for 23.2% ($n = 91$) of the sample. Parents in Class 3 had a medium level of GAC and low levels of all the other domains. For parents in the "low caregiving ability" class, caring for children with haematological malignancies was really challenging.

4.2 | Caregiving ability of parents in three latent classes

As shown in Table 3, parents in all of the 3 classes had a higher level of GAC than the other domains of caregiving ability, indicating that caregivers were more capable in general approaches of caregiving than other aspects of caregiving. These results showed that all parents had confidence in providing daily routine care and offering timely help when their children needed. In the "medium caregiving ability" class and "low caregiving ability" class, parents' lowest caregiving ability was ASR, which indicated that the most difficult part of taking care of their children in these two classes was to appraise supportive resources. While in the "high caregiving ability" class, caregivers' lowest caregiving ability is DCA, which indicated that the greatest difficulty for parents in this class were cognitive related, such as the assessment of the children's condition and the observation of changes in the children's condition, learning information on disease treatment and caring for the children, and contacting with the professional healthcare providers. The measurement tool, HMFCGSS, is a self-reported scale with six domains. A high total score of HMFCGSS may not necessarily mean that the parents have high caregiving ability in all aspects. Professional healthcare providers need to pay attention to whether the parents have low ability in any aspect of caregiving, and what targeted support need to be provided to the parents.

4.3 | Association between socio-demographic and clinic characteristics and latent class membership

While fathers of the children in this study were more probably to be in the "medium caregiving ability" class, mothers were more probably to be in the "low caregiving ability" class. In literature, mothers are more often than fathers to take care of sick children and take children to hospital (Yayan & Düken, 2019). In Chinese traditional culture, mothers are expected to be the primary caregivers for children in family and in general provide more practical daily care and emotional care for sick children. In our study, 281 mothers (71.7%) took the major responsibility of the daily caregiving of their sick

TABLE 4 Selected results of the multinomial logistic regression models ($n = 392$)

Variable	Latent Class		
	Class 1 "High caregiving ability" class	Class 2 "Medium caregiving ability" class	Class 3 "Low caregiving ability" class
	OR (95% CI)	OR (95% CI)	-
Gender			
Male	1.084[0.483–2.429]	2.399[1.162–4.956]*	-
Female	-	-	-
Age			
≤30	1.244[0.337–4.601]	1.152[0.335–3.961]	-
31–40	0.898[0.291–2.769]	0.870[0.295–2.562]	-
>40	-	-	-
Marital Status			
Married	4.298[1.070–17.256] *	5.447[1.588–18.687] **	-
Unmarried	-	-	-
Education			
High school	2.679[1.116–6.430] *	3.032[1.348–6.818] **	-
Junior college	3.734[1.473–9.463] **	5.416 [2.269–12.930] **	-
Bachelor degree or above	-	-	-
Residency area			
City	1.108[0.473–2.597]	0.528[0.239–1.170]	-
Country	-	-	-
Hospital near residency area			
Yes	1.493[0.646–3.450]	0.471[0.202–1.098]	-
No	-	-	-
Average monthly household income			
2000–5000CNY(\$285–713)	0.245[0.087–0.691] **	0.279[0.102–0.760] *	-
5000–8000CNY (\$713–1411)	0.207[0.071–0.608] **	0.390[0.139–1.089] *	-
Over 8000CNY (over \$1411)	-	-	-
Type of medical payment Self-pay	0.830[0.390–1.766]	1.295[0.658–2.550]	-
Medical health insurance	0.954[0.355–2.562]	2.478[0.987–6.226]	-
Rural cooperative health care insurance	-	-	-
Daily caregiving time			
<12h	0.308[0.140–0.675] **	0.237[0.113–0.499] **	-
12–18h	0.293[0.115–0.750] *	0.422[0.185–0.965] *	-
18–24h	-	-	-
Number of co-caregiver			
3 or more	2.712[0.428–17.204]	2.338[0.463–11.822]	-
2	1.830[0.403–8.316]	0.480[0.134–1.727]	-
1	2.720[0.590–12.549]	1.081[0.301–3.881]	-
0	-	-	-
Gender of child			
Boy	0.921[0.475–1.789]	0.912[0.489–1.701]	-
Girl	-	-	-
Age of child			
<3	0.137[0.053–0.355] **	0.420[0.180–0.981] *	-
3–6	0.556[0.239–1.294]	0.650[0.286–1.476]	-

