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Original Research

Caregiver burnout in parents of children with neurogenic bladder: Prevalence and determinants

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Summary

Objective
To investigate the prevalence and determinants of caregiving burnout among parents of children with neurogenic bladder in China.

Methods
A multi-center, cross-sectional study was conducted from January 2022 to March 2024. A total of 238 parents of children with NB from tertiary hospitals in Shenzhen, Wuhan, Zhengzhou, and Chongqing were enrolled. Validated scales were used to assess parenting burnout, work-family conflict, co-parenting quality, and psychological capital. Multiple linear regression and interaction analyses were performed to identify key predictors.

Results
The mean parental burnout score was (96.11 ± 26.96), with 28.6 % of parents experiencing high burnout. Significant predictors included lower educational level ($\beta = -0.254$, $p < 0.001$), gender of parents ($\beta = 0.153$, $p = 0.001$), lower monthly income ($\beta = -0.166$, $p = 0.001$), higher work-family conflict ($\beta = 0.194$, $p < 0.001$), poorer co-parenting ($\beta = -0.232$, $p < 0.001$), and lower psychological capital ($\beta = -0.167$, $p = < 0.001$). Disease severity and time since diagnosis interacted with income to exacerbate burnout in low-income families.

Conclusion
Parents of children with NB experience high levels of caregiving burnout, influenced by socioeconomic, psychological, and family-system factors. Targeted interventions—such as financial aid, psychological support, and co-parenting programs—are urgently needed to mitigate burnout and improve family outcomes.

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Introduction

Family caregiving burden has become a major global public health concern, particularly with improved survival rates for children with chronic illnesses [1]. In China, the "Healthy China 2030" initiative emphasizes integrated psychological support for affected families. However, research has predominantly focused on common pediatric conditions like cancer [2] and autism [3], with rare urological diseases such as neurogenic bladder (NB) receiving limited attention [4].

NB, often resulting from conditions like spina bifida or spinal cord injury, involves complex, long-term management including intermittent catheterization and close monitoring. Its global prevalence in children is estimated at 0.1 % to 1 % [5,6]. The intensive care demands—often 4–6 h daily—place significant psychological [7], economic, and social strain on parents, with 40～60 % experiencing caregiver burnout, emotional exhaustion, and social isolation [8]. This not only affects parental wellbeing but may also compromise treatment adherence and child health outcomes.

While caregiver burnout is well-documented among adult patient caregivers, studies focusing on parents of children with chronic diseases—especially urological conditions like NB—remain scarce [9,10]. Key psychosocial factors such as psychological capital, co-parenting quality [11–13], and work-family conflict are known to influence caregiver mental health [14], yet their combined impact on burnout in NB parents is unclear.

To address this gap, the present investigation is guided by an integrated framework combining the Caregiver Stress Model [15] and Psychological Capital Theory [16]. The Caregiver Stress Model provides a structure by positing that caregiver outcomes are determined by primary stressors (e.g., the child's illness severity) and the resources available to cope with them, including socioeconomic (e.g., income, education), social (e.g., co-parenting), and psychological resources. Psychological Capital Theory directly informs the latter, specifying four key positive psychological resources—self-efficacy, resilience, hope, and optimism—that constitute an individual's capacity to cope with adversity and are theorized to buffer the impact of stressors.

Integrating these models suggests that the intensive care demands of a child with NB lead to burnout through pathways exacerbated by work-family conflict, yet buffered by socioeconomic resources, effective co-parenting, and positive psychological capital. This multi-factor framework enables a systematic examination of the complex interplay of risk and protective factors shaping parental burnout. Specifically, based on this integrated framework, several key propositions are advanced. First, primary stressors—notably greater disease severity—are posited to directly increase burnout risk, particularly when combined with lower socioeconomic resources (including education and income) and female gender. Second, psychosocial resources such as higher psychological capital and better co-parenting quality are expected to independently buffer against burnout, serving as protective factors. Third, the chronicity of care, reflected in time since diagnosis, is hypothesized to interact with economic resources; specifically, low-income families may experience an accumulating disadvantage over time, whereas higher income may attenuate this trajectory. Finally, the protective role of education may itself be moderated by parent gender, in light of the gendered distribution of caregiving roles and responsibilities.

Guided by the Caregiver Stress Model [15] and Psychological Capital Theory [16], the present study aims to systematically examine how child-related care demands, psychological resources, family support, and environmental challenges interact to influence burnout among parents of children with NB. In line with "Healthy China 2030" goals, this research provides empirical evidence to inform targeted psychological interventions.

Based on the theoretical framework outlined above, the study propose the following specific hypotheses: H1: Lower socioeconomic status (indicated by lower education and income), female gender of the parent, and greater disease severity of the child will be directly associated with higher levels of parental burnout; H2: Higher levels of psychosocial resources—specifically, greater psychological capital and better co-parenting quality—will be associated with lower burnout, independent of demographic and clinical factors; H3: The association between time since diagnosis and burnout will be moderated by family income, such that this association will be stronger (more positive) for families with lower income compared to those with higher income; H4: The protective effect of higher education against burnout will be moderated by parent gender, with a stronger buffering effect anticipated for mothers, reflecting the gendered nature of primary caregiving responsibilities.

