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Impact of Novel Coronavirus Vaccination on the Clinical Characteristics and Parental Care Needs of Infected Children During a High-Intensity Epidemic Period

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Abstract: *Objective:* This study aimed to investigate the impact of COVID-19 vaccination on the clinical characteristics and care needs of infected children during a high-intensity pandemic and to measure the potential effects of vaccination on children's health status and healthcare utilization. *Methods:* A sample of 903 children who had recently been infected with the novel coronavirus and came to our hospital's emergency department from January 11 to January 30, 2023, was used as the research object in this retrospective study. The questionnaire on unknown coronavirus infection was filled out anonymously, and SPSS20.0 software was used for statistical data analysis. *Results:* The baseline conditions of 903 subjects were studied, including 505 males, accounting for 55.92%, and 398 females, accounting for 44.08%. The age of infection was mainly concentrated in preschool children (26.02%) and school-age children (38.76%). Regarding vaccination, 561 cases were vaccinated, accounting for 62.13%. Among them, 37 children received one dose of vaccine, accounting for 4.1%, 463 children received two doses, accounting for 51.27%, and 61 children received three doses, accounting for 6.76%. For previous allergic diseases, 180 children had a history of allergic diseases, accounting for 19.93%. Regarding sources of infection, the most common source was someone at home, accounting for 82.61%. Vaccination can effectively reduce the fever of children infected with the new coronavirus, the number of outpatient and emergency doctor visits, and the risk of hospitalization. In addition, regarding treatment, children in the vaccinated group were more likely to be treated at home, and the types of drugs used also differed from those in the non-vaccinated group. However, the vaccination group has a relatively high incidence of symptoms such as sore throat, cough, abnormal sense of smell and taste, muscle soreness, and headache. However, these are mild clinical symptoms and do not affect children's physical health and development. Parental care needs for children infected with COVID-19 are disparate, and parents of vaccinated children have lower proportions of needs for child care. *Conclusion:* Vaccination positively impacts the clinical outcomes of children infected with COVID-19 and their parents' well-being.

Keywords: Children; Novel coronavirus vaccine; Novel coronavirus

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1. Introduction

The novel coronavirus (COVID-19) pandemic has wreaked havoc on global health systems and social and economic activity. Although it was initially believed that COVID-19 mainly affected adults, with the global spread of Omicron strains, the infection rate in children has shown an increasing trend [1,2]. However, the incidence rate is lower than that of adults, and severe disease may also occur, it can even lead to the death of children [3]. In addition, children may be asymptomatic carriers of the virus and contribute to community transmission [4]. In this context, vaccination with an effective COVID-19 vaccine is essential to mitigate the spread of the virus and its impact on public health. Given that vaccine efficacy and coverage play a crucial role in controlling the spread of the virus, this study aimed to investigate the impact of COVID-19 vaccination on the clinical characteristics and care needs of infected children during a high-intensity pandemic, measuring the impact of vaccination on children and the potential effects on health status and healthcare utilization.

2. Research methods

2.1. Selection and recruitment of research subjects

A retrospective study was conducted on 1,000 children who had recently been infected with the new coronavirus and came to the emergency department of our hospital from January 11 to January 30, 2023. Among them, 97 children were excluded due to uncertain infection, and the remaining 903 cases were included in the study. The “Diagnosis and Treatment Plan for Novel Coronavirus Pneumonia (Trial Tenth Edition)” can be referred to for objects and diagnostic criteria. This study was approved by the Ethics Committee of Children's Hospital Affiliated with the Capital Institute of Pediatrics (ethical review number SHERLLM2023040), and informed consent was waived.

2.2. Data collection method and process

The questionnaire was designed based on the literature review. After being reviewed by experts, the QR code of the “Questionnaire on Novel Coronavirus Infection in Children in Emergency Departments” was placed on the emergency triage desk and clinic. They were first guided and accompanied by the triage nurse. Parents who visit the hospital scanned the QR code and filled in the form anonymously. If anything is missing, the doctor will guide the parents to scan the QR code and fill it in anonymously. If there are any questions, the guide will explain it.

