

# A Clinical Nursing Care Study on the Prevalence of Rotavirus Infection and Acute Diarrhea in Vaccinated Chinese Pediatric Population from 2019–2022

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**Purpose:** To investigate the prevalence of rotavirus infection and acute diarrhea after immunization and further assess the quality of nursing care provided by the nurses to such patients.

**Methods:** A total of 432 children aged 3–36 months with acute diarrhea between February 2019 and March 2022 were enrolled, and rotavirus testing was performed within 24 h using a rotavirus enzyme immunoassay kit. Clinical characteristics were evaluated, and regression analysis was performed.

**Results:** Eighty vaccinated children (18.5%) were confirmed to have rotavirus infection out of 432 children. The prevalence of rotavirus positivity was the highest at 20–28 months (22 cases, 24.44%) and 11–19 months age group (27 cases, 22.50%). There is a significant association between rotavirus infection and hygiene score ( $p = 0.009$ ). Based on the association with quality of nursing care, rotavirus infection was association with “appropriate care” ( $p = 0.001$ ).

**Conclusion:** Rotavirus infection was strongly associated with poor hygiene score which may be due to the hygienic nature of the mother and her family. Nursing care assessments revealed a huge gap between nurses and the guardians, which reflects the behavior of Chinese nurses. Thus, an intervention is required by the policymakers for implementing effective strategies of quality nursing for the improvement of the pediatric patients with rotavirus gastroenteritis.

**Keywords:** rotavirus infection, pediatric population, nursing care, logistic regression

## Introduction

Rotavirus (RV) was first discovered in 1970, and since its discovery, it has been associated with most diarrheal infections among pediatric age group.<sup>1</sup> Rotavirus is responsible for many severe dehydration cases associated with diarrheal infections that requires hospital admission.<sup>2</sup> Rotaviruses were also among the first viral agents that were considered as major cause of viral acute gastroenteritis (AGE) in the pediatric age group between 6–24 months.<sup>3</sup> The clinical symptoms of rotavirus infection range from mild watery stools to severe diarrhea and fever, which cause dehydration and electrolyte imbalance.<sup>4</sup> Acute diarrhea due to rotavirus infection is associated with loose and watery stools coupled with abdominal pain, vomiting, weight loss, and fever.<sup>4</sup> Many people believe diarrhea is a mild disease, however; acute diarrhea and severe gastroenteritis are the main cause of child mortality and morbidity among infants and the pediatric population.<sup>5</sup> Acute cases of gastroenteritis account for 1.34 million deaths in the child population below 5 years.<sup>6</sup> In China, an estimate 0.5 million children die every year because diarrhea and viral diarrhea are its main cause.<sup>7</sup> Even though 60–70% of the global countries have introduced rotavirus vaccine programs and immunization, there are still reports of rotavirus infection among children in the age group between 3–60 months. This infection is independent of socioeconomic factors and hygiene conditions.<sup>8</sup> In fact, rotavirus hospitalizations and mortality still exists in children below 5 years even after vaccination.<sup>9</sup> A study from 2006–2019 observed a sustained impact on rotavirus and AGE hospitalizations even after vaccination.<sup>10</sup> Thus, suggesting numerous countries to maintain the rotavirus immunization program and establish surveillance systems on its benefits.<sup>10</sup> Even though China is considered as one of the high burden from diarrhea, RV vaccination

is not incorporated in the national immunization program till date.<sup>11,12</sup> So far, only two vaccines are licensed for rotavirus vaccination, the first one is LLR (Lanzhou lamb RV vaccine) which was introduced in 2001 with 600–700 million doses administered annually from 2011 to 2018.<sup>13</sup> However, the efficacy of LLR has not been approved in the international market and another vaccine RotaTeq RV which is internationally approved was licensed in China in 2018.<sup>14</sup> The RVs which infect humans is very diverse and there 36 G types and 51 P types of RVs (G1-G36 and P[1]-P[51]) based on the RCWG international classification.<sup>15</sup> A study on the isolates of RVs in China reported G3, G1, G2 and G4 as the most prevalent G type, and, P [8] and P[4] as the most prevalent P types.<sup>15</sup> Since 2012, G9P[8] subtype is reported to be the most dominant RV strain in China among children with acute diarrhea.<sup>16</sup> However, with improved hygienic and clean environmental conditions, infections of other gut and intestinal microbial pathogens have been reduced in China. Since the introduction of the rotavirus vaccine program in China, there has been a decrease in rotavirus infection and hospital admissions due to rotavirus diarrhea among children between 3–60 months.<sup>17</sup> Moreover, rotavirus vaccination provides a prospective remedy, and has been proven to be the best way to tackle severe rotavirus disease, and the occurrence of rotavirus infection persists among infants and children.<sup>10</sup> Because of the delay in the vaccination schedule and low vaccination rate, rotavirus infection in China is not protected properly.<sup>18</sup> Apart from China, the WHO recommends the rotavirus national immunization programme as a top priority in Southeast Asian countries.<sup>19</sup> Looking at the benefits of RV vaccination in the Asian region, the policy makers of the Chinese national immunization programs (NIP) should consider it as a top priority.<sup>20,21</sup> Moreover, neighboring countries like India and Pakistan have already scale up their NIP for rotavirus vaccines which observed a drastic reduction in infant mortality.<sup>19</sup> However, rotavirus diarrhea remains a major cause of morbidity in the pediatric population in China.<sup>22</sup> Although there have been numerous epidemiological and clinical studies on rotavirus diarrhea because of certain effective rotavirus vaccines, the treatment has remained the same for the past three decades.<sup>23</sup> This is because the underlying cause of the disease is not properly understood, and most treatments include oral rehydration and breastfeeding.<sup>24</sup> However, nursing care support plays an essential role in pediatric patients and infants with acute diarrhea. Nursing care also plays an important role in supporting the mothers of infants and pediatric patients. With the intervention of proper nursing care, various problems such as electrolyte disorders, recovery of gastrointestinal function, parental satisfaction and improved quality of life can be achieved for the treatment of pediatric diarrhea.<sup>25</sup> Even though most of the mother or guardian were able to provide correct medication and preventive measures for rotavirus gastroenteritis, they lack a very basic information and knowledge about the proper management of disease related to dehydration and sensitization.<sup>26</sup> On the other hand, apparent nursing care support for pediatric patients and mothers has not been properly studied. Therefore, this study aimed to establish the association between nursing care and the prevalence of acute diarrhea due to rotavirus infection among vaccinated Chinese pediatric population aged between 3 to 36 months. The study might provide the bridging gap between the quality of nursing care and the guardian in terms of pediatric nursing care. In fact, study will examine the quality and moral responsibility of the nurses in caring pediatric patients with acute diarrhea.

