



Preoperative anxiety in children aged 2–7 years old: a cross-sectional analysis of the associated risk factors

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Background: Preoperative anxiety in children is harmful. Despite this, there is a scarcity of studies examining the incidence of preoperative anxiety and its related effects in China. This study investigated preoperative anxiety in children aged 2 to 7 in the pediatric surgery department of a tertiary hospital in China. The factors influencing preoperative anxiety in these children were identified.

Methods: The researchers used the Chinese version of the modified Yale Preoperative Anxiety Scale (CmYPAS) and the Short Form of CmYPAS (CmYPAS-SF) to assess the preoperative anxiety state of children aged 2 to 7 who underwent elective surgery in the pediatric department of a tertiary hospital in China from July 1, 2020 to September 30, 2020 were enrolled in this study. The generalized estimating equation model was used to analyze the factors influencing preoperative anxiety in children.

Results: The preoperative anxiety rate of 220 children in the tertiary hospital was 67.6%. Multivariate analysis revealed that children who attended elementary school had a lower risk of preoperative anxiety compared to children who did not attend school [odds ratio (OR) =0.39, 95% confidence interval (CI), 0.19 to 0.79, P=0.010]. Children whose caregivers felt very worried experienced an increased risk of preoperative anxiety compared to children whose caregivers were not worried about the surgery at all (OR =3.40, 95% CI, 1.35 to 8.56, P=0.009). Children who were very resistant, cried violently, twisted their bodies during puncturing the needle were 5.8 times more likely to experience preoperative anxiety compared to children who were very cooperative. The risk of preoperative anxiety in children who cooperated with a staff member was about 1.5 times higher than that of children who were very cooperative.

Conclusions: The incidence of preoperative anxiety in children aged 2 to 7 in the tertiary hospital in China was similar to the children in other countries. The caregivers' degree of concern prior to the operation and the degree of cooperation from the children during puncturing the indwelling needle were the main factors influencing the occurrence of preoperative anxiety.

Keywords: Preoperative anxiety in children; CmYPAS; CmYPAS-SF; anxiety status; influencing factors

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Introduction

Preoperative anxiety manifests itself as nervousness, worry, or even fear. This can result in increased blood pressure, elevated heart rate, and increased sensitivity, which can, in turn, manifest clinically as decreased pain threshold leading to increased postoperative pain, greater demand for analgesics, and increased agitation and delirium during recovery, all of which can seriously affect the outcome of the operation and rehabilitation of the patient (1). For children, preoperative anxiety can be more harmful than in adults. First, children are more likely to experience increased autonomic nervous activity compared to adults, leading to prolonged anesthesia induction time, anesthesia duration, and recovery time (2,3). Second, fear of the unknown hinders a child's ability to adapt to unfamiliar medical environments and may increase the incidence of accidental injuries. Furthermore, children with anxiety before surgery are 3 times more likely to experience delirium, nightmares, separation anxiety, sleep disorders, crying at night, enuresis, tantrums, apathy, withdrawal, eating disorders, attacks on authority, and negative behavioral changes such as increased fear of medical staff (4-9). Studies have shown that these negative behaviors can be observed even one year after discharge from the hospital (10) and may even have a long-term negative impact on the child's future medical interactions and hinder their normal growth and development (4). Researches from other countries have reported that about 65–80% of children will experience preoperative anxiety (11,12). This is complicated further by the psychological characteristics of 2 to 7 years old preschool children who are generally more variable, impulsive, and react unintentionally. They are aware of the existence of their parents and are more likely to experience fear and separation anxiety (13-15). After the age of 8 years, children tend to be more accepting, and with persuasion, these children can start to tolerate separation. Therefore, preoperative anxiety in children, especially pre-school children, is a clinical problem that demands more attention.

There are extensive studies in other countries on children's anxiety during the perioperative period. However, there are numerous differences between China and other countries with regards to the growth environment, educational concepts, and children's relationship with their parents. Therefore, the research experience of other countries may not be relevant to China. The belated research into children's preoperative anxiety in China has mainly focused on interventions without a clear understanding of the current status of preoperative anxiety

in Chinese children, and hence the intervention protocols lack pertinence.

