Effect of the COVID-19 Pandemic on Vaccination Compliance among Children Attending Assiut University Children's Hospital

Gehad Gamal Ahmed*, Mohamed Hamdy Ghazally, Ismail Lofty Mohamad, Ekram Mohamed Abdelkhalek,

Pediatric Department, Faculty of Medicine, Assiut University, Assiut, Egypt.

Public Health and Community Department, Faculty of Medicine, Assiut University, Assiut, Egypt.

Correspondence Author: Gehad Gamal Ahmed

E-mail: *gehadgamal098@gmail.com*

Abstract:

Introduction: The COVID-19 pandemic has severely affected global health services such as vaccinations. Even briefly, the disruption of immunization services will increase the number of susceptible individuals, raising the risks of an upsurge in outbreak-prone vaccine-preventable diseases.

Objectives: To evaluate the impact of the COVID-19 pandemic on pediatric vaccination compliance among children attending Assiut University Children's Hospital.

Patient and Methods: This was a cross-sectional hospital-based study to evaluate the impact of the COVID-19 pandemic on pediatric vaccination compliance among children attending Assiut University Children's Hospital and to assess the general health profile of the studied children. The study included 116 children up to 2 years of age, with a duration of 1 year (from 5/2021 to 6/2022). All children were subjected to a full clinical history at the time of vaccination, and information regarding immunization and practices was collected using a semi-structured questionnaire.

Results: Over one-third were aged 6 to 12 months; nearly three-quarters were rural residents, and half were from middle-class families. Neonatal health problems were reported among more than one-third of the newborns.

Only five children had COVID-19 infection, and more than two-thirds of caregivers agreed to vaccinate their child during the COVID-19 pandemic.

Conclusion: Our results showed no significant relation between COVID-19 infection and incomplete vaccination; however, neonatal problems were associated with a higher vaccination rate.

Keywords: COVID-19; Vaccination; Pandemic; Questionnaire.

Introduction:

COVID-19 is caused by a new coronavirus called Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). On March 11th, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic **[1].** The first outbreak occurred in Wuhan, China **[2]**

The COVID-19 pandemic has severely affected global health services **[3].** It is important not to overlook the value of public health preventive interventions, such as vaccinations, which cannot be postponed **[4].**

As reported by WHO, even briefly, the disruption of immunization services will increase the number of susceptible individuals, raising the risks of an upsurge in outbreak-prone Vaccine Preventable Diseases **[5].** The reduction of vaccination coverage could cause an increase in morbidity and mortality among children. Consequently, a greater burden could be placed on health systems.

Egypt declared a national emergency to control the COVID-19 pandemic and implemented a stay-at-home order. Such strategies might decrease accessibility to

routine immunization services, leaving children at risk for vaccine-preventable diseases and complications **[6].**

Great efforts are needed to catch children not up-to-date with routine vaccines. Parental concerns about potentially exposing their children to COVID-19 during vaccination visits might contribute to noncompliance. Reminding parents of the vital need to protect their children against serious vaccine-preventable diseases is critical **[7].** The current study aims to evaluate the impact of the COVID-19 pandemic on pediatric vaccination compliance among children attending Assiut University Children's Hospital and to assess the general health profile of the studied children.

Patients and Methods

Study Design:

This was a cross-sectional hospital-based study conducted at Assiut University Children's Hospital.

Study Population:

Children aged 1 month to 2 years.

Sample Size Calculation:

Sample size was calculated using EPI INFO version 7 software (Center for Disease Control and Prevention, Atlanta, Georgia, USA), Based on a prevalence of 92% vaccinated rate of Egyptian children according to the Egyptian Demographic Health Survey (2014). Calculation resulted in a sample of 113 children (confidence interval 95% and power 80%), and it was increased to 125 to overcome the non-response rate.

Study Instrument:

A semi-structured questionnaire was constructed for direct interviews.

The questionnaire consisted of 3 sections:

- The first section consisted of items to explore socio-demographic characteristics of respondents (age, family number, home number, home rooms, father's education, father's job, mother's education, mother's job and Socio-economic level of the families of the studied children which determined by using the socio-economic status scale developed by El-Gilany et al. **[8].**
- The second section contained items to assess the child's data (age, sex, religion, residence, number of brothers and sisters, order of the child among living siblings, mode of delivery, and place of delivery). Moreover, data regarding maternal and neonatal delivery-related complications, including the need for intubation, neonatal problems, feeding type, and the number of twins' pregnancies, were obtained.
- The third section contained COVID-19 infection among studied children, including symptoms of COVID-19 infection, hospital admission, family member infected with COVID-19 infection, acceptance of COVID-19 vaccination, causes and places of delayed vaccinations, precautionary measures at sites of vaccination, and general vaccinations received among the studied children.

Data Collection:

Fieldwork started from 5/2021 to 6/2022. The researcher randomly selected three days of the week. The caregivers of all targeted children who came in on the randomly selected days of the week were invited to participate in the study.