## Materials and Methods

### Setting and Population

The study was conducted among children age group 3–36 months who were admitted with acute diarrhea between February 2019 and March 2022. The enrollment criteria included only children who were vaccinated against rotavirus and had an episode of acute diarrhea. Acute diarrhea is defined as the passage of loose stools more than three times a day, lasting for at least 7 to 10 days.<sup>27</sup>

### Study Design

Pediatric patients who were vaccinated with the rotavirus vaccine in the age group between 3–36 months and who had acute diarrhea with three or more loose watery stools per day, for at least 7–10 days were included in the study.<sup>27</sup> Rotavirus testing was performed by a laboratory technician with expertise in rotavirus identification. Rotavirus infection was tested by collecting stool samples processed within 24 h and confirmed using a rotavirus enzyme immunoassay kit (Human Rotavirus antigen, RV Ag ELISA Kit). Clinical characteristics such as vaccination status, nutritional status (weight-for-length/height z-score), breastfeeding and hygiene score details were evaluated and recorded by a pediatrician and two hospital nurses. Demographic details such as age, sex, and employment status of the guardians were also recorded using a standard questionnaire. Hygiene score was assessed based

on a modified protocol developed by Jayarajah et al.<sup>28</sup> Guardians were also asked about the frequency of stools, feeding information, and onset of diarrhea before hospital admission.

## Acute Diarrhea Severity Assessment

The severity of acute diarrhea was assessed using the Vesikari Scoring System (VSS)<sup>29</sup> and Clark Scoring System (CSS).<sup>30</sup> The severity of acute diarrhea was evaluated by two resident professionals and one nurse within 12 h of hospital admission and the severity of the illness was scored using the Vesikari Scoring System (VSS) and Clark Scoring System (CSS).

## Assessment of Quality Nursing Care

Nursing quality of is a concept with multidimensional properties and uses with different meanings. In this study, the quality of pediatric nursing care scale for pediatric mothers was assessed based on three factors and seven attributes as described by Cho and Bang with slight modifications. Table 1 presents the factors and attributes.<sup>31</sup>

## Statistical Analysis

All statistical analyses were carried out using SPSS 17.0 Inc (SPSS, Inc., USA). Logistic regression analysis was performed to evaluate the relationship between rotavirus infection and the characteristics of the children and parents. Logistic regression analysis was performed to evaluate factors associated with rotavirus positive and severe diarrhea taking these variable as dependent and setting the covariates as Patient's age, Gender, Nutritional Status, Breastfeeding, Mother's age, Mother's employment status and Hygiene Score. Furthermore, logistic regression analysis was carried out setting the covariates of quality of nursing care (Skillfulness and knowledgeable", "Respect, Kindness and trustworthy", "Appropriate care", "Caring and responsiveness", "Entertainment", "Communication and information sharing", "Advocacy") setting in two different evaluations viz. employment status and the age of the mother; and Rotavirus positivity and severe diarrhea as the dependent variables. Statistical significance was set as a p-value < 0.05.

## Results

### Characteristics of Pediatric Patients

In this study, 468 children aged 3–36 months with an episode of acute diarrhea enrolled in the hospital were evaluated. The patient characteristics are presented in Table 2 and flowchart of patients inclusion process is shown in Figure 1. Twenty-one (3.85%) children were excluded because of the non-availability of a consent letter from the guardian and another 15 children (3.21%) were excluded because of comorbidities. Hence, 432 children (92.31%) were evaluated for clinical analysis. The mean age of children was 16.21 months and the median age was 14 months. The youngest patient was 3 months old (11 patients, 2.5%) and the oldest was 36 months old (6 patients, 1.4%). The frequency of boys was 226 (52.3%) compared to 206 girls (47.7%). The frequency of

**Table 1** Factors and Attributes for Assessing the Quality of Pediatric Nursing Care

Factors	Attributes
Character of the nurse	Skillfulness and knowledgeable
	Respect, Kindness and trustworthy
Nursing activities	Appropriate care
	Caring and responsiveness
	Entertainment
Parent-Nurse interaction	Communication and information sharing
	Advocacy