This study investigated the preoperative anxiety status in children aged 2 to 7 years in a tertiary hospital in China. The factors influencing preoperative anxiety in these children were identified. This information will form the basis for the development of targeted preoperative anxiety intervention measures for young children. We present the following article in accordance with the STROBE reporting checklist (available at <https://dx.doi.org/10.21037/tp-21-215>).

Methods

Participants

Children aged 2 to 7 years old who underwent elective surgery in the pediatric surgery department of a tertiary hospital in China from July 1, 2020 to September 30, 2020 were selected for this study.

Children were included if they satisfied the following inclusion criteria: (I) children aged 2 to 7 years undergoing elective surgery; (II) the children's guardians or caregivers voluntarily participated in this project and provided informed consent; (III) the children's caregiver has an acceptable ability to read, write, and speak Chinese.

The following exclusion criteria were applied: (I) children with confirmed developmental delay or mood anxiety disorder; (II) children who were administered preoperative sedative drugs; (III) children living in a non-Chinese language and cultural background; and (IV) children who were asleep during the preoperative monitoring period.

Sample size

This cross-sectional survey study was designed to investigate the incidence of preoperative anxiety in children in a tertiary hospital in China. The overall rate was estimated to be 60%, thus a two-sided test was used, with significance set at 0.05 and allowable error set at 0.1. The sample size was $N=100$, calculated using PASS 15 software. Assuming 20% loss to follow-up/disqualification, at least 125 cases must be included in this study as the research target.

Research tools

Questionnaire regarding the basic characteristics of the children

The in-house-designed questionnaire included basic

characteristics of the patients such as age, gender, ethnicity, type of operation, education status, history of hospitalization or operation, family type, ability to pay for this hospitalization, hospital care, the degree of caregiver anxiety related to the child's surgery, and the degree of cooperation during placement of the indwelling needle. The type of surgery is defined according to the surgical level, with first and second level operations regarded as minor operations, and third and fourth level operations regarded as major operations.

The Chinese version of the modified Yale Preoperative Anxiety Scale (CmYPAS)

The CmYPAS is an observational behavioral scale specifically designed to evaluate preoperative anxiety in children aged 2–12 years. The mYPAS compiled by Kain (16) was adapted and translated into Chinese by Guan and colleagues (17) with good reliability and validity. Using this scale, the child's anxiety state can be assessed within 1 minute. The scale contains the following five dimensions: activity, occurrence, emotional expression, obvious alertness, and dependence on parents. Each dimension has four behavioral descriptions, with the exception of the second dimension which has six behavioral descriptions. The scoring method is: the scores of the four behavior descriptions selected in the first, third, fourth, and five dimensions are 0.25, 0.5, 0.75, and 1.0, respectively, and the scores of the six behavior descriptions selected in the second dimension are respectively 0.1667, 0.333, 0.500, 0.667, 0.833, 1.0. The total scores of the 5 dimensions are added and multiplied by 20 and converted into a percentile system. The CmYPAS score ranges from 23.333 to 100 points. The degree of anxiety is divided into groups for each 30 points (18). The higher the score, the greater the degree of preoperative anxiety experienced by the child.

The simplified Chinese version of the modified Yale Preoperative Anxiety Scale-Short Form (CmYPAS-SF)

Considering that children are not always accompanied by their parents before surgery, in order to accurately assess the anxiety state of children before surgery, this study also used the CmYPAS-SF. The Chinese version of the scale was translated by Dai *et al.* (19). This simplified scale has good reliability and validity. Compared with mYPAS, the dimension of dependence on parents is subtracted. The remaining dimensions and the scoring methods are the same as for mYPAS. The final score is multiplied by 25 and converted into a percentile system. The total possible score

ranges from 22.917 to 100 points.

Research methods

On the morning of the operation, the researcher introduced the content, purpose, significance, and process of the study to the children and their caregivers in detail. After obtaining signed informed consent from the children and their caregivers, the basic data of the children was collated. The researchers used CmYPAS to assess the anxiety of the children at two time points, namely just as they exited the operating room elevator (T1) and inside the preoperative waiting room (T2). The CmYPAS-SF was used at the next two time points, namely when children entered the operating room (T3) and during the anesthesia induction period (T4). The anxiety state at each time point was assessed.