Therefore, this cross-sectional study surveyed 238 parents of children with NB from four Chinese cities, using validated tools to assess burnout and its predictors. The goal is to identify key determinants and inform future supportive strategies.

Methods

Participants

This study utilized a convenience sampling method to enroll parents of children diagnosed with neurogenic bladder (NB). Recruitment took place over a 26-month period (January 2022 to March 2024) across the pediatric urology departments of four tertiary Grade A hospitals located in Shenzhen, Wuhan, Zhengzhou, and Chongqing, China. A total of 258 families were assessed for eligibility against predefined inclusion and exclusion criteria.

The final analytic sample comprised 238 families. This represents a participation rate of 90.49 %, derived from 238 valid questionnaires returned out of 263 distributed. Attrition was exclusively due to 20 exclusions: 15 families did not meet the inclusion criteria, and 5 families declined to participate after the study was fully explained. All families meeting the eligibility criteria during the data collection windows were invited to participate. The notably high participation rate is postulated to result from two primary factors: first, the direct, onsite communication of the

study's purpose and value by trained research personnel; and second, the guaranteed anonymity of the survey responses. No financial compensation was provided to participants to prevent any potential coercion.

Inclusion criteria: Eligible parents were required to fulfill all of the following conditions: 1) Their child had received a formal diagnosis of NB, as per the established criteria outlined in the reference text Urology [17]; 2) A minimum of one month had elapsed since the child's initial diagnosis; 3) The child was 18 years of age or younger at the time of enrollment; 4) The parent was identified as the child's primary caregiver; 5) The parent was capable of normal communication and voluntarily provided informed consent. **Exclusion criteria:** Potential participants were excluded based on the following: 1) The child had a comorbid major physical or mental illness that could confound the assessment of caregiver burden; 2) The child had other significant medical conditions unrelated to NB; 3) The parent had a documented history of mental disorders or other serious health conditions that could impair their ability to complete the survey reliably.

Patient stratification and clinical variables

To address the heterogeneity of the NB population and its potential impact on caregiver burnout, we collected data on the primary underlying etiology of NB for each child. Participants were stratified into the following diagnostic subgroups based on medical record review: 1) Spina bifida (including myelomeningocele); 2) Spinal cord injury; 3) Cerebral palsy; 4) Other (e.g., sacral agenesis, neurodegenerative diseases). Furthermore, to preliminarily account for disease severity, we recorded the primary method of bladder management for each child, categorized as: 1) Clean Intermittent Catheterization (CIC), 2) Medication only, 3) Reconstructive surgery (e.g., bladder augmentation, Mitrofanoff channel creation, or urinary diversion procedures such as ileal conduit), or 4) No specific treatment. CIC was used as a proxy indicator for more severe bladder dysfunction requiring active, intensive management. This was complemented by the physician's global assessment of disease severity, classified as mild, moderate, or severe.

Measures

A questionnaire was used, and the purpose of the questionnaire and the specifications for filling in the questions were explained to the parents of the affected children before the survey, and informed consent was obtained from the parents of the affected children. Data were collected via both paper-based and electronic questionnaires (distributed using Questionnaire Star). All responses were anonymized. To ensure data quality, electronic submissions were restricted to a single attempt with a minimum time requirement. Paper questionnaires were distributed and collected on-site, where they were promptly reviewed for completeness. A total of 263 copies were distributed and 238 valid questionnaires were recovered, with a valid recovery rate of 90.49 %. Questionnaires were considered invalid and excluded if they had extensive missing data (>20 % of items on any key scale) or showed clear response patterns (e.g., identical answers for all items). The final dataset contained minimal missing values (<1.5 % of all data points). Using listwise deletion for regression analyses, as simulation studies suggest this approach is acceptable with such low rates of missingness. While we cannot definitively determine the missing data mechanism, the minimal and sporadic pattern of missingness suggests it is unlikely to substantially bias our results.

General socio-demographic data

Information of the parents of the affected children, including gender, age, education level, monthly family income, etc.

Parenting burnout assessment scale

Roskam et al. [18]who developed an assessment tool containing four dimensions, including parental emotional exhaustion feeling, boredom with parental role, estrangement from children, and self-comparison, totaling 23 entries. Cheng Huabin [19] then revised it to form the Chinese version of the PBA(parenting burnout assessment scale, PBA), in which a Likert 7-point scale was used, with each entry ranging from 1 to 7, with higher numbers indicating higher burnout. The Cronbach's alpha coefficient of the Chinese version of the PBA was 0.952, showing its good internal consistency. The Cronbach's alpha coefficient for this scale in this study was 0.938.

Simple co-parenting scale

Feinberg et al. [20] designed the Simple Co-parenting Scale in 2012 to assess the quality of family co-parenting relationships. The scale consists of 7 dimensions and 14 entries on a Likert 7-point scale, in order from 0 to 6, with a total score range of 0—84, with higher scores indicating better co-parenting. Wu Jiaming [21] subsequently translated and adapted the scale into Chinese. The Cronbach's alpha for the overall Chinese version was 0.613, while the values for the mutual recognition and mutual support dimensions were 0.638 and 0.708, respectively, indicating adequate internal consistency. The scale had a Cronbach's alpha coefficient of 0.897 in this study.