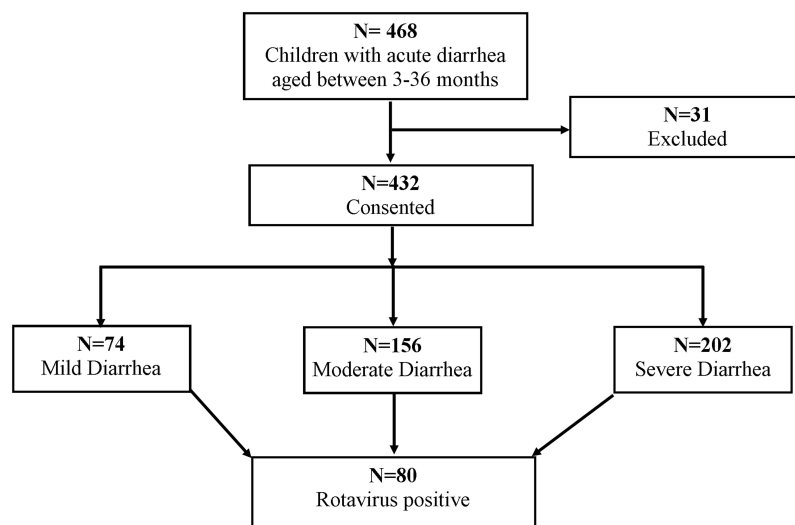
**Table 2** Characteristics of the Pediatric Patients with Acute Diarrhea Admitted from February 2019 and March 2022

Characteristics	Rotavirus Positive (N=80), n (%)	Mild Diarrhea (N=74), n (%)	Moderate Diarrhea (N=156), n (%)	Severe Diarrhea (N=202), n (%)
<b>Age group (months)</b>				
3–10 months (n=154)	18 (11.69)	19 (12.34)	54 (35.06)	81 (52.60)
11–19 months (n=120)	27 (22.50)	22 (18.33)	39 (32.50)	59 (49.17)
20–28 months (n= 90)	22 (24.44)	19 (21.11)	31 (34.44)	40 (44.44)
29–36 months (n= 68)	13 (19.12)	14 (20.59)	32 (47.06)	22 (32.35)
<b>Sex</b>				
Boy	39 (17.26)	39 (17.26)	84 (37.17)	103 (45.58)
Girl	41 (19.20)	35 (16.99)	72 (34.95)	99 (48.06)
<b>Nutritional Status</b>				
Normal	55 (19.86)	43 (15.52)	98 (35.38)	136 (49.10)
Marginally Wasted	14 (15.22)	19 (20.65)	34 (36.96)	39 (42.39)
Moderately Wasted	10 (20.41)	9 (18.37)	19 (38.78)	21 (42.86)
Severely Wasted	1 (7.14)	3 (21.43)	5 (35.71)	6 (42.86)
<b>Exclusive breastfeeding</b>				
Yes	47 (17.47)	45 (16.73)	94 (34.94)	130 (48.33)
No	33 (20.25)	29 (17.79)	62 (38.04)	72 (44.14)
<b>Age of Mother</b>				
Below 25	28 (16.97)	25 (15.15)	59 (35.76)	81 (49.09)
26 and above	52 (19.48)	49 (18.35)	97 (36.33)	121 (45.32)
<b>Employment Status of Mother</b>				
Working women, (YES)	41 (16.87)	43 (17.70)	85 (34.98)	115 (47.33)
Not working (NO)	39 (20.63)	31 (16.40)	71 (37.57)	87 (46.03)
<b>Hygiene Score</b>				
Good/Moderate (1)	53 (23.35)	43 (18.94)	76 (33.48)	108 (47.58)
Unsatisfactory (2)	27 (13.17)	31 (15.12)	80 (39.02)	94 (45.85)

diarrhea severity was highest in the severe group with (202 patients, 46.8%) and lowest in the moderate group (74 patients, 17.1%). The age group of 3–10 months comprises the majority of patients, which accounting for 154 patients (35.6%). Breastfeeding was observed in the majority of patients by their mothers (62.3%), whereas 14 children (3.2%) were severely wasted based on their nutritional status for age for weight.

## Rotavirus Infection and Its Prevalence

Stool samples of 80 children (18.5%) were confirmed to have rotaviruses from a total of 432 children (Table 2). The prevalence of rotavirus infection was highest in the 20–28 months and 11–19 months age groups, with 22 cases (24.44%) and 27 cases (22.50%), respectively. The least was observed at 3–10 months and 29–36 months in 18 cases (11.69%) and