Statistical analysis

The SPSS 24.0 software was used for data processing and statistical analyses. Measurement data are expressed as mean \pm standard deviation, and count data are expressed as rate. According to data type, the *t*-test, rank sum test, chi-square test, adjusted chi-square test, or Fisher's exact test was used. Univariate analysis was conducted to assess the correlation of different factors with preoperative anxiety, and the generalized estimating equation model was used to analyze the factors influencing preoperative anxiety in children. A two-sided test was used, and the significance level was set at $\alpha=0.05$.

Ethical principles

All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). This study has been reviewed and approved by the Institute's Biomedical Ethics Committee in the hospital (approval number: #2019849).

Results

Inclusion of research subjects

A total of 220 patients who underwent elective surgery between July 1, 2020 and September 30, 2020 were enrolled in this study. The average age of the children was 4.54 ± 1.71 years. The basic characteristics of the research subjects are shown in *Table 1*.

Table 1 Basic characteristics of the enrolled patients (N=220)

Basic characteristics	Stratification	N (%)
Gender	Male	144 (65.5)
	Female	76 (34.5)
Ethnicity	Han nationality	204 (92.7)
	Tibetan	7 (3.2)
	Yi nationality	5 (2.3)
	Others	4 (1.8)
Education status	Did not attend school	69 (31.4)
	Kindergarten	103 (46.8)
	Elementary school	48 (21.8)
Types of surgery	Minor surgery	162 (73.6)
	Major surgery	58 (26.4)
Hospitalization history	Nil	105 (47.7)
	Previous admission	115 (52.3)
Operation history	Nil	156 (70.9)
	Previous operation	64 (29.1)
Family types	Nuclear family (a family of three or living with parents and siblings)	132 (60.0)
	Single parent (divorced or widowed)	1 (0.5)
	Extended family (living with grandparents or grandparents)	86 (39.1)
	Mixed	1 (0.5)
Ability to pay for this hospitalization	Able to pay	159 (72.3)
	Reluctant to pay	49 (22.3)
	Inability to pay	12 (5.5)
The degree of caregiver anxiety related to the child's surgery	Not worried at all	37 (16.8)
	A little worried	114 (51.8)
	Moderately worried but acceptable	30 (13.6)
	Very worried and overwhelmed	39 (17.7)
The degree of cooperation with regards to the child's indwelling needle before puncture	Very cooperative	94 (42.7)
	A little resistance, but can cooperate through encouragement or reward	35 (15.9)
	Not very cooperative, require a person to assist	37 (16.8)
	Very resistant, crying, twisting, and requiring several people to assist	54 (24.5)

The status and univariate analysis of preoperative anxiety in children aged 2 to 7 years

The incidence of anxiety at the 4 preoperative times for the 220 children was 67.6%. Univariate analysis (Table 2) showed that children's preoperative anxiety was significantly different at each of the preoperative assessment time points. Different characteristics such as educational status, also significantly affected preoperative anxiety. There were significant correlations between risk of preoperative anxiety and each of the following: history of hospitalization and surgery, degree of the caregiver's anxiety regarding the child's surgery, and the degree of cooperation during placement of the indwelling needle (Table 2). As the sample size of Tibetan, Yi, and other ethnic groups was small, the three groups were combined and designated "others" for univariate analysis. Similarly, since "reluctant to pay" and "inability to pay" both suggest economic strain, these were combined and designated the "barely/unpayable" group.

Multivariate analysis of preoperative anxiety in children aged 2 to 7 years

Multivariate analyses (Table 3) demonstrated a statistically significant difference in the incidence of anxiety among children at the four different time points prior to surgery. The risk of preoperative anxiety was significantly decreased in children who attend elementary school compared to children who do not attend school [odds ratio (OR) =0.39, 95% confidence interval (CI), 0.19 to 0.79, P=0.010]. The risk of preoperative anxiety was significantly higher in children whose caregivers felt very worried and overwhelmed compared to children whose caregivers were not worried at all about the operation (OR =3.40, 95% CI, 1.35 to 8.56, P=0.009). The degree of cooperation in indwelling the needle before puncture will affect the risk of preoperative anxiety in children.