Work-family conflict scale

The Work-Family Conflict Scale developed by Netemeyer [22] was used, including the work-family conflict dimension and the family-work conflict dimension. It is scored on a five-point Likert scale, with "1—5" indicating "completely disagree - completely agree", and the higher the score, the more obvious the work-family conflict perceived by the individual. This scale has been widely used in China. The Cronbach's alpha coefficient for this scale in this study was 0.873.

Psychological capital scale

The Positive Mental Capital Scale compiled by Zhang Gao [23] was used, including four dimensions of self-efficacy, resilience, hope, and optimism, with a total of 26 entries, and the higher the score, the higher the mental capital capacity, of which, 8, 10, 12, 14, and 15 are reverse scoring. The Cronbach's alpha coefficient of this study is 0.933.

Statistical methods

Variable selection for the multivariate model was guided by the Caregiver Stress Model [15] and Psychological Capital Theory [16]. This conceptual framework informed the inclusion of variables representing: (1) Primary stressors (disease severity, time since diagnosis); (2) Socioeconomic resources (education, income); (3) Psychological resources (psychological capital); (4) Family-system resources (co-parenting quality). Work-family conflict was conceptualized as a key mechanism, representing the potential mediation pathway through which care demands translate into burnout outcomes.

While acknowledge potential conceptual overlap among some predictors, they were retained for their distinct theoretical roles. Education and income, though related, represent distinct socioeconomic dimensions—education reflecting knowledge, problem-solving skills, and health literacy, while income captures material resources and purchasing power. Similarly, psychological capital (intrapsychic resources), work-family conflict (role conflict), and co-parenting quality (dyadic support) represent fundamentally different mechanisms within the stress process. Their simultaneous inclusion allows for a robust test of their independent associations with parental burnout.

SPSS 25.0 software was used for statistical analysis. Prior to analysis, data were screened for missing values, outliers, and adherence to statistical test assumptions. The missing data pattern was assessed and found to be random. The normality of continuous data was assessed using the Shapiro—Wilk test. Data conforming to a normal distribution were expressed as mean ± standard deviation ($\overline{x} \pm s$), while non-normally distributed data were expressed as median and interquartile range. Categorical data were expressed as frequencies and percentages (%). Comparisons of parenting burnout scores across different demographic and clinical subgroups (e.g., etiology, bladder management method) were performed using independent t-tests or one-way ANOVA for normally distributed data. The Mann—Whitney U or Kruskal—Wallis H tests were used for non-normally distributed data. Pearson correlation analysis was used to examine the relationships between parenting burnout, work-family conflict, co-parenting, and psychological capital for normally distributed data. Otherwise, spearman's rank correlation was applied.

Comparisons of parenting burnout scores across different demographic and clinical subgroups were performed using independent t-tests or one-way ANOVA. To control the false discovery rate (FDR) in the context of multiple comparisons, the Benjamini-Hochberg procedure was applied to adjust p-values from all univariate tests presented in Table 1. The FDR-adjusted q-values are reported alongside the original p-values, with $q < 0.05$ considered statistically significant after correction.

To enhance the clinical interpretability of the parenting burnout scores, we categorized participants into three groups based on their mean item score on the parental Burnout Assessment (PBA), consistent with approaches used in prior literature [24]: 1) Low burnout: Mean score <3.5 (corresponding to a frequency of less than once a month); 2) Moderate burnout: Mean score 3.5—4.9 (corresponding to a frequency of a few times a month to once a week); 3)

Table 1 Comparison of parenting burnout levels among parents of children with NB with different characteristics ($\overline{x} \pm s$).

Items		N	$\overline{x} \pm s$	t/F	P	q (FDR)
Relationship with child	Father	52	85.04 ± 14.29	−3.42	0.001	0.006
	Mother	186	99.20 ± 26.91			
Age (years)	26—35	56	97.18 ± 27.55	0.59	0.555	0.666
	36—47	103	93.97 ± 26.77			
	48—55	79	98.14 ± 26.92			
Education level	High school or below	28	113.43 ± 21.96	13.62	<0.001	<0.001
	College	73	102.97 ± 26.39			
	Undergraduate	110	92.37 ± 27.12			
	Master's or above	27	74.81 ± 11.39			
Monthly family income (¥)	5000—8000	11	126.27 ± 18.71	9.58	<0.001	<0.001
	8001—10,000	69	103.83 ± 27.22			
	10,001—20,000	125	90.66 ± 25.45			
	>20,000	33	90.58 ± 24.51			
Time since diagnosis (months)	<6	33	88.06 ± 21.63	1.25	0.591	0.666
	6—12	154	86.10 ± 23.14			
	12—24	41	85.24 ± 22.51			
	>24	10	86.19 ± 21.62			
Religious belief	Yes	73	95.38 ± 27.18	−0.28	0.78	0.780
	No	165	96.43 ± 26.94			
Number of children	1	150	97.71 ± 27.48	1.19	0.23	0.345
	≥2	88	93.39 ± 25.98			
Disease severity (Doctor diagnosis)	Mild	72	92.49 ± 22.77	15.34	<0.001	<0.001
	Moderate	124	98.56 ± 21.23			
	Severe	42	118.82 ± 23.61			

Note: FDR correction for multiple comparisons was performed using the Benjamini-Hochberg procedure. Bolded q-values indicate statistical significance after FDR adjustment ($q < 0.05$).