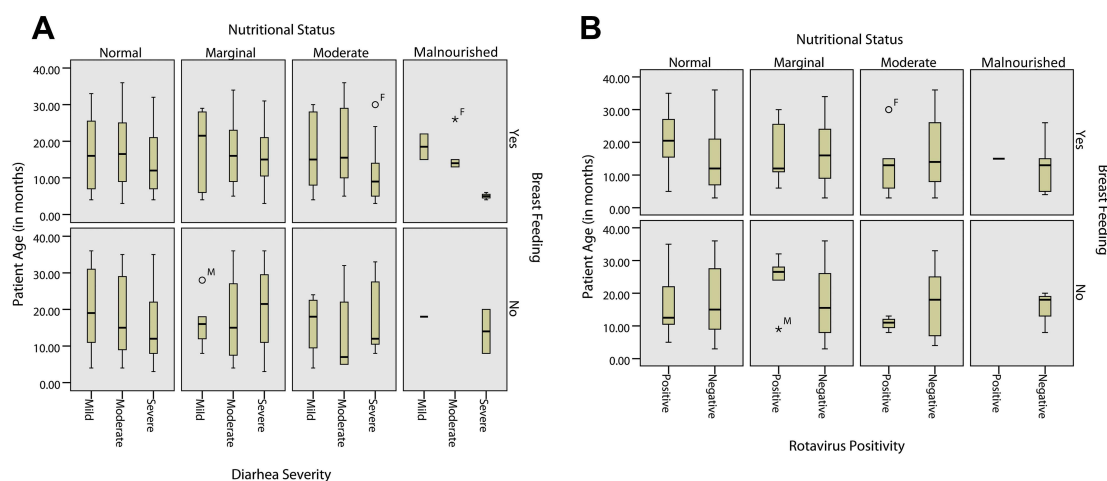


**Figure 1** Flowchart of patient inclusion process indicating the number of included patients and excluded patients.

13 cases (19.12%), respectively (Table 2). There was not much difference in the prevalence of rotavirus based on the sex ratio with 41 (19.20%) females and 39 males (17.26%). Interestingly, the severely wasted group had a rotavirus positive incidence rate of 7.14% with a single case compared to 55 (19.86%) cases of normal based on the nutritional status for z-score. Moreover, the incidence of rotavirus positivity rate was higher in the breastfeeding group (47 cases) than in the weaning group (33 cases). The box-plot representing the prevalence of rotavirus infection based on diarrhea severity and rotavirus positivity with respect to patient's age, nutritional status and breast feeding is shown in Figure 2A and B. There has been an increase in rotavirus cases with increasing maternal age. The mother's age group of 26 years and above had a total of 52 positive cases compared to 28 cases in the mother's age group below 25 years (Table 2). There was little variation in the positive cases based on employment status (41 vs 39 cases). However, the majority of severe diarrhea cases were observed in 115 children of working women (47.33%) (Table 2).

## Clinical Severity Among Rotavirus Infected Children

The majority of rotavirus positive patients had diarrhea duration of 1–4 days in 47 cases (58.75%), whereas the frequency of 1–3 diarrhea per day accounted for 41 cases (51.25%). However, vomiting was not present in the most cases (48.75%)

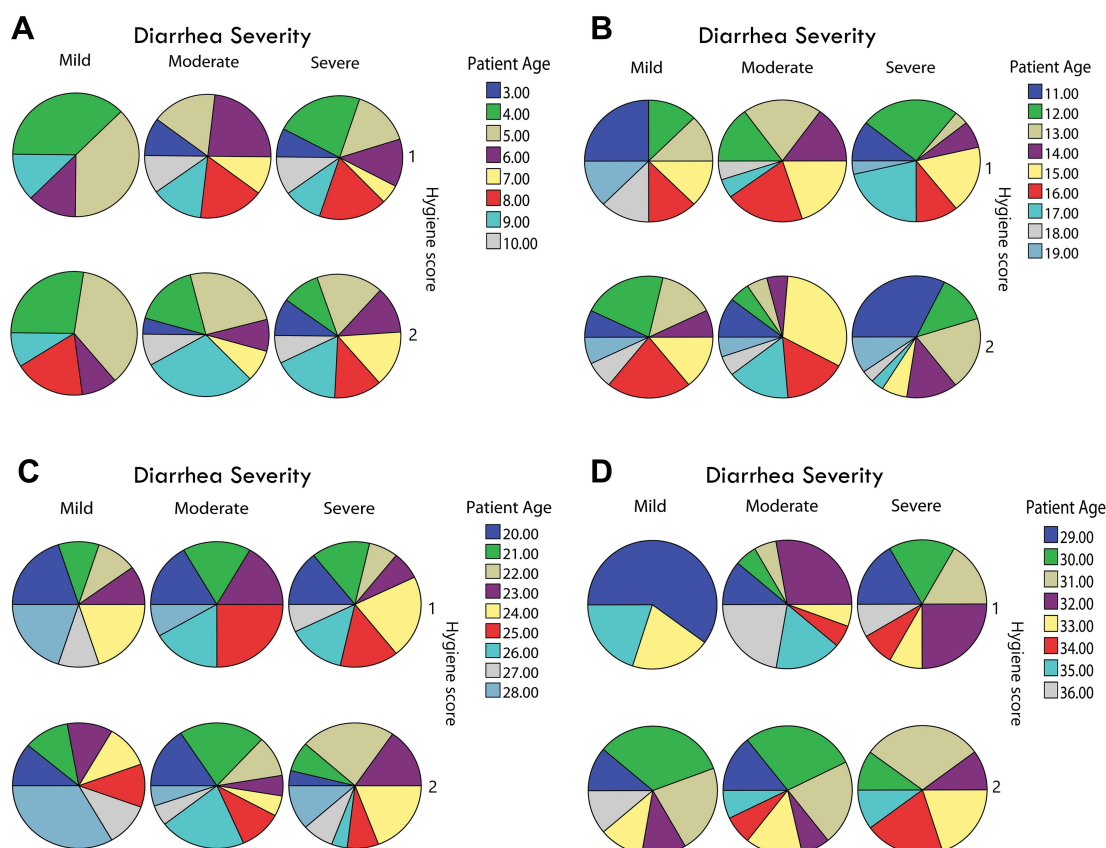


**Figure 2** Box-plot representing the prevalence of rotavirus infection based on (A) diarrhea severity and (B) rotavirus positivity with respect to patient's age, nutritional status and breast feeding. \*Represents extremes and °Indicates outliers.

(Table 3). A higher number of rotavirus positive patients was also observed in the normal nutritional status group with 55 cases (19.86%) (Table 2). The prevalence of rotavirus infection was higher among weaning children (33 cases, 20.25%) than among exclusively breastfed children with mother's milk (47 cases, 17.47%) (Table 2). The positivity rate was also higher in the mother group (26 years and above), with 52 cases (19.48%) (Table 2). However, there was no significant variation in the positive rate based on the employment status of mothers (41 cases vs 39 cases). The pie-chart distribution showing the prevalence of diarrhea severity and rotavirus infection based on hygiene score and patient's age is shown in Figures 3 and 4 respectively. The severity of acute diarrhea based on the modified Vesikari Scoring System (VSS) and Clark Scoring System (CSS) is shown in Table 3.