Discussion

The current status of preoperative anxiety in children aged 2 to 7 years

In this study, the incidence of preoperative anxiety in children aged 2 to 7 years in China was 67.6%, which was comparable to that observed in other countries (11). The incidences of anxiety at the 4 assessment time points were 50.5%, 62.3%, 78.6%, and 79.1%. Using T1 as the references, that is, the time point at which the children

exited the operating room elevator, the incidence of anxiety increased by 84.0% by the time they reached the preoperative waiting area (T2). When the children reached the operating room (T3), anxiety had increased by approximately 3.812 times compared to T1, and during the induction of anesthesia (T4) anxiety was elevated by about 3.965 fold compared to T1. The main reason for this dramatic increase in anxiety in the operating room can be explained by the implementation of hospital epidemic protocols which only allowed caregivers to accompany patients in the preoperative waiting area. Caregivers were not permitted to enter the operating room and this separation significantly changed the child's preoperative anxiety levels. It was also noted that some parents provided psychological comfort while caring for their children. When these children were separated from their carers, they may be nervous, expressionless, and even ask questions repeatedly. In a few patients, anxiety manifested as weeping, crying, or even fleeing. One child in this study experienced chronic pain and as part of the psychological comfort, his mother repeatedly emphasized that the surgery will prevent the recurrence of pain. As a result, this child showed a positive response to the surgery, with little preoperative anxiety.

Preoperative anxiety can cause great and far-reaching harm to children. In this study, 48 of the 220 preoperative children attended primary school, and the risk of anxiety in this group was significantly reduced by 61.2% compared to children who did not attend school. Kindergarten children also showed a reduced risk of anxiety compared to children who did not attend school, however, the difference was not statistically significant. Children who are not enrolled in school tend to have insufficient cognitive understanding about diseases or surgery, inaccurate descriptions of their own emotions, and their emotional expressions are often different from older children. This study demonstrated that children who are not enrolled in school are more likely to have preoperative anxiety, and this is consistent with the results of Kain *et al.* and Mccann *et al.* (13-15).

The influence of caregiver anxiety on children's preoperative anxiety

To date, the effects of parental presence on child anxiety has remained controversial. Kain and colleagues suggested that parental presence does not affect the incidence of anxiety in children (20-22). However, many other studies have suggested that parental presence can reduce a child's anxiety and enhance cooperation, which is beneficial for

Table 2 Univariate analysis of preoperative anxiety in children aged 2 to 7 years

Variables	Total (N)	Without anxiety, N (%)	With anxiety, N (%)	Statistical value	Point probability
Assessment times				57.888 ^a	<0.001
T1	220 (25.0)	109 (49.5)	111 (50.5)		
T2	220 (25.0)	83 (37.7)	137 (62.3)		
T3	220 (25.0)	47 (21.4)	173 (78.6)		
T4	220 (25.0)	46 (20.9)	174 (79.1)		
Gender				2.051 ^a	0.152
Male	576 (65.5)	196 (68.8)	380 (63.9)		
Female	304 (34.5)	89 (31.2)	215 (36.1)		
Ethnicity				1.720 ^a	0.190
Han nationality	816 (92.7)	269 (94.4)	547 (91.9)		
Others	64 (7.3)	16 (5.6)	48 (8.1)		
Education status				56.359 ^a	<0.001
Did not attend school	276 (31.4)	47 (16.5)	229 (38.5)		
Kindergarten	412 (46.8)	143 (50.2)	269 (45.2)		
Elementary school	192 (21.8)	95 (33.3)	97 (16.3)		
Types of surgery				0.000 ^a	0.982
Minor surgery	648 (73.6)	210 (73.7)	438 (73.6)		
Major surgery	232 (26.4)	75 (26.3)	157 (26.4)		
Hospitalization history				12.004 ^a	0.001
Never	420 (47.7)	112 (39.3)	308 (51.8)		
Have been	460 (52.3)	173 (60.7)	287 (48.2)		
Operation history				4.995 ^a	0.025
Never	624 (70.9)	188 (66.0)	436 (73.3)		
Have been	256 (29.1)	97 (34.0)	159 (26.7)		
Family types				2.359 ^b	0.494
Nuclear family (a family of three or living with parents, siblings)	528 (60.0)	178 (62.5)	350 (58.8)		
Single parent (divorced or widowed)	4 (0.5)	1 (0.4)	3 (0.5)		
Extended family (living with grandparents or grandparents)	344 (39.1)	106 (37.2)	238 (40.0)		
Recombinant	4 (0.5)	0 (0.0)	4 (0.7)		
Ability to pay for this hospitalization				2.601 ^b	0.107
Ability to pay	636 (72.3)	216 (75.8)	420 (70.6)		
Reluctant/unpayable payment	244 (27.7)	69 (24.2)	175 (29.4)		