2.3. Data processing and analysis methods

According to the vaccination status, the subjects were divided into the unvaccinated and vaccinated groups. The vaccinated group included one dose, two doses, and three doses. SPSS20.0 software was used for statistical analysis of the data. Count data were expressed as cases (%). Comparisons between groups were performed using the x^2 test or Fisher’s exact probability method. $P < 0.05$ indicated that there is a statistically significant difference.

3. Research result

3.1. Basic characteristics and vaccination status of study subjects

The baseline conditions of 903 subjects were analyzed, including 505 males, accounting for 55.92%, and 398 females, accounting for 44.08%. The age of infection was mainly concentrated in preschool children (26.02%) and school-age children (38.76%). In terms of vaccination, 561 cases were vaccinated, accounting for 62.13%,

of which 37 cases were vaccinated with one dose of vaccine, accounting for 4.1%, 463 cases were vaccinated with two doses of vaccine, accounting for 51.27%, and 61 cases were vaccinated with three doses of vaccine, accounting for 6.76%. Regarding previous allergic diseases, 180 cases had a history of allergic diseases, accounting for 19.93%. Regarding the source of infection, the most common source of infection is a person in the household infected with COVID-19., accounting for 82.61%, as shown in **Table 1**.

Table 1. The baseline situation of children infected with novel coronavirus (n = 903)

Variable	Number of cases (%)
Gender	
Male	505 (55.92)
Female	398 (44.08)
Age of onset	
Newborn (0–28 days)	7 (0.78)
Infant (January–November)	67 (7.42)
Toddlers (1–2 years old)	138 (15.28)
Preschoolers (3–5 years old)	235 (26.02)
School-age children (6–11 years old)	350 (38.76)
Teenagers (12–18 years old)	106 (11.74)
Vaccination status	
0 dose	342 (37.87)
1 dose	37 (4.1)
2 doses	463 (51.27)
3 doses	61 (6.76)
Past allergic disease	
Yes	180 (19.93)
No	723 (80.07)
Source of infection	
No obvious source of infection found	108 (11.96)
Someone at home is infected	746 (82.61)
Contact with relatives and friends	18 (1.99)
Contact in public places	29 (3.21)
Other	2 (0.22)

3.2. Impact of vaccination on clinical presentation and treatment of children

The study found that the fever situation differed between the vaccinated and unvaccinated groups. In the vaccinated group, 95.01% of the children had a fever, while in the unvaccinated group, 97.66% had a fever. There was a statistically significant difference between the two groups ($P < 0.05$). Regarding the highest body temperature, the vaccination group also showed a clear advantage, and the proportion of children with a body temperature above 39℃ was higher in the non-vaccination group.

The incidence of sore throat, cough, abnormal sense of smell and taste, muscle aches, and headaches in the vaccinated group was higher than that in the unvaccinated group, and the difference between the two groups was statistically significant ($P < 0.05$). Clinical symptoms such as nasal congestion, hoarseness, wheezing, chest pain, dyspnea, vomiting, diarrhea, and convulsions were not significantly different between the two groups ($P > 0.05$).

Regarding treatment methods, the use rate of proprietary Chinese medicines and compound cold medicines in the vaccinated group was significantly higher than that of the unvaccinated group, and the use rate of acetaminophen was significantly lower than that of the unvaccinated group. In addition, the choice of medical treatment methods in vaccination group is also significantly different from that of the unvaccinated group. The

vaccinated group is more likely to stay at home without seeking medical treatment, which may be related to the milder clinical symptoms of vaccinated children. When comparing the recovery time of symptoms, there was no significant difference between the two groups ($P > 0.05$). About 80% of infected children recovered from symptoms within a week. The results are presented in **Table 2** and **Table 3**.