**Table 3** Distribution of Cases Within the Clinical Parameters of the Vesikari Score and Clark Score for Severe Gastroenteritis (N=80)

Parameters	n (%)
<b>Diarrhea duration (days)</b>	
1–4	47 (58.75)
5	21 (26.25)
≥ 6	12 (15.0)
<b>Frequency of diarrhea per day</b>	
1–3	41 (51.25)
4–5	30 (37.50)
≥ 6	9 (11.25)
<b>Duration of vomiting (days)</b>	
0	39 (48.75)
1	20 (25.0)
2	11 (13.75)
≥ 3	10 (12.50)
<b>Frequency of vomiting per day</b>	
0	39 (48.75)
1–2	34 (42.50)
3–4	7 (8.75)
≥ 5	0 (0.0)
<b>Rectal Temperature (°C)</b>	
< 38.2	22 (27.50)
38.3–38.7	39 (48.75)
≥ 38.8	19 (23.75)



**Figure 3** Pie-chart distribution showing the prevalence of diarrhea severity based on hygiene score and patient's age based on (A) 3–10 months (B) 11–19 months (C) 20–28 months and (D) 29–36 months age group.

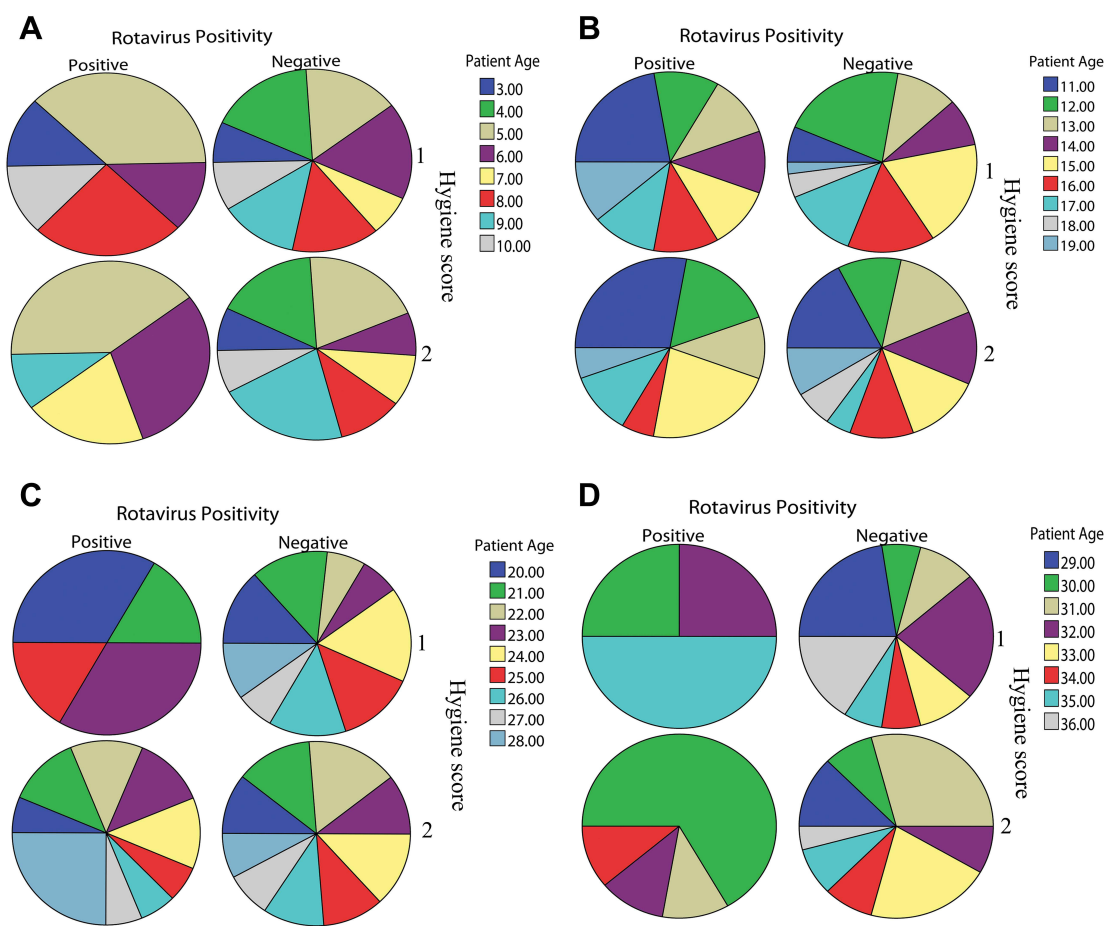
## Association of Clinical Characteristics with Rotavirus Infection and Severe Diarrhea

Logistic regression analysis was performed for rotavirus infection and severe diarrhea to determine statistical significance based on factors such as age, sex, nutritional status, exclusive breastfeeding, mother's age, employment status and hygiene score. Table 4 presents the results of the logistic regression analysis for rotavirus infection and severe diarrhea. In the case of rotavirus infection, there was a strong association with the hygiene score with  $p=0.009$ . Thus revealing that the rotavirus infection may due to the hygienic nature of the mother and her family. Moreover, rotavirus infection in the age group 20–28 months was the highest at 24.44%, although the difference was not statistically significant. In the case of severe diarrhea, there was a significant association ( $p<0.05$ ) in the age group 11–19 months ( $p=0.006$ ) and 20–28 months ( $p=0.028$ ).