- The researcher herself interviewed each child caregiver separately in a classroom beside the clinic, taking the following precautions:
  - Wearing a mask by both researchers and caregivers.
  - Maintain a 1-meter space between the researcher and the caregivers.
  - Caregivers were informed of the study's nature and goal and were asked for voluntary participation.
- Data collection from children's caregivers who agreed to be included in the study. After explaining the aim of the study, the interview with every caregiver took about 10 minutes.

Statistical Analysis:

Data were checked, entered, and analyzed using SPSS version 21 for data processing. Data were expressed as numbers and percentages for qualitative variables and mean + standard deviation (SD) for quantitative variables. Data analysis and comparison between groups were done using the chi-square test.

Ethical Considerations:

- Approval from the Ethics of Scientific Research Committee, Faculty of Medicine, Assiut University was obtained, verbal and written consents were obtained from all the caregivers of the patients, and the Privacy and confidentiality of all obtained information were observed without intervention in the prescribed treatment.

Results:

Table (1): Socio-demographic information of studied children, Assiut University Children's Hospital, 2022

Personal data	No. (116)	%
Sex:		
Male	64	55.2%
Female	52	44.8%
Age: (months)		
< 6	39	33.6%
6 – 12	46	39.7%
> 12	31	26.7%
Median (IQR)	7.0 (4.0-13.0)	
Religion:		
Muslim	109	94.0%
Christian	7	6.0%
Residence:		
Rural	63	54.3%
Urban	53	45.7%
Mother job:		
Working	31	26.7%
Not working	85	73.3%
Social class:		
Low	26	22.4%
Middle	58	50.0%
High	32	27.6%

Table (2): COVID-19 infection and its impact on children's vaccination

Items		No. (116)	%
Did the child have COVID-19?	Yes	5	4.3%
	No	111	95.7%
Symptoms of COVID-19:	Cough	5	4.3%
	Running nose	4	3.4%
	Fever	2	1.7%
	Fatigue and Sore Throat	1	0.8%
Needed admission (n=5):	Yes	1	0.8%
	No	4	3.4%
Family history of COVID-19 infection:	Yes	36	31.0%
	No	80	69.0%
Did you agree to vaccinate your child during the COVID-19 pandemic?	Yes	44	37.9%
	No	63	54.3%
	Don't know	9	7.8%
Did the COVID-19 pandemic affect vaccination time?	Yes	4	3.4%
	No	112	96.6%
Receive any vaccine at home from a nurse:	Yes	29	25.0%
	No	87	75.0%
Precautionary measures during vaccination:	Mask	116	100.0%
	Alcohol	47	40.5%
	Gloves	2	1.7%

It was found that five children (4.3%) had COVID-19, and 0.9% of them needed admission. Regarding children's vaccinations during the COVID-19 pandemic, 37.9% of the children's caregivers agreed to vaccinate their children during the epidemic, and the vast majority of children received their vaccination on time, as 96.6% of the children's caregivers reported that the epidemic did not affect the time of child vaccination. However, the COVID-19 pandemic affected vaccination time in 3.4% of studied children, mainly because they were infected with the COVID-19 virus.

One quarter of the children received the obligatory vaccines at home by a nurse, either because they or their caregivers were ill. As precautionary measures during the vaccination sessions, all children's caregivers wore masks, 1.7% wore gloves, and 40.5% used alcohol.

Table (3): Coverage for the expanded program of immunization obligatory vaccines among the studied children

Items	Yes		No		NA	
	No.	%	No.	%	No.	%
Polio vaccine	116	100.0%	0	0.0%	0	0.0%
BCG vaccine	113	97.4%	3	2.6%	0	0.0%
Hepatitis B vaccine	104	89.7%	12	10.3%	0	0.0%
Triple vaccination	99	85.3%	11	9.5%	6	5.2%
MMR vaccine	34	29.3%	6	5.2%	76	65.5%
Booster dose	16	13.8%	2	1.7%	98	84.5%
Vitamin A	30	25.9%	47	40.5%	39	33.6%

NA: Not Applicable

All children received the oral polio vaccine, and 97.4% had the BCG vaccine. The vaccination coverage of Hepatitis B, Triple, and MMR vaccines were 89.7%, 85.3% and 29.3%, respectively. It was found that 13.8% had the booster doses and 25.9% had Vitamin A.

Table (4): Relationship between vaccination status and the socio-demographic factors of the studied children

Variables		Complete vaccinations (n= 53)		Incomplete vaccinations (n= 63)		P-value
		No.	%	No.	%	
Sex:	Male	29	54.7%	35	55.6%	0.928
	Female	24	45.3%	28	44.4%	
Age: (months)	< 6	25	47.2%	14	22.2%	0.000*
	6 – 12	10	18.9%	36	57.1%	
	> 12	18	34.0%	13	20.6%	
Residence:	Rural	30	56.6%	33	52.4%	0.649
	Urban	23	43.4%	30	47.6%	
Father education:	Illiterate	2	3.8%	12	19.0%	0.034*
	Basic education	14	26.4%	13	20.6%	
	Secondary	13	24.5%	8	12.7%	
	University	18	34.0%	27	42.9%	
	Postgraduate	6	11.3%	3	4.8%	
Mother education:	Illiterate	4	7.5%	11	17.5%	0.374
	Basic education	12	22.6%	15	23.8%	
	Secondary	15	28.3%	12	19.0%	
	University	17	32.1%	22	34.9%	
	Postgraduate	5	9.4%	3	4.8%	
Mother job:	Working	15	28.3%	16	25.4%	0.725
	Not working	38	71.7%	47	74.6%	
Social class:	Low	7	13.2%	19	30.2%	0.025*
	Middle	26	49.1%	32	50.8%	
	High	20	37.7%	12	19.0%	