Table 2. Comparison of clinical symptoms and treatment between the vaccinated group and the non-vaccinated group of children infected with novel coronavirus (n = 903)

	Inoculation (n = 561)	Not vaccinated (n = 342)	x^2 value	*P* value
Clinical symptoms				
Fever	533 (95.01)	334 (97.66)	3.904	0.048
Maximum body temperature	-	-	11.167	0.011
37.3–38℃	36 (6.75)	19 (5.69)	-	-
38.1–39℃	212 (39.77)	113 (33.83)	-	-
39.1–40℃	253 (47.47)	162 (48.5)	-	-
> 40℃	32 (6.00)	40 (11.98)	-	-
Runny nose	182 (32.44)	90 (26.32)	3.789	0.052
Sore throat	154 (27.45)	26 (7.6)	52.448	< .0001
Hoarse voice	47 (8.38)	42 (12.28)	3.643	0.0563
Cough	265 (47.24)	128 (37.43)	8.319	0.004
Respite	10 (1.78)	13 (3.8)	3.488	0.062
Chest pain and tightness *	4 (0.71)	1 (0.29)	-	0.655
Difficulty breathing *	2 (0.36)	2 (0.58)	-	0.636
Vomiting	60 (10.7)	33 (9.65)	0.2517	0.6159
Diarrhea	30 (5.35)	26 (7.60)	1.857	0.173
Abnormal sense of smell and taste	31 (5.53)	6 (1.75)	7.6909	0.0056
Muscle ache	73 (13.01)	16 (4.68)	16.610	< .0001
Headache	117 (20.86)	17 (4.97)	42.4240	< .0001
Convulsions *	7 (1.25)	4 (1.17)	-	1.000
Weakness	107 (19.07)	48 (14.04)	3.793	0.052
Rash	20 (3.57)	14 (4.09)	0.164	0.686
Other symptoms	23 (4.1)	21 (6.14)	1.909	0.167
Asymptomatic infection	11 (1.96)	7 (2.05)	0.008	0.929
Clinical treatment				
Taking medicine	512 (91.27)	309 (90.35)	0.215	0.643
Drug type				
Ibuprofen	339 (66.21)	206 (66.67)	0.018	0.894
Acetaminophen	150 (29.3)	115 (37.22)	5.530	0.019
Antibiotic	33 (6.45)	13 (4.21)	1.825	0.177
Oseltamivir phosphate or ribavirin*	4 (0.78)	7 (2.27)	-	0.113
Chinese patent medicine	136 (26.56)	38 (12.3)	23.477	< .0001
Compound cold medicine	61 (11.91)	14 (4.53)	12.655	0.0004
Other drugs	38 (7.42)	32 (10.36)	2.127	0.145
Medical treatment methods	-	-	19.189	0.0007
Staying at home without seeking medical treatment	526 (93.76)	293 (85.67)	-	-
Internet online consultation	5 (0.89)	9 (2.63)	-	-
Outpatient visit	15 (2.67)	18 (5.26)	-	-
Emergency room visit	15 (2.67)	19 (5.56)	-	-
Hospitalization	0 (0)	3 (0.88)	-	-

*Fisher exact probability method

Table 3. Comparison of symptom recovery time between vaccinated and unvaccinated children infected with novel coronavirus (n = 885)

	Inoculation (n = 550)	Not vaccinated (n = 335)	x^2 value	*P* value
Symptom recovery time	-	-	2.743	0.602
1–3 days	231 (42)	148 (44.18)	-	-
4–7 days	200 (36.36)	128 (38.21)	-	-
8–14 days	76 (13.82)	36 (10.75)	-	-
14–28 days	30 (5.45)	14 (4.18)	-	-
> 28 days	13 (2.36)	9 (2.69)	-	-

3.3. Parents' care needs and conditions after vaccination

Parents in the vaccinated group who needed nursing guidance were significantly lower than those in the unvaccinated group, including antipyretic nursing methods, nursing of respiratory symptoms such as cough and sputum, nursing guidance of gastrointestinal symptoms such as vomiting and diarrhea, nursing care of convulsions, and nutrition and diet guidance. Regarding nursing guidance methods, there was no significant difference between the parents of the vaccinated group and those of the unvaccinated group. The results are shown in **Table 4**.