## Factors Associated with the Quality of Nursing Care

The characteristics of the nursing care assessment are presented in Table 5. In the severe diarrhea category, the major frequency of the guardian or the mother was not satisfied in terms of “Skillfulness and knowledgeable” (46.22% (Satisfied) vs 47.51% (Not Satisfied)); “Respect, Kindness and trustworthy” (42.21% vs 53.85%); “Appropriate care” (46.18% vs 47.54%); “Caring and responsiveness” (46.61% vs 46.94%) and “Entertainment” (45.36% vs 47.79%). However, these categories of guardians showed a higher satisfactory frequency over “Communication and information sharing” (52.48 vs 41.74) and “Advocacy” (48.52% vs 43.83%). In contrast, the guardians of the rotavirus positive group showed a slightly higher frequency of satisfaction with “Skillfulness and knowledgeable” (19.52% vs 17.13%); “Respect, Kindness and trustworthy” (20.53% vs 15.38%); “Appropriate care” (23.69% vs 11.48%); “Caring and responsiveness” (24.58% vs 11.22%); “Entertainment” (18.58% vs 18.47%) and “Communication and information sharing” (19.31% vs





**Figure 4** Pie-chart distribution showing the prevalence of rotavirus infection based on hygiene score and patient's age based on (A) 3–10 months (B) 11–19 months (C) 20–28 months and (D) 29–36 months age group.

17.83%). The logistic regression analysis observed that there was a no significant association of the nursing care quality based on the mother's age and Employment status except for "Communication and information sharing" with a p-value of 0.004 (Table 6). However, there are some weak interactions on "Skillfulness and knowledgeable" with the age of the mother's ( $p=0.057$ ) and their employment status ( $p=0.058$ ).

**Table 4** Logistic Regression Analysis with Patient Characteristics Among the Pediatric Patients with Rotavirus Infection and Severe Diarrhea Admitted from February 2019 and March 2022

Characteristics	Rotavirus Positive		Severe Diarrhea	
	Odds Ratio (95 CI)	p-value	Odds Ratio (95 CI)	p-value
<b>Patient age</b>				
3–10 months (Ref)				
11–19 months	1.72 (0.78–3.79)	0.183	0.43 (0.23–0.79)	0.006
20–28 months	0.77 (0.36–1.64)	0.492	0.50 (0.26–0.93)	0.029
29–36 months	0.70 (0.32–1.55)	0.379	0.58 (0.30–1.14)	0.113

(Continued)



**Table 4** (Continued).

Characteristics	Rotavirus Positive		Severe Diarrhea	
	Odds Ratio (95 CI)	p-value	Odds Ratio (95 CI)	p-value
<b>Gender</b>	1.33 (0.80–2.20)	0.271	1.12 (0.76–1.66)	0.562
<b>Nutritional Status</b>				
Normal (Ref)				
Marginal wasted	0.29 (0.04–2.34)	0.245	0.64 (0.21–1.93)	0.427
Moderate wasted	0.46 (0.05–3.93)	0.475	0.86 (0.27–2.74)	0.797
Severely wasted	0.25 (0.03–2.22)	0.211	0.86 (0.25–2.92)	0.803
<b>Breastfeeding</b>	1.18 (0.71–1.98)	0.522	0.89 (0.60–1.33)	0.560
<b>Mother's age</b>	1.32 (0.79–1.99)	0.538	0.85 (0.57–1.27)	0.424
<b>Mother's employment status</b>	1.32 (0.79–2.21)	0.283	0.87 (0.58–1.30)	0.491
<b>Hygiene Score</b>	0.5 (0.30–0.084)	0.009	0.92 (0.63–1.36)	0.687

**Table 5** Characteristics of Nursing Care Quality Assessment Based on Standard Questionnaire

Quality of Pediatric Nursing Care	Rotavirus Positive (N=80), n (%)	Mild Diarrhea (N=74), n (%)	Moderate Diarrhea (N=156), n (%)	Severe Diarrhea (N=202), n (%)
<b>Skillfulness and knowledgeable</b>				
Satisfied	49 (19.52)	45 (17.93)	90 (35.86)	116 (46.22)
Not Satisfied	31 (17.13)	29 (16.02)	66 (36.46)	86 (47.51)
<b>Respect, Kindness and trustworthy</b>				
Satisfied	54 (20.53)	44 (16.73)	108 (41.06)	111 (42.21)
Not Satisfied	26 (15.38)	30 (17.75)	48 (28.40)	91 (53.85)
<b>Appropriate care</b>				
Satisfied	59 (23.69)	43 (17.27)	91 (36.55)	115 (46.18)
Not Satisfied	21 (11.48)	31 (16.94)	65 (35.52)	87 (47.54)
<b>Caring and responsiveness</b>				
Satisfied	58 (24.58)	41 (17.37)	85 (36.02)	110 (46.61)
Not Satisfied	22 (11.22)	33 (16.84)	71 (36.22)	92 (46.94)
<b>Entertainment</b>				
Satisfied	34 (18.58)	30 (16.39)	70 (38.52)	83 (45.36)
Not Satisfied	46 (18.47)	44 (17.67)	86 (34.54)	119 (47.79)
<b>Communication and information sharing</b>				
Satisfied	39 (19.31)	28 (13.86)	68 (33.66)	106 (52.48)

(Continued)