Table 2 (continued)

Table 2 (continued)

Variables	Total (N)	Without anxiety, N (%)	With anxiety, N (%)	Statistical value	Point probability
The degree of anxiety of the inpatient caregivers about the child's surgery				29.306 ^a	<0.001
Not worried at all	148 (16.8)	55 (19.3)	93 (15.6)		
A little worried	456 (51.8)	157 (55.1)	299 (50.3)		
Moderately worried but acceptable	120 (13.6)	50 (17.5)	70 (11.8)		
Very worried and overwhelmed	156 (17.7)	23 (8.1)	133 (22.4)		
The degree of cooperation in the child's indwelling needle before puncture				82.988 ^a	<0.001
Very cooperative	376 (42.7)	176 (61.8)	200 (33.6)		
A little resistance, but can cooperate through encouragement or reward	140 (15.9)	49 (17.2)	91 (15.3)		
Not very cooperative, need a person to assist	148 (16.8)	34 (11.9)	114 (19.2)		
Very resistant, crying, twisting, and needing several people to press	216 (24.5)	26 (9.1)	190 (31.9)		

Note: ^a, Chi-square test χ^2 value; ^b, Fisher exact probability.

both parents and anesthesiologists (23–25). The results of this current study demonstrated that children experienced significantly higher anxiety in the absence of their caregiver, that is, at the moment of entering the operating room (T3) and during the anesthesia induction period (T4), compared to when they were with their caregiver, namely, when they were in the elevator (T1) and in the preoperative waiting area (T2). Interestingly, however, the presence of an anxious caregiver led to an increase in preoperative anxiety in children. The specific manifestation is that when the caregiver is very worried and overwhelmed, the risk of anxiety in children may be increased. Indeed, children with anxious caregivers were 2.4 times more likely to experience preoperative anxiety. Therefore, while it may be beneficial to have a caregiver with the patient during the administration of anesthesia, consideration should be given to the personality and anxiety characteristics of the caregivers. Caregivers who are prone to morbid anxiety or whose personality is more anxious are not suitable for escorting children during the induction of anesthesia.

The influence of preoperative puncture experience on children's preoperative anxiety

There is still much controversy regarding whether

anesthesia in children should be induced via intravenous injection or mask inhalation. Some believe that conscious venipuncture and parental separation can cause too much anxiety (13,26), and thus the inhalation method should be used to induce anesthesia to reduce trauma to the child. In the United States, inhalation induction is also the most common anesthesia induction technique. However, in many other countries in the world, intravenous induction is more common, as experience has shown that children are not only afraid of needles, but they are also apprehensive about face masks. Under normal circumstances, it is difficult for children to accept any foreign objects on their face and most children will immediately show resistance. Furthermore, as the concentration of volatile anesthetics increases, an unfamiliar, pungent smell is usually produced in the mask, and even the most well-prepared older children will become agitated (27,28). Consistent with the findings of Aguilera *et al.* (29), our current study demonstrated that the unpleasant preoperative puncture experience increased the risk of preoperative anxiety in children. Specifically, when the needle was placed before the puncture, the children became very resistant, cried, twisted, and required several people to assist. The risk of preoperative anxiety was about 5.8 times higher than that of a very cooperative child. The risk of preoperative anxiety in children who

Table 3 Multivariate analysis of preoperative anxiety in children aged 2 to 7 years