High burnout: Mean score ≥5.0 (corresponding to a frequency of a few times a week or more).

This categorization allows for a more intuitive understanding of the burden experienced by parents and facilitates the identification of subgroups requiring urgent clinical attention.

To identify independent factors influencing parenting burnout, a multiple linear regression analysis was performed. The dependent variable was the parenting burnout score. Independent variables were selected based on a combination of theoretical relevance and statistical significance in the univariate analyses (Table 1) and correlation analysis (Table 3).

The final model included the following predictors: parent gender, educational level, monthly household income, disease severity, work-family conflict, co-parenting, and psychological capital. A hierarchical entry method was not used, instead, all selected variables were entered simultaneously into the model. The model's goodness-of-fit was assessed using the coefficient of determination (R^2 and adjusted R^2). The variance inflation factor (VIF) was examined for each predictor to check for multicollinearity, with a VIF <5 considered acceptable. The assumptions of linear regression, including linearity, homoscedasticity, and normality of residuals, were inspected graphically using scatterplots of residuals versus predicted values and normal probability plots (p-p plots). No significant violations were observed. The test level was set at $\alpha = 0.05$ (two-tailed). Based on the above methodological framework, the following results were obtained.

Ethical considerations

The Ethics Committee of Shenzhen Children's Hospital reviewed ethical principles from GCP(2020 and 2022), Ethical Review Measures (2016), the Helsinki Declaration, and CIOMS Guidelines.

Result

Parenting burnout score of children with NB

The analysis of our cohort yielded the following key findings. In this study, the parenting burnout score of parents of children with NB (96.11 ± 26.96), the mean score of the entries (4.18 ± 1.17), and the overall parenting burnout behaviors were in the range of "a few times a month" to "once a week". Comparison of parenting burnout levels among parents of NB children with different characteristics (Table 1). After adjusting for multiple comparisons using the false discovery rate (FDR) method, four demographic and clinical factors remained significantly associated with parenting burnout (Table 1). These included the relationship with the child ($q = 0.006$), educational level ($q < 0.001$), monthly family income ($q < 0.001$), and disease severity ($q < 0.001$). Parent age, time since diagnosis, religious belief, and number of children were not significantly associated with burnout after FDR correction (all $q > 0.05$).

To further delineate the clinical relevance, parents were categorized into burnout severity levels based on their mean item score. The distribution revealed that a substantial proportion of parents were experiencing clinically significant levels of burnout: 68 (28.6 %) were in the high burnout range, 125 (52.5 %) experienced moderate burnout, and 45 (18.9 %) were in the low burnout category (Table 2).

The distribution of parenting burnout levels across different demographic and clinical characteristics is

Table 2 Distribution of parenting burnout levels among parents of children with NB with different characteristics, n (%).

Characteristic	Subgroup	Low Burnout (n = 45)	Moderate Burnout (n = 125)	High Burnout (n = 68)	P (χ^2)
Overall		45 (18.9 %)	125 (52.5 %)	68 (28.6 %)	
Relationship	Father	15 (28.8 %)	28 (53.8 %)	9 (17.3 %)	0.032
	Mother	30 (16.1 %)	97 (52.2 %)	59 (31.7 %)	
Education	High school or below	1 (3.6 %)	10 (35.7 %)	17 (60.7 %)	<0.001
	College	8 (11.0 %)	38 (52.1 %)	27 (36.9 %)	
	Undergraduate	22 (20.0 %)	62 (56.4 %)	26 (23.6 %)	
	Master's or above	14 (51.9 %)	11 (40.7 %)	2 (7.4 %)	
Disease severity	Mild	18 (25.0 %)	42 (58.3 %)	12 (16.7 %)	<0.001
	Moderate	22 (17.7 %)	68 (54.8 %)	34 (27.4 %)	
	Severe	5 (11.9 %)	15 (35.7 %)	22 (52.4 %)	

Table 3 Correlations between parenting burnout and work-family conflict, co-parenting, and psychological capital among parents of children with NB.

	Work-family conflict	Co-parenting	Psychological Capital	Parenting Burnout
Work-family conflict	1			
Co-parenting	−0.398[a]	1		
Psychological capital	−0.389[a]	0.426[a]	1	
Parenting burnout	0.447[a]	−0.481[a]	−0.415[a]	1

[a] At the 0.01 level (two-tailed), the correlation was significant.

detailed in Table 2. Notably, a significantly higher proportion of mothers (31.7 %), parents with lower educational attainment (60.7 %) in the high-school-or-below group), and parents of children with severe disease (52.4 %) fell into the high burnout category (all $p < 0.05$).