**Table 5** (Continued).

Quality of Pediatric Nursing Care	Rotavirus Positive (N=80), n (%)	Mild Diarrhea (N=74), n (%)	Moderate Diarrhea (N=156), n (%)	Severe Diarrhea (N=202), n (%)
Not Satisfied	41 (17.83)	46 (20.0)	88 (38.26)	96 (41.74)
<b>Advocacy</b>				
Satisfied	50 (18.52)	47 (17.41)	92 (34.07)	131 (48.52)
Not Satisfied	30 (18.52)	27 (16.67)	64 (39.51)	71 (43.83)

**Table 6** Logistic Regression Analysis with Nursing Care Quality Based on Mother's Age and Employment Status Conducted from February 2019 and March 2022

	Age of Mother		Employment Status	
	Odds Ratio (95 CI)	P value	Odds Ratio (95 CI)	P value
Skillfulness and knowledgeable	0.68 (0.45–1.01)	0.057	0.69 (0.47–1.01)	0.058
Respect, Kindness and trustworthy	0.96 (0.64–1.44)	0.830	1.41 (0.95–2.10)	0.091
Appropriate care	1.21 (0.81–1.80)	0.353	0.97 (0.66–1.43)	0.862
Caring and responsiveness	0.94 (0.63–1.40)	0.762	1.19 (0.80–1.76)	0.386
Entertainment	0.98 (0.65–1.46)	0.913	1.10 (0.74–1.63)	0.631
Communication and information sharing	1.79 (1.20–2.66)	0.004	0.88 (0.60–1.30)	0.518
Advocacy	1.03 (0.68–1.54)	0.906	0.87 (0.58–1.30)	0.495

## Association of Nursing Care with Rotavirus Infection and Severe Diarrhea

The logistic regression analysis to determine the association of nursing care with rotavirus infection and severe diarrhea is presented in Table 7. In case of rotavirus infection, there was strong association with “Appropriate care” ( $p=0.001$ ). However, in case of severe diarrhea, there was association with “Respect, Kindness and trustworthy” ( $P=0.012$ ) and Communication and information sharing ( $P=0.023$ ). Thus suggesting that recovery from rotavirus infection depends on

**Table 7** Logistic Regression Analysis with Nursing Care Quality Among the Pediatric Patients with Rotavirus Infection and Severe Diarrhea Admitted from February 2019 and March 2022

	Rotavirus Positivity		Diarrhea Severity	
	Odds Ratio (95 CI)	P value	Odds Ratio (95 CI)	P value
Skillfulness and knowledgeable	0.82 (0.49–1.36)	0.442	1.05 (0.71–1.55)	0.812
Respect, Kindness and trustworthy	0.70 (0.42–1.19)	0.187	1.66 (1.12–2.47)	0.012
Appropriate care	0.40 (0.23–0.70)	0.001	1.04 (0.70–1.53)	0.847
Caring and responsiveness	0.70 (0.42–1.16)	0.167	0.95 (0.64–1.40)	0.788
Entertainment	1.05 (0.63–1.74)	0.855	1.15 (0.77–1.70)	0.497
Communication and information sharing	0.86 (0.52–1.41)	0.545	0.64 (0.44–0.94)	0.023
Advocacy	1.00 (0.60–1.67)	0.996	0.80 (0.54–1.20)	0.285

the appropriate care from the nursing staff. Moreover, there is a gap with the nursing staff based on “Communication and information sharing” and “Respect, Kindness and trustworthy” which may have an impact on severe diarrhea.

## Discussion

The study observed that rotavirus infection still exists among the vaccinated Chinese population. Based on the clinical analysis, rotavirus infection is mostly associated with the hygienic nature of the mother. Additionally, severe diarrhea was associated with 20–28 months and 11–19 months age group. On the other hand, the guardians were not satisfied with the nursing care quality and the logistic regression analysis suggests that that recovery from rotavirus infection depends on the Appropriate care from the nursing staff. Moreover, there was association with nursing cared based on “Communication and information sharing” and “Respect, Kindness and trustworthy” which may have an impact on pediatric patients with severe diarrhea. In fact, rotavirus generally causes severe infectious diarrhea in infants and children, especially in the age group of 3–35 months old.<sup>32</sup> Severe acute diarrhea, also termed gastroenteritis is most notably caused by rotaviruses. In the majority of cases of acute gastroenteritis or severe diarrhea in infants, children require special emergency care and hospital admission for better management.<sup>33</sup> There are also certain cases in which an infant may be infected with the virus two or three times via the fecal-oral route. However, the severity of infection decreases with re-infection with rotavirus.<sup>34</sup> The main reason for re-infection is the unhygienic nature of children from contaminated food and drinks.<sup>34</sup> In the present study, the prevalence of rotavirus positive infection was 18.52%, which was comparatively lower than that reported by Zhao et al<sup>35</sup> and Dian et al.<sup>36</sup> There are also studies which observed that children with acute diarrhea who were not vaccinated tested negative for rotavirus. This may be due to the protective nature of the vaccine or attributable to herd immunity, which results from an overall protective effect of the immunization program on both immunized and non-immunized children.<sup>17,37</sup> Fortunately, no mortality was observed in this study. In China, a clinical study on the Lanzhou lamb rotavirus (LLR) vaccine, which was licensed in 2000, reported its effectiveness to be 35% against rotavirus gastroenteritis and 53% against moderate to severe diarrhea.<sup>38</sup> Thus, the effectiveness of the rotavirus vaccine is questionable. In fact, RV vaccination does not guarantee for a total protection against young children, however it can reduce the severity of rotavirus gastroenteritis. The severity scoring system used in the present investigation is based on a modified scoring system developed by Ruuska and Vesikari.<sup>29</sup> In fact, the comparison of severity scores is difficult because of the variation in the different classification systems and scores. Both scoring system have been used in various clinical trials to evaluate rotavirus vaccine efficacy.<sup>39</sup> The study also observed that the rate of rotavirus infection was high at 11–19 months (22.50%) and 20–28 months (24.44%), which is somewhat similar to another study.<sup>40</sup> In fact, the World Health Organization has reported that rotavirus infection is likely to occur in the age group between 6–24 months, with a peak incidence at 9–12 months.<sup>41</sup> Age groups from 6–24 months are at risk because of their small body size, which may lose a majority of their body fluid by severe dehydration during diarrhea. In the present study, no significant association was found between rotavirus infection and exclusive breastfeeding. The number of exclusively breastfed children with rotavirus infection was slightly higher than that of weaned children. The inclination of the number of weaned children in this study may be related to the mother’s employment status. It is also reported that a high level of weaning is associated with working women or working mothers.<sup>42</sup> Overall, the frequency of exclusive breastfeeding children was 269 cases (62.27) compared to 163 cases (37.73), which may be because of the common belief among the Chinese that breastfeeding reduces the burden of diarrhea and gastrointestinal infections. Studies have reported that breast milk contains secretory antibodies, IgA, and other immune cells that protect the intestinal epithelium from microbial pathogens.<sup>43</sup> The study also observed a majority of guardian or the mother were not satisfied in terms of the seven attributes assessed for nursing care quality such as “Skillfulness and knowledgeable”, “Respect, Kindness and trustworthy”, “Appropriate care”, “Caring and responsiveness” and “Entertainment”. Additionally, the logistic regression analysis based on the association of nursing care with rotavirus infection and severe diarrhea suggests that recovery from rotavirus infection depends on the “Appropriate care” from the nursing staff. Moreover, severe diarrhea was associated with “Communication and information sharing” and “Respect, Kindness and trustworthy” from the nursing staff which may have an impact on recovery of the pediatric patients. The quality of nursing care and improvement in patient care and safety are a challenging task. Decisions regarding nursing practice management are also becoming more important, and nursing in the nursing practice area has become more important.