Variables	Groups	B	Std. Error	Wald Chi-Square	Sig.	OR	95% Wald confidence interval for OR	
							Lower	Upper
Assessment times	T4	1.602	0.2092	58.660	0.000	4.965	3.295	7.482
	T3	1.571	0.2038	59.413	0.000	4.812	3.227	7.174
	T2	0.610	0.1130	29.153	0.000	1.840	1.475	2.296
	T1*	0				1		
Education status	Elementary school	-0.947	0.3655	6.715	0.010	0.388	0.189	0.794
	Kindergarten	-0.592	0.3219	3.378	0.066	0.553	0.294	1.040
	Did not attend school*	0				1		
Hospitalization history	Previous hospitalization	-0.528	0.3133	2.836	0.092	0.590	0.319	1.090
	Never*	0				1		
Operation history	Previous operation	-0.090	0.3070	0.085	0.770	0.914	0.501	1.669
	Never*	0				1		
The degree of anxiety of the caregivers about the child's surgery	Very worried and overwhelmed	1.225	0.4705	6.778	0.009	3.404	1.354	8.560
	Moderately worried but acceptable	-0.400	0.4157	0.924	0.336	0.671	0.297	1.515
	A little worried	-0.023	0.2976	0.006	0.939	0.978	0.546	1.752
	Not worried at all*	0				1		
The degree of cooperation regarding the child's indwelling needle before puncture	Very resistant, crying, twisting, and needing several people to assist	1.766	0.4268	17.118	0.000	5.845	2.533	13.492
	Not very cooperative, needed a person to assist	0.927	0.4093	5.131	0.023	2.527	1.133	5.637
	A little resistance, but can cooperate through encouragement or reward	0.298	0.3519	0.719	0.397	1.348	0.676	2.686
	Very cooperative*	0				1		

Note: *Reference group.

required assistance by personnel was about 1.5 times higher than that of very cooperative children. There was no risk of preoperative anxiety in children who showed little resistance and could cooperate through encouragement or rewards. Similarly, very cooperative children had no risk of preoperative anxiety. Therefore, when conscious venipuncture before surgery is inevitable, medical staff and caregivers should encourage children to face the needle bravely through encouraging words and patient explanations, or local topical anesthetics can be applied to

reduce pain during needle puncture to minimize fear (30).

Identifying the influencing factors of preoperative anxiety in children plays a crucial role in reducing preoperative anxiety. Because the stacking of interventions is not the better and generalized interventional methods have not always been successful. Kain *et al.* (31) found that a well-designed and costly preoperative behavioral plan had a limited effect on minimizing anxiety and had no significant beneficial effect on the induction of anesthesia. Therefore, management of preoperative anxiety should be based on

the conditions of the particular hospital, the characteristics of the medical group, individual differences, and repeated clinical experience.

There are many influencing factors for the occurrence of preoperative anxiety in children. Among them, some influencing factors are objective facts which cannot be changed, and some influencing factors are caused by long-term living environment influences which cannot be effective through short-term intervention during hospitalization. So it is very necessary to investigate the possible influencing factors that can cause or affect preoperative anxiety in children and can be intervened in a short time during hospitalization. This study showed that the degree of concern experienced by the caregivers regarding the child's surgery and the degree of cooperation from the child before placement of the indwelling needle were the main influencing factors for the child's preoperative anxiety. Targeted intervention measures should be conducted to reduce the child's incidence of preoperative anxiety and reduce the associated harm.

Study limitations and suggestions for follow-up research

There were several limitations to this study. First, in addition to the influencing factors shown in the survey conclusions, this study conducted interviews with some children's caregivers during the investigation and determined that the children's preoperative anxiety may be related to the caregivers. Indeed, the caregiver's cognition and the child's personality traits may be related. In cases where the caregiver expressed that the child would be unable to cooperate with the medical treatment and would cry violently, the child was often assessed as having preoperative anxiety. However, this study may be limited by the lack of investigation into the personality characteristics of all the subjects included and the cognition of the caregivers. Second, this study was limited by manpower, time, and region, and only a single-center status survey was conducted. Thus, the relationship between risk factors and preoperative stress was merely exploratory. Future follow-up studies involving multi-centers in different regions should be conducted to confirm the causal relationship between risk factors and preoperative anxiety in children.

Conclusions

The incidence of preoperative anxiety in children aged 2

to 7 years in our tertiary hospital in China was similar to the incidence of preoperative anxiety in children in other countries. The degree of concern of the caregivers prior to the operation and the degree of cooperation from the child during placement of the indwelling needle were the main factors influencing the occurrence of preoperative anxiety. Interventions should be designed to reduce the incidence of preoperative anxiety in children.

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Footnote

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Ethical Statement: The authors are 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. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013) and the study was approved by the Ethics Committee of the West China Hospital, Sichuan University (#2019849). The children's guardians or caregivers voluntarily participated in this project and provided informed consent.

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