A multifactorial analysis of parenting burnout affecting parents of children with NB

The multiple linear regression model was employed to test the study's hypotheses (H1−H4). As summarized in Table 4 and 5, the results provided support for hypotheses H1, H2, and H3, while H4 was not supported by the data.

The multiple linear regression model was statistically significant ($F = 26.330$, $p < 0.001$) and explained 40 % of the variance in parenting burnout scores ($R^2 = 0.40$, Adjusted $R^2 = 0.382$). All variance inflation factors (VIF) were below 1.4, indicating no concerning multicollinearity. Disease severity emerged as a significant predictor of parenting burnout ($\beta = 0.218$, $p < 0.001$), indicating that for each level increase in disease severity (from mild to moderate to severe), parenting burnout scores increased by an average of 11.33 points. Other significant predictors included lower educational level ($\beta = -0.254$, $p < 0.001$), gender of parents ($\beta = 0.153$, $p = 0.001$), lower monthly income ($\beta = -0.166$, $p < 0.001$), higher work-family conflict ($\beta = 0.194$, $p < 0.001$), lower co-parenting quality ($\beta = -0.232$, $p < 0.001$), and lower psychological capital ($\beta = -0.167, p < 0.001$).

Moderating role of time since diagnosis and other interactions

The multiple linear regression model examining main effects was statistically significant ($F = 26.330$, $p < 0.001$) and explained 40.1 % of the variance in parenting burnout (Table 5). To test our specific hypotheses (H3 and H4) regarding moderation, as well as to explore the stress-buffering role of psychological capital, three interaction terms were added to the model. The results of these moderation analyses are presented in Table 6. The model including interaction terms accounted for a slightly greater proportion of variance (Adjusted $R^2 = 0.395$).

To further investigate the dynamic nature of burnout, we examined whether the association between key predictors and burnout was moderated by the time since the child's diagnosis. A significant interaction was found between time since diagnosis and monthly household income ($\beta = 0.138$, $p = 0.024$). Simple slope analysis (Fig. 1) revealed that for families with lower monthly income (<10,000 CNY), parenting burnout scores significantly increased with longer time since diagnosis ($B = 5.32$, $p = 0.008$). In contrast, for families with higher monthly income (≥10,000 CNY), time since diagnosis was not significantly associated with burnout ($B = 1.15$, $p = 0.287$).

Interaction effect of time since diagnosis and monthly household income on parenting burnout scores. Simple slopes are shown for families with monthly income below 10,000 CNY (solid line) and those with monthly income of 10,000 CNY or above (dashed line). The shaded areas represent 95 % confidence intervals.

Furthermore, the study explored the interaction between parent gender and educational level. The interaction term was not statistically significant ($\beta = -0.087$, $p = 0.154$), suggesting that the protective effect of higher education against burnout did not differentially affect mothers and fathers in our sample. Given the sample size constraints and to maintain model parsimony, only the significant 'time since diagnosis × income' interaction term was retained in the final model. The inclusion of this interaction term slightly improved the model's explanatory power (Adjusted $R^2 = 0.395$ vs. 0.382 in the main-effects-only model).

Consistent with the stress-buffering hypothesis [25], a significant interaction was observed between disease severity and psychological capital ($\beta = 0.150$, $p = 0.008$). To interpret this interaction, simple slope analyses were conducted, evaluating the association between psychological capital and burnout at each level of disease severity (mild, moderate, severe). Psychological capital was negatively associated with burnout across all groups, but this protective effect was strongest among parents of children with severe disease ($B = -0.52$, $p < 0.001$). The association was also significant, though somewhat less pronounced, in the moderate ($B = -0.38$, $p < 0.001$) and mild disease severity groups ($B = -0.21$, $p = 0.012$).

Stratified analysis by etiology and disease severity proxy

Parenting burnout scores varied among parents of children with different underlying etiologies. Parents of children with spina bifida ($n = 68$) reported the highest mean burnout score (88.71 ± 24.81), followed by those with

Table 4 Assignment of independent variables.

Independent variable	Assign values
Relationship with children	Father = 1, Mother = 2
Educational level	High school and lower = 1, Specialized subject = 2, Undergraduate = 3, Master's degree or higher = 4
Monthly household income (¥)	5000-8000 = 1, 8001−10000 = 2, 10,001−20,000 = 3, >20,000 = 4
Disease severity	Mild = 1, Moderate = 2, Severe = 3
Work-family conflict	Original values
Co-parenting	Original values
Psychological capital	Original values

Table 5 Multiple linear regression analysis of parenting burnout affecting parents of children with NB.