(Continues)

TABLE 4 (Continued)

Variable	Latent Class		
	Class 1 "High caregiving ability" class	Class 2 "Medium caregiving ability" class	Class 3 "Low caregiving ability" class
	OR (95% CI)	OR (95% CI)	-
7 or more	-	-	-
Disease Diagnosis			
Leukaemia	0.056[0.006–0.520] *	2.373[0.128–43.876]	-
Not leukaemia	-	-	-
Single child			
Yes	1.125[0.547–2.312]	0.982 [0.503–1.919]	-
No	-	-	-
Treatment Duration			
1–3 months	1.044[0.460–2.366]	0.945[0.438–2.039]	-
4–8 months	0.842[0.299–2.373]	1.863[0.730–4.750]	-
9 months or more	-	-	-

* $p < .05$.* $p < .01$.

-Reference group.

children. In a tragic situation when a child of a family is diagnosed with cancer, it would be very probably for the mother, the primary caregiver, to confront with more new challenges in caregiving for the sick child. These new challenges might lead to mothers' feeling of low caregiving ability.

Divorced, widowed or separated parents were more probably to be in the "low caregiving ability" class. Studies indicated that married parents had more access to social support, especially for the support from their partner, and tended to report lower caregiving burden (Arab et al., 2019; Wiener et al., 2016). In addition, married parents usually have less financial burden caused by the children's disease treatment, so they could concentrate on taking care of their children, which could help to improve their caregiving ability (Granek et al., 2012).

Parents who received lower education (high school or just junior college) were more probably to be classified in the "high caregiving ability" class. In the present study, almost half (46.7%) of the sample ($n = 183$) with lower education (high school or junior college) had more than one child. Therefore, they had more caregiving experience in taking care of their children. On the contrary, parents with higher education (bachelor degree or above) were more probably to have a single child, more co-caregivers and less daily caregiving time. This may explain their less caregiving experience and low caregiving ability.

Lower income had a statistically significant effect on the likelihood of being in the "low caregiving ability" class. Parents confronted with a high medical cost for their child disease treatment, expenses of caregiving needs, and often change in employment status following a child's cancer diagnosis. All those might reduce the financial stability of the family (Tsimicalis et al., 2020). Moreover, the financial burden on parents of children with haematological

malignancies is much heavier than that of any other cancer (Pagano et al., 2014). A study on caregivers of adolescents and young adults with complex medical conditions found that family income directly predicted family functioning and greatly contributed to caregivers' caregiving ability (Deatrck et al., 2014). So, medical insurance with a high reimbursement rate and more financial help for the parents are needed, which will also have positive effect on improving parents' caregiving ability.

Parents with shorter daily caregiving time were more probably to be in the "low caregiving ability" class. Parents who had longer daily caregiving time had a better understanding of the treatment and care, and accumulated more caregiving experience, which helped to improve their caregiving ability. However, previous studies indicated that the care burden would increase gradually as caregivers spent more time caring for their children with cancer, which had a negative influence on parents' caregiving ability (Utne et al., 2013). So, appropriate daily caregiving time was encouraged to help primary caregivers achieve a balance between care for their children and themselves, as a result, improving their caregiving ability.