Table 4. Comparison of the needs for nursing guidance between vaccinated and unvaccinated children infected with novel coronavirus

	Vaccinated	Not vaccinated	x^2 value	*P* value
Nursing Guidance (n = 903)				
No guidance required	161 (28.7)	68 (19.88)	8.724	0.003
Guidance on antipyretic care methods	236 (42.07)	210 (61.4)	31.780	< .0001
Nursing guidance for respiratory symptoms such as cough and sputum	297 (52.94)	213 (62.28)	7.540	0.006
Nursing guidance for gastrointestinal symptoms such as vomiting and diarrhea	233 (41.53)	179 (52.34)	10.001	0.002
Nursing guidance for convulsions	201 (35.83)	183 (53.51)	27.173	< .0001
Nutritional diet guidance	183 (32.62)	152 (44.44)	12.730	0.0004
Other	12 (2.14)	17 (4.97)	5.481	0.019
Nursing guidance method (n = 674)				
Face-to-face with the caregiver	76 (19.00)	55 (20.07)	0.120	0.730
Online nursing clinic	273 (68.25)	194 (70.8)	0.498	0.480
Related video	274 (68.5)	196 (71.53)	0.709	0.400
Other	9 (2.25)	5 (1.82)	0.145	0.704

4. Discussion

This study shows that vaccination can effectively reduce the fever of children infected with the new coronavirus, the number of outpatient and emergency visits, and the risk of hospitalization. In addition, regarding treatment, children in the vaccinated group were more likely to be treated at home, and the types of drugs used also differed from those in the non-vaccinated group. However, the vaccination group had a relatively high incidence of symptoms such as sore throat, cough, abnormal sense of smell and taste, muscle aches, and headaches

related to the co-action of vaccination and viral infection in the body, and these mild clinical symptoms harm the children. There is no apparent impact on the physical health and development of children. Therefore, in promoting vaccination, relevant care and treatment measures need to be guided and popularized to improve the overall effect of vaccination. The study also highlights the disparity in parents' care needs for children infected with COVID-19. Parents of vaccinated children reported lower rates of childcare needs, suggesting fewer challenges related to caring for their children during illness as well as potential economic benefits of COVID-19 vaccination.