Items	Regression coefficient	Standard error	Standardised regression coefficient	t	P	95%CI	VIF
(Constant)	128.451	12.583		10.208	<0.001		
Gender of parents	9.956	3.082	0.153	3.230	<0.001	(3.88, 16.03)	1.015
Educational level	−8.124	1.532	−0.254	−5.302	<0.001	(−11.4,-5.11)	1.042
Monthly household income	−6.028	1.735	−0.166	−3.474	<0.001	(−9.44, −2.62)	1.045
Disease severity	11.326	2.418	0.218	4.684	<0.001	(6.56, 16.09)	1.125
Work-family conflict	0.451	0.124	0.194	3.637	<0.001	(0.21, 0.70)	1.302
Psychological capital	−0.178	0.058	−0.167	−3.069	<0.001	(-0.29, −0.06)	1.328
Co-parenting	−0.408	0.096	−0.232	−4.250	<0.001	(-0.60, −0.22)	1.355

Notes: $F = 26.330$, $P < 0.001$, $R^2 = 0.401$, Adjusted $R^2 = 0.382$.

Table 6 Analysis of the interaction effect between psychological capital and disease severity on parental burnout.

Interaction Terms	β	SE	t	P	95%CI
Time since diagnosis × Monthly income	0.138	0.061	2.268-	0.024*	(0.02,0.26)
Parent gender × Educational level	−0.087	0.061	−1.430	0.154	(−0.21,0.03)
Disease severity × Psychological capital	0.150	0.056	2.660	0.008**	(0.04,0.26)

Notes: SE = Standard Error; β = standardized coefficient; CI = Confidence Interval. The overall model with interactions was significant: $F = 24.850$, $p < 0.001$, $R^2 = 0.412$, Adjusted $R^2 = 0.395$. *$p < 0.05$, **$p < 0.01$.

spinal cord injury ($n = 82$, 105.63 ± 28.42), cerebral palsy ($n = 45$, 95.25 ± 25.12), and other causes ($n = 43$, 85.31 ± 22.93) ($p < 0.01$). Regarding bladder management, parents of children requiring Clean Intermittent Catheterization (CIC) ($n = 112$) had significantly higher burnout scores (102.51 ± 27.35) compared to those whose children were on medication only ($n = 75$, 90.14 ± 25.62) or required less intensive management ($p < 0.001$), Table 7.

Discussion

This study systematically evaluated the prevalence and determinants of parental caregiving burnout among families of children with NB. Drawing on a large, multi-centre sample of 238 families across Shenzhen, Wuhan, Zhengzhou, and Chongqing, the study employed validated instruments to measure caregiving burnout and its associations with psychological capital, co-parenting, and work—family conflict. The findings revealed a mean parental burnout score of 96.11 ± 26.96, corresponding to a frequency between "a few times a month" and "once a week", significantly higher than that reported by parents of healthy children (2.09 ± 0.94) [26]. Beyond the mean scores, our categorization of burnout levels reveals a more pressing clinical picture: over one-quarter (28.6 %) of parents were in the high burnout range, experiencing symptoms several times a week or more. This group, particularly concentrated among mothers, those with lower education, and caregivers of severely affected children, represents a

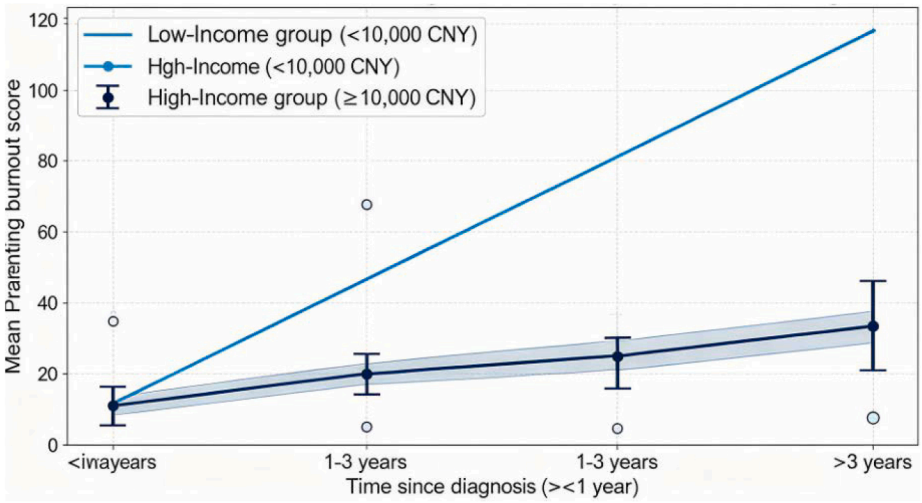

Fig. 1 Interaction effects of time since diagnosis and monthly income on parenting burnout.

Table 7 Comparison of parenting burnout scores among parents of children with NB by underlying etiology.