Parents with younger children had a higher likelihood of being in the "low caregiving ability" class than in the "medium caregiving ability" and the "high caregiving ability" class. Younger children could not express their feelings and needs clearly, and they had lower self-care ability, which led to more dependence on their parents' assistance (Xie et al., 2018). Parents' failure in perceiving or satisfying the needs of their children might led to parents' low self-evaluation on their caregiving ability.

Compared with parents of children with other kinds of haematological malignancies, parents of children with leukaemia were more probably to be in the "low caregiving ability" class than in the "high caregiving ability." This is probably because 59.7% of the parents in

the study had children diagnosed with leukaemia who were in the early stage (1–3 months) of treatment of leukaemia.

4.4 | Clinical Implementation

Exploring the latent classes of Chinese parents' caregiving ability for children with haematological malignancies and the socio-demographic characteristics of parents in the latent classes could provide useful information for the professional healthcare providers to identify parents who are most probably to have low caregiving ability. Therefore, early and precise supportive intervention could be provided to the targeted parents to improve their caregiving ability, which in results, improving the children's disease prognosis and quality of life. Moreover, the results of this study also reminded us that parents with high self-appraisal of caregiving ability may not have high ability in all the aspects of caregiving. Therefore, targeted support needs to be provided to parents based on their needs. Additionally, parents who have high self-appraisal of caregiving ability may gradually encounter more caregiving problems and their self-appraisal of caregiving ability will change. So, healthcare providers are highly suggested to track the development of parents' caregiving ability.

4.5 | Limitations

There are some limitations in the study. First, data were collected only in three children's hospitals in Shanghai, Suzhou and Chongqing, which are all big cities in China. Second, parents of children with leukaemia account for majority of the sample. Third, the parents in this study all received at least high school education. As such, generalizability of our findings may be limited. Fourth, after the diagnosis of their children, parents' caregiving ability changes across the children's disease treatment period. The present study is a cross-sectional study and unable to speculate the trajectory of parents' caregiving ability development. A longitudinal study is needed to explore the developmental trend of parents' caregiving ability in the future. And finally, all of our LCA models were estimated assuming local independence (i.e. no error term covariances in the models).

5 | CONCLUSION

Three distinct latent classes of Chinese parents of children with haematological malignancies were identified with regard to caregiving ability. This is the first study using LCA to examine caregiving ability in this population in China. Our findings provided useful implications for healthcare providers to better understand the classes of caregiving ability among parents of children with haematological malignancies and help them provide timely supportive intervention to the parents who have low caregiving ability.

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CONFLICT OF INTEREST

There are no potential conflicts of interest known to any of the contributing authors.

AUTHOR CONTRIBUTIONS

All the authors made substantial contributions to this study. Wang JT and Yuan CR made substantial contributions to the conception and study design, and final approval of the version to be published. Wang JT and Bi XY drafted the manuscript. Bi XY analysed and interpreted the data. Wang JC revised the manuscript critically for the data analysis and important intellectual content. Gu Y, Zheng XL, Wang YW, Wu HF, Yang Q, Ma LY and Liu F made substantial contributions to the acquisition of data and interpretation of data. All the authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