There is a significant difference between complete vaccinations and incomplete vaccinations with regard to age, father education, and social class; Children with complete vaccination were detected more frequently in children less than 6 months, whose fathers had secondary education or above (69.8%), and in high-class families (37.7%).

Table (4): Relationship between vaccination status and neonatal and postnatal factors of the studied children

Items		Complete vaccinations (n= 53)		Incomplete vaccinations (n= 63)		P-value
		No.	%	No.	%	
Mode of delivery:	Vaginal delivery	18	34.0%	23	36.5%	0.775
	Cesarean section	35	66.0%	40	63.5%	
Neonatal complications after delivery:	Yes	12	22.6%	11	17.5%	0.486
	No	41	77.4%	52	82.5%	
Neonatal problems:	Yes	27	50.9%	17	27.0%	0.008*
	No	26	49.1%	46	73.0%	
Number of brothers:	None	24	45.3%	24	38.1%	
	One	19	35.8%	18	28.6%	0.213
	Two or more	10	18.9%	21	33.3%	
Number of sisters:	None	27	50.9%	27	42.9%	
	One	19	35.8%	31	49.2%	0.306
	Two or more	7	13.2%	5	7.9%	
The order of the child among the living siblings:	First	16	30.2%	11	17.5%	0.239
	Second	8	15.1%	9	14.3%	
	Last	29	54.7%	43	68.3%	

There is a significant difference between the groups with regard to history of neonatal problems.

Table (5): Relationship between vaccination status and COVID-19 infection of the studied children

COVID-19	Complete vaccinations (n= 53)		Incomplete accinations (n= 63)		P-value
	No.	%	No.	%	
Did the child have COVID-19?					
Yes	4	7.5%	1	1.6%	0.177
No	49	92.5%	62	98.4%	

There is no statistically significant difference between the vaccination status of the studied children and their infection with COVID-19.

Discussion

Out of 116 children included in this study, 4.3% had COVID-19 infection, presented with mild symptoms such as cough, runny nose, fatigue, fever, and sore throat, and only one child was admitted to the hospital. These findings agreed with other studies **[9]** and **[10]**. In this study, the pandemic of COVID-19 delayed immunization for 3.4% of the studied children, primarily because they were infected with the COVID-19 virus. This high vaccination compliance can be explained by the immunization services offered at the Children's University Hospital at the tertiary level, including no waiting time, suitability of the timing of immunization sessions, and experience of service providers. Compared to this finding, Alsuhaibani and Alaqeel found that 73.2% of the parents of children below two years of age had appointments scheduled for their child's vaccination during the pandemic in the Qassim region of Saudi Arabia. In addition, 23.4% of the parents reported a delay of more than one month in their child's immunization. The most common reason for the delay was the fear of being infected by COVID-19**[11]**.

In Pakistan, Chandir et al. documented a reduction in immunization of 52% during the lockdown period **[12]**. Malini et al. reported that there was a decline in routine childhood vaccine delivery following the start of the COVID-19 pandemic **[13]**.

On the other hand, before the COVID-19 pandemic, the United States of America maintained high coverage for most recommended vaccines for children **[14]**.

This study revealed that nearly 38% of the children's caregivers agree to vaccinate their child during the COVID-19 pandemic. This finding is consistent with the previous study in Saudi Arabia, as most parents had a positive attitude toward the importance of children's vaccinations on time **[11].**

Due to the fear of COVID-19 infection, 25% of the families preferred to get their child the routine vaccination at home. This can be explained by the fact that the social distancing strategies were effectively implemented in April 2020. This agrees with a retrospective study conducted at King Saud University Medical City, Riyadh, Saudi Arabia, which found that all vaccination visits during April and May 2020 were reduced except for the birth vaccinations **[15]**.

Vaccination coverage is an important indicator of population health and the quality of health care provided by health services, in addition to revealing aspects of child health and health care services. Among the studied children, 45.7% completed their vaccination. Similar decreases in coverage were observed in other studies. A study assessing vaccine coverage among children aged 0-18 found marked increases in routine vaccine uptake between June and August of

2020 compared with the same period in 2019**[13]** and **[16]**.

In the current study, all studied children received the polio vaccine, and 97.4% had the BCG vaccine. It was found that 89.7%, 85.3% and 29.3% of the children had Hepatitis B, Triple, and MMR vaccines, respectively. Birth vaccinations (Oral poli and BCG vaccines) are obligatory to be administered within 72 hours of birth and before obtaining a birth certificate, and this explains the difference in decline between the birth