Grouping method	Items	n	PBA	F	P
Grouped by etiology	Spinal bifida	68	88.71 ± 24.81	15.62	<0.001**
	Spinal cord injury	82	105.63 ± 28.42*		
	Cerebral palsy	45	95.25 ± 25.12		
	Others	43	85.31 ± 22.93		
Grouped by bladder management method	CIC	112	102.51 ± 27.35*	12.45	<0.001**
	Medication only	75	90.14 ± 25.62		
	Urinary diversion surgery	32	95.32 ± 26.24		
	No specific treatment	19	80.43 ± 20.19		

Note: One-way ANOVA revealed significant differences in parenting burnout scores across subgroups. Post-hoc comparisons using Tukey's HSD test were conducted for significant ANOVA results. Parents of children with spina bifida reported significantly higher burnout than all other groups (all $P < 0.01$). Additionally, parents of children requiring clean intermittent catheterization (CIC) had significantly higher burnout than those in the medication-only and no-treatment groups (both $P < 0.001$). *$p < 0.05$, **$p < 0.01$.

population at high risk for negative personal and familial outcomes, including depression, couple conflict, and neglectful parenting behaviors. The identification of this vulnerable subgroup is crucial for directing targeted psychological support and clinical resources.

The present study tested a theoretical model of parenting burnout in parents of children with NB. Our findings largely confirmed the hypothesized relationships. Specifically, the data supported our core predictions that burnout is driven by socioeconomic and clinical stressors (**H1**) and buffered by psychosocial resources (**H2**). The significant moderating role of income in the chronicity of care (**H3**) highlights a critical dynamic often overlooked in cross-sectional studies. However, the hypothesized gendered effect of education (**H4**) was not observed, suggesting a more complex relationship in this population.

The analysis of interaction effects provides nuanced insights beyond the main effects, clarifying how risk factors operate in specific contexts. First, a significant interaction was observed between time since diagnosis and monthly household income ($\beta = 0.138$, $p = 0.024$). Simple slope analysis revealed that for families with lower monthly income (<10,000 CNY), parenting burnout scores increased significantly with longer time since diagnosis ($B = 5.32$, $p = 0.008$), whereas no such association was found for higher-income families ($B = 1.15$, $p = 0.287$). This pattern is consistent with an accumulation of disadvantage model [27], suggesting that the financial and emotional strain of caring for a child with NB compounds over time when families lack the economic resources to buffer these chronic demands.

Second, contrary to our hypothesis, the interaction between parent gender and educational level was not statistically significant ($\beta = -0.087$, $p = 0.154$). This indicates that the protective effect of higher education against burnout did not differentially affect mothers and fathers in our sample. This finding may suggest that the overwhelming pressure of managing a child's complex NB care supersedes more subtle gendered role expectations, or that the psychological resources garnered from education are equally valuable for all primary caregivers in this high-stress context.

Furthermore, the significant interaction between disease severity and psychological capital ($\beta = 0.15$, $p = 0.008$) offers critical support for the stress-buffering hypothesis central to Psychological Capital Theory [16]. This finding indicates that the protective effect of psychological capital is not uniform but is most potent under conditions of high clinical burden. For parents caring for a child with severe NB, higher levels of resilience, optimism, and self-efficacy were associated with a markedly smaller increase in burnout compared to parents with lower psychological capital. This underscores that interventions aimed at bolstering psychological resources may be particularly impactful for the subgroup of caregivers facing the most intensive and complex care demands.

Contrary to our hypothesis, the study did not find a significant interaction between parent gender and educational level. This indicates that the benefit of higher education in mitigating burnout is similarly protective for both mothers and fathers in our Chinese cohort. This could be interpreted as a positive sign of shifting gender norms, where the psychological resources gained from education are equally valuable for all caregivers in managing chronic stress. Alternatively, the overwhelming pressure of caring for a child with NB might supersede the more subtle effects of gendered role expectations in this specific context.

Our stratified analyses provide important insights into how clinical heterogeneity within the NB population affects parenting burnout. The significantly higher burnout observed among parents of children with spina bifida aligns with clinical observations that these children often have the most complex medical needs, including potential cognitive impairments, mobility limitations, and bowel dysfunction in addition to bladder issues [28]. This multidimensional care burden likely explains why these parents experience greater exhaustion than those caring for children with other NB etiologies.

Similarly, the association between bladder management intensity and burnout underscores how treatment demands directly impact caregiver wellbeing. The requirement for Clean Intermittent Catheterization (CIC)—typically performed every 4-6 h—represents a substantial time commitment and technical challenge that can disrupt family routines and employment [7]. Our finding that CIC was associated with the highest burnout levels highlights the need for targeted support for families managing this intensive regimen.

Multivariate regression analysis identified several key predictors of burnout, including lower income, lower

education, female gender, elevated work—family conflict, poor co-parenting quality, and reduced psychological capital. These findings reflect the multidimensional challenges faced by NB caregivers and underscore the complexity of the caregiving experience in this population.

NB is a functional disorder of the bladder and urethra, caused by partial or complete injury to the central or peripheral nervous system. Aetiologies often include spinal dysraphism, trauma, and tumours [29]. The chronicity and complexity of the condition increase the intensity of care demands and impose a substantial psychological and logistical burden on families [30]. Management typically requires life-long adherence to intermittent catheterization, bladder training, and hygiene maintenance [31], tasks that are time-consuming, technically demanding, and often financially burdensome. Poor treatment adherence is common in NB [32,33], necessitating constant parental oversight to avoid complications. The extended nature of caregiving consumes considerable parental time and energy [34—36], making it difficult to balance employment and family responsibilities. This imbalance contributes directly to caregiver burnout [36,37].