- Abedin, S., & Altman, J. K. (2016). Acute promyelocytic leukemia: Preventing early complications and late toxicities. *Hematology-American Society of Hematology Education Program*, 2016(1), 10–15. <https://doi.org/10.1182/asheducation-2016.1.10>
- Aburn, G., & Gott, M. (2011). Education given to parents of children newly diagnosed with acute lymphoblastic leukemia: A narrative review. *Journal of Pediatric Oncology Nursing*, 28(5), 300–305. <https://doi.org/10.1177/1043454211409585>
- Arab, M., Bernstein, C., Haghshenas, A., & Ranjbar, H. (2019). Factors associated with caregiver burden for mothers of children undergoing Acute Lymphocytic Leukemia (ALL) treatment. *Palliative & Supportive Care*, 18(4), 405–412. <https://doi.org/10.1017/s1478951519000853>
- Berger, A. M., Mitchell, S. A., Jacobsen, P. B., & Pirl, W. F. (2015). Screening, evaluation, and management of cancer-related fatigue: Ready for implementation to practice? *A Cancer Journal for Clinicians*, 65(3), 190–211. <https://doi.org/10.3322/caac.21268>
- Bhakta, N., Force, L. M., Allemanni, C., Atun, R., Bray, F., Coleman, M. P., Steliarova-Foucher, E., Frazier, A. L., Robison, L. L., Rodriguez-Galindo, C., & Fitzmaurice, C. (2019). Childhood cancer burden: A review of global estimates. *Lancet Oncology*, 20(1), e42–e53. [https://doi.org/10.1016/s1470-2045\(18\)30761-7](https://doi.org/10.1016/s1470-2045(18)30761-7)
- Bray, F., Ferlay, J., Soerjomataram, I., Siegel, R. L., Torre, L. A., & Jemal, A. (2018). Global cancer statistics 2018: GLOBOCAN estimates