The pediatric patients and infants with acute diarrhea lacks proper expression and in majority of the cases, the medical practitioner is unable to understand their medical condition for the treatment. Therefore, the intervention of

nursing staff is very much essential for providing effective nursing care for these patients with acute diarrhea and gastroenteritis.<sup>25</sup> Moreover, with the adoption of “Two-Child Policy” in China, the pediatric healthcare system and pediatric nursing is still behind its demand. This is because the children population of China is around 250 billion which comprises 15% of global children population. Therefore, there is an urgent requirement for necessary pediatric clinical practice and nursing guidelines to improve the pediatric healthcare and pediatric nursing system in China.<sup>44</sup> In the present study, the assessment of nursing care in children infected with rotavirus implied that quality health care is important for all people, especially pediatric children with severe diarrhea. This is because pediatric children with severe diarrhea require special care for hydration to meet growth and developmental need.<sup>45</sup> In fact, a good nursing care can improved the quality of life of the pediatric acute diarrhea by tackling the problems like electrolyte disorders, gastrointestinal function and guardian’s satisfaction.<sup>25</sup> Moreover, a majority of the pediatric mother have a very limited information and knowledge regarding the correct management of acute diarrhea and related to dehydration and hygienic practices.<sup>26</sup> Nonetheless, nurses are concerned about the quality of care and have moral and authorized responsibilities for the care of pediatric patients. Therefore, the intervention of nursing care is very much essential for the diarrheic pediatric patients. This study examines the attributes of pediatric child care nursing quality through conceptual analysis. Moreover, establishing the concept and clear understanding of childcare quality is a prerequisite for providing quality care to children.<sup>46</sup> However, with the multidimensional properties of the concept and its variability according to the situation and context, an understanding of the concept in the field of child nursing practice is limited in China.

Through nursing care, with an endeavor to understand the emotions of the pediatric patients and by providing psychological education and health education for their family members, misconceptions and proper treatment can be improve the recovery and physical symptoms of the diarrheic pediatric patients. Based on the results of this study, the quality of child care can be measured, and the results demonstrate the behaviors of Chinese nurses towards pediatric nursing care which need to be improved. Therefore, an overall intervention of quality nursing care is necessary for the effective improvement of the pediatric patients with rotavirus gastroenteritis.

However, the present study has some limitations; first the data on rotavirus infection was focus in one particular hospital and location in China. Secondly, there was no control to measure the disease severity apart from the scoring system. Third, the study is irrespective of the type of the vaccine given to the patients either RotaTeq or LLR rotavirus vaccine.

## Conclusion

To conclude, rotavirus infection persists among vaccinated pediatric children in China. The infection is linked with hygienic nature of the mother and guardian. On the other hand, the majority of guardians or mothers were not satisfied in terms of nursing care quality which reflects the behaviors of Chinese nurses towards pediatric care and patients. In general, intervention of proper nursing care is essential for the diarrheic pediatric patients in China. This is because quality nursing care can improved the quality of life with proper management of electrolyte disorders and caregiver’s satisfaction. Therefore, this study recommends integrating special nursing care education and training program for pediatric nurses to improve their skills and knowledge.

## Data Sharing Statement

All data and materials were included in this paper. The corresponding author could provide all data upon reasonable request.

## Ethics Approval and Informed Consent

The study was done following the guidelines of the Declaration of Helsinki and its later amendments. Ethical approval was granted by the Ethics Committee of Shanxi Children’s Hospital (Approval No. 2019-0156 dated 9 Jan 2019). Written informed consent was taken from the parents and guardians of the child. The enrolled children were free from other severe diseases and severe medical conditions.

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## Disclosure

The author reports no conflicts of interest in this work.

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