Importantly, this study also revealed novel insights. Among all factors assessed, work—family conflict demonstrated a particularly strong association with parental burnout ($\beta = 0.194$), indicating the extent to which NB-related care disrupts caregivers' occupational and personal lives. Mothers were significantly more affected than fathers ($p = 0.001$), consistent with prior research linking primary caregiving roles to elevated emotional exhaustion [38]. These results highlight the gendered burden of care and the need for structural and psychosocial interventions tailored to high-risk subgroups.

These findings support the caregiver stress model, which posits that caregiving demands (primary stressors) impact outcomes through individual and family-level buffers. Higher psychological capital was associated with lower burnout ($\beta = -0.167$, $p < 0.001$), aligning with Luthans' theory that positive psychological resources, such as self-efficacy and optimism, reduce stress [16]. Similarly, co-parenting quality showed a strong protective effect ($\beta = -0.232$, $p < 0.001$), in line with Feinberg's work on the value of shared parenting [39]. Families with stronger co-parenting relationships, marked by mutual support and collaborative caregiving, reported significantly lower burnout levels. This finding aligns with Feinberg's theoretical framework, which emphasizes that cooperative co-parenting enhances parental adjustment and buffers the emotional burden of caregiving [40]. In contrast, low co-parenting quality may amplify stress through role ambiguity, interparental conflict, or uneven caregiving responsibilities [41].

The observed level of parental burnout is consistent with findings from studies involving caregivers of children with chronic illnesses. Cici et al. [42] identified work—family conflict and psychological capital as key predictors of caregiver stress in similar populations. Cici's research, involving 212 families with chronic disease children, found work-family conflict and psychological capital as core factors influencing parental mental health, which is highly consistent with our discoveries in the neurogenic bladder pediatric population. However, our study offers a more comprehensive design and depth. Unlike Cici et al.'s single-dimensional analysis, we innovatively integrated psychological capital, co-parenting, and work-family conflict to systematically assess the complex mechanisms influencing caregiving burnout. Gawlik et al. [43] further highlighted the mental burden experienced by working parents engaged in intensive caregiving roles.

In line with these reports, the present study found that higher work—family conflict was significantly associated with increased parental burnout, supporting the results of Zeng et al. [44]. Co-parenting quality also played a critical role: positive co-parenting correlated negatively with burnout, while negative co-parenting showed a positive association—findings consistent with those of Lin et al. [45]. Moreover, psychological capital emerged as a strong protective factor, with higher levels linked to lower burnout, echoing prior evidence on the stress-buffering role of personal psychological resources [46]. These multidimensional research findings not only validate existing literature but also deepen our understanding of the psychological dynamics experienced by parents of NB patients [47—49].

Targeted psychological interventions are needed, especially for low-income (monthly income <8000 RMB) and less-educated families, who showed the highest burnout levels. Hospitals could provide combined psychological counselling and caregiving skill training to strengthen caregiver resilience [50,51]. Interventions aimed at improving co-parenting—such as family therapy—may also be beneficial. From a policy perspective, the "Healthy China 2030" initiative should expand its focus to include caregiver mental health screening during routine NB follow-up. Establishing dedicated financial support mechanisms for rare disease families could further reduce burden. Further research should explore how NB clinical features (e.g., incontinence frequency) relate to caregiver burnout. Digital interventions targeting psychological capital—such as app-based training—should be developed and tested. Cross-cultural comparisons may also reveal differences in coping strategies among NB families globally.

Conclusion

This study is the first to systematically assess parental caregiving burnout in families of children with neurogenic bladder in China. It provides empirical evidence for shaping family-centered psychological support strategies and highlights the need for integrated, long-term caregiver care in rare pediatric conditions.

Limitations

This study has several limitations. Its cross-sectional design precludes causal inferences. The sample was recruited via convenience sampling from urban tertiary centers, potentially introducing selection bias and limiting representativeness. Although we achieved a high participation rate, the reliance on self-reported measures risks common method bias. While we introduced preliminary stratification by etiology and bladder management type, we did not include a comprehensive, clinically validated measure of

overall disease severity or account for key confounders such as the presence and severity of intellectual disability or other major comorbidities. Future research should employ longitudinal designs, incorporate objective clinical indicators of disease severity, and recruit more diverse samples to better understand the causal pathways and specific challenges faced by different subgroups within the NB population.

While the study introduced preliminary stratification by etiology and bladder management type, it is important to emphasize that our proxies for disease severity (i.e., bladder management method and physician's global assessment) are indirect indicators. We did not include a comprehensive, clinically validated measure of overall disease severity or account for key confounders such as the presence and severity of intellectual disability. Future research should employ longitudinal designs, incorporate objective clinical indicators (e.g., urodynamic studies, renal function tests) to validate and refine these severity proxies, and recruit more diverse samples.

Ethics approval

The study involving human participants were reviewed and approved by ShenZhen Children' hospital Ethics Committee. The author provided the written informed consent to participate in this study.

Consent

All the participants are aware of the content and purpose of the survey and participate voluntarily.

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Conflict of interest

None Declared.

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