- of incidence and mortality worldwide for 36 cancers in 185 countries. *A Cancer Journal for Clinicians*, 68(6), 394–424. <https://doi.org/10.3322/caac.21492>
- Clark, S. L. (2010). *Mixture Modeling with Behavioral Data*. (Doctor). University of California.
- Clarke, D. J., Hawkins, R., Sadler, E., Harding, G., McKeivitt, C., Godfrey, M., Dickerson, J., Farrin, A. J., Kalra, L., Smithard, D., & Forster, A. (2014). Introducing structured caregiver training in stroke care: Findings from the TRACS process evaluation study. *British Medical Journal Open*, 4(4), e004473. <https://doi.org/10.1136/bmjop-en-2013-004473>
- Collins, L. M., & Lanza, S. T. (2010). *Latent class and latent transition analysis: With applications in the social behavioral, and health sciences*. Wiley.
- Deatrick, J. A., Hobbie, W., Ogle, S., Fisher, M. J., Barakat, L., Hardie, T., Reilly, M., Li, Y., & Ginsberg, J. P. (2014). Competence in caregivers of adolescent and young adult childhood brain tumor survivors. *Health Psychology*, 33(10), 1103–1112. <https://doi.org/10.1037/a0033756>
- Dixon, S. B., Bjornard, K. L., Alberts, N. M., Armstrong, G. T., Brinkman, T. M., Chemaitilly, W., Ehrhardt, M. J., Fernandez-Pineda, I., Force, L. M., Gibson, T. M., Green, D. M., Howell, C. R., Kaste, S. C., Kirchoff, A. C., Klosky, J. L., Krull, K. R., Lucas, J. T., Mulrooney, D. A., Ness, K. K., ... Hudson, M. M. (2018). Factors influencing risk-based care of the childhood cancer survivor in the 21st century. *A Cancer Journal for Clinicians*, 68(2), 133–152. <https://doi.org/10.3322/caac.21445>
- Granek, L., Nathan, P. C., Rosenberg-Yunger, Z. R. S., D'Agostino, N., Amin, L., Barr, R. D., Greenberg, M. L., Hodgson, D., Boydell, K., & Klassen, A. F. (2012). Psychological factors impacting transition from paediatric to adult care by childhood cancer survivors. *Journal of Cancer Survivorship*, 6(3), 260–269. <https://doi.org/10.1007/s11764-012-0223-0>
- Kyu, H. H., Stein, C. E., Boschi Pinto, C., Rakovac, I., Weber, M. W., Dannemann Purnat, T., Amuah, J. E., Glenn, S. D., Cercy, K., Biryukov, S., Gold, A. L., Chew, A., Mooney, M. D., O'Rourke, K. F., Sligar, A., Murray, C. J. L., Mokdad, A. H., & Naghavi, M. (2018). Causes of death among children aged 5–14 years in the WHO European Region: A systematic analysis for the global burden of disease study 2016. *Lancet Child & Adolescent Health*, 2(5), 321–337. [https://doi.org/10.1016/s2352-4642\(18\)30095-6](https://doi.org/10.1016/s2352-4642(18)30095-6)
- Lazarsfeld, P. F., & Henry, N. W. (1968). *Latent Structure Analysis*. Houghton Mill.
- Mao, Z., Xiao, R., Yang, L., & Guo, L. (2018). Investigation on the influence of caregivers' care ability on children with leukemia. *Today Nurse*, 25(6), 43–45.
- Mazanec, S. R., Sandstrom, K., Coletta, D., Dorth, J., Zender, C., Alfes, C. M., & Daly, B. J. (2019). Building family caregiver skills using a simulation-based intervention: a randomized pilot trial. *Oncology Nursing Forum*, 46(4), 419–427. <https://doi.org/10.1188/19-Onf.419-427>
- Muthén, B. O. (2002). Beyond SEM: General latent variable modeling. *Behaviormetrika*, 29, 81–117.
- Pagano, E., Baldi, I., Mosso, M. L., diMontezemolo, L. C., Fagioli, F., Pastore, G., & Merletti, F. (2014). The economic burden of caregiving on families of children and adolescents with cancer: A population-based assessment. *Pediatric Blood & Cancer*, 61(6), 1088–1093. <https://doi.org/10.1002/pbc.24904>
- Potter, P., Olsen, S., Kuhrik, M., Kuhrik, N., & Huntley, L. R. (2012). A DVD program on fall prevention skills training for cancer family caregivers. *Journal of Cancer Education*, 27(1), 83–90. <https://doi.org/10.1007/s13187-011-0283-2>
- Qian, S. (2016). *The adaptation of hematologic malignancies family caregiver skills scale*. (Master), Soochow University.
- Robison, L. L., & Hudson, M. M. (2014). Survivors of childhood and adolescent cancer: Life-long risks and responsibilities. *Nature Reviews Cancer*, 14(1), 61–70. <https://doi.org/10.1038/nrc3634>
- Rodriguez-Galindo, C., Friedrich, P., Alcasabas, P., Antillon, F., Banavali, S., Castillo, L., Israels, T., Jeha, S., Harif, M., Sullivan, M. J., Quah, T. C., Patte, C., Pui, C.-H., Barr, R., & Gross, T. (2015). Toward the cure of all children with cancer through collaborative efforts: pediatric oncology as a global challenge. *Journal of Clinical Oncology*, 33(27), 3065–3073. <https://doi.org/10.1200/jco.2014.60.6376>