4.1. Effect of vaccination on clinical characteristics of infected children

Fever is a common symptom of novel coronavirus infection, and the effect of vaccination in reducing fever in infected children is crucial. From the results of this study, the proportion of fever and the highest body temperature in the vaccinated group were lower than those in the unvaccinated group, which shows that vaccination can effectively reduce the fever of children infected with the new coronavirus. Viral infection is related to excessive activation of the body's immune response. Among the 97 COVID-19 children aged 3–14 admitted to a hospital in Xi'an, 17.1% (6/35) of the fully vaccinated children had a fever lower than 43.5% (10/23) of the unvaccinated children. The difference was statistically significant. Compared with unvaccinated children, fully vaccinated children have milder clinical symptoms and lower viral loads [5]. Eleven children with COVID-19 who were infected with the new coronavirus Delta variant were included in the vaccination group after being vaccinated in designated hospitals in Henan Province. Thirty-one children were included in the unvaccinated group, and the clinical characteristics of children with new coronavirus pneumonia who were infected with the new coronavirus Delta variant after being vaccinated or not vaccinated with the new coronavirus inactivated vaccine (referred to as the new crown vaccine) were compared, including fever, cough, and expectoration. There was no statistically significant difference in the incidence of clinical symptoms between the two groups. The levels of aspartate aminotransferase, lactate dehydrogenase, and creatine kinase isoenzymes in the vaccinated group were significantly lower than those in the non-vaccinated group. However, the B lymphocytes and total T lymphocytes (CD3+) in the vaccinated group were lower than that of the unvaccinated group, suggesting that vaccination with the new crown vaccine may reduce the damage to the myocardium of the new coronavirus Delta variant in children. However, it is necessary to be wary of impaired immune function [6]. Studies have also confirmed that COVID-19 inactivated vaccination can significantly shorten the time for viral nucleic acid to turn negative, thus effectively shorten the isolation time and hospitalization time of symptomatic cases, which is of great significance for reducing virus transmission, the risk of infection, and the consumption of medical resources [7]. These suggest that vaccination with inactivated COVID-19 vaccination, as an effective public health measure, has the potential to mitigate the impact of the pandemic on children's health. However, the current research has many limitations, such as small sample size and incomplete research. Therefore, it is necessary to carry out further comprehensive and in-depth research on the effect of inactivated COVID-19 vaccine on children to better evaluate the advantages and disadvantages of vaccination, and provide a more scientific and healthier plan for children's vaccination. Based on the findings of a systematic review and meta-analysis to evaluate the safety and efficacy of COVID-19 mRNA vaccines in children aged 5–11 years [8], the mRNA vaccine has a moderate preventive effect on the variant infection of COVID-19 in children. However, it may have an excellent protective effect on hospitalization caused by COVID-19 infection. The results of this systematic review and meta-analysis can be used as a basis for public health policy and personal decision-making regarding COVID-19 mRNA vaccination of children aged 5–11 years.

4.2. Impact of COVID-19 vaccination on the care needs of parents of infected children

Vaccination has significantly impacted the care needs of parents of infected children. The need for nursing instruction was lower among parents in the vaccinated group, indicating the importance of vaccination in reducing the burden of parental care. It also shows that vaccination may reduce parents' anxiety and concerns about their children's health after being infected with the new coronavirus. In addition, the proportion of vaccinated children infected with the new coronavirus was lower than that of children in the unvaccinated group. However, the proportion of adverse reactions such as sore throat, cough, abnormal sense of smell and taste, muscle aches, and headaches was higher than that of children in the unvaccinated group. Therefore, providing more refined and individualized care and treatment plans for post-vaccinated children is necessary to alleviate parents' worries and anxieties. With the high-intensity epidemic of COVID-19, the method of nursing guidance has also undergone tremendous changes. In order to meet the needs of parents, doctors and nurses use various nursing guidance methods, including face-to-face guidance, remote video guidance, and telephone consultation. Research has shown that each of these different nursing instruction modalities has their own characteristics, but the effectiveness of use in different settings will also vary. For example, face-to-face instruction works better in a hospital, but remote video instruction is more applicable in a home environment [9].

5. Research limitations and insufficient analysis

This study was a survey conducted through social media platforms during the high-intensity epidemic of the new coronavirus, thus there are some limitations. First, although the questionnaire survey targets children, there may still be selection bias when selecting respondents. There are uncontrollable influencing factors such as age, gender, and parent's education level. Therefore, it takes effort to meet the representativeness and reliability of the sample. Hence, the research results still need to be compared and verified with other studies to improve the reliability of the findings of this study. Secondly, because the vaccination group includes children who have only received one dose, the effect of the vaccine may be underestimated. Thirdly, the sample size is small, thus multiple centers and large samples must further verify the research conclusion to provide a better and reliable clinical basis for promoting and improving COVID-19 vaccination.

6. Conclusion

In conclusion, the results of this study suggest that vaccination has a potential positive impact on both the clinical outcomes of children infected with COVID-19 and the well-being of their parents.

Disclosure statement

The authors declare no conflict of interest.

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