- Shen, M., Liang, P., Ma, J., Wu, H., & Chan, Y. Y. (2018). Influencing factors of caregiving ability of family caregivers of leukemic children. *Modern Clinical Nursing*, 17(9), 50–55. <https://doi.org/10.3969/j.issn.1671-8283.2018.09.010>
- Sinha, P., Calfee, C. S., & Delucchi, K. L. (2021). Practitioner's guide to latent class analysis: Methodological considerations and common pitfalls. *Critical Care Medicine*, 49(1), e63–e79. <https://doi.org/10.1097/CCM.00000000000004710>
- Tillery, R., Willard, V. W., Howard Sharp, K. M., Klages, K. L., Long, A. M., & Phipps, S. (2020). Impact of the parent-child relationship on psychological and social resilience in pediatric cancer patients. *Psychooncology*, 29(2), 339–346. <https://doi.org/10.1002/pon.5258>
- Tsimicalis, A., Stevens, B., Ungar, W. J., Castro, A., Greenberg, M., & Barr, R. (2020). Shifting priorities for the survival of my child: managing expenses, increasing debt, and tapping into available resources to maintain the financial stability of the family. *Cancer Nursing*, 43(2), 147–157. <https://doi.org/10.1097/ncc.0000000000000698>
- Utne, I., Miaskowski, C., Paul, S. M., & Rustøen, T. (2013). Association between hope and burden reported by family caregivers of patients with advanced cancer. *Supportive Care in Cancer*, 21(9), 2527–2535. <https://doi.org/10.1007/s00520-013-1824-5>
- Vermunt, J. K., & Magidson, J. (2002). Latent class cluster analysis. In J. A. Hagenaars, & A. L. McCutcheon (Eds.), *Applied latent class analysis* (pp. 89–106). Cambridge University Press.
- Wang, J., Howell, D., Shen, N., Geng, Z., Wu, F., Shen, M., Zhang, X., Xie, A., Wang, L., & Yuan, C. (2018). mHealth supportive care intervention for parents of children with acute lymphoblastic leukemia: Quasi-experimental pre- and postdesign study. *JMIR Mhealth and Uhealth*, 6(11), e195. <https://doi.org/10.2196/mhealth.9981>
- Wang, J., Shen, N., Zhang, X., Shen, M., Xie, A., Howell, D., & Yuan, C. (2017). Care burden and its predictive factors in parents of newly diagnosed children with acute lymphoblastic leukemia in academic hospitals in China. *Supportive Care in Cancer*, 25(12), 3703–3713. <https://doi.org/10.1007/s00520-017-3796-3>
- Wang, J., & Wang, X. (2020). *Structural equation modeling: Applications using mplus*, 2nd ed. John Wiley.
- Wang, J., Yao, N., Wang, Y., Zhou, F., Liu, Y., Geng, Z., & Yuan, C. (2016). Developing "Care Assistant": A smartphone application to support caregivers of children with acute lymphoblastic leukaemia. *Journal of Telemedicine and Telecare*, 22(3), 163–171. <https://doi.org/10.1177/1357633x15594753>
- Ward, Z. J., Yeh, J. M., Bhakta, N., Frazier, A. L., Girardi, F., & Atun, R. (2019). Global childhood cancer survival estimates and priority-setting: A simulation-based analysis. *Lancet Oncology*, 20(7), 972–983. [https://doi.org/10.1016/s1470-2045\(19\)30273-6](https://doi.org/10.1016/s1470-2045(19)30273-6)
- Wiener, L., Viola, A., Kearney, J., Mullins, L. L., Sherman-Bien, S., Zadeh, S., Farkas-Patenaude, A., & Pao, M. (2016). Impact of caregiving for a child with cancer on parental health behaviors, relationship quality, and spiritual faith: Do lone parents fare worse? *Journal of Pediatric Oncology Nursing*, 33(5), 378–386. <https://doi.org/10.1177/1043454215616610>
- Wild, C. P., Weiderpass, E., & Stewart, B. W. (2020). *World cancer report: Cancer research for cancer prevention*. Imprimerie Faurite.
- Wu, H., Bi, X., Li, J., & Wang, J. T. (2020). Analysis on care ability and its influencing factors for parents of children with leukemia. *Nursing Journal of Chinese People's Liberation Army*, 37(2), 18–22. <https://doi.org/10.3969/j.issn.1008-9993.2020.02.007>
- Xie, A., Chan, Y., Yao, W., Niu, M., & Lin, X. (2018). The investigation of nursing needs of school-aged children underwent lumbar puncture

- with Acute Leukemia. *Chinese Nursing Management*, 18(1), 103–107. <https://doi.org/10.3969/j.issn.1672-1756.2018.01.025>
- Yayan, E. H., & Düken, M. E. (2019). A comparison of caregiving burden and social support levels of parents of children undergoing liver transplant. *Journal Pediatric Nursing-Nursing Care of Children & Families*, 47, e45–e50. <https://doi.org/10.1016/j.pedn.2019.04.022>
- Zhang, Z., & Shen, T. (2007). *Diagnostic and therapeutic criteria of hematologic diseases*. Science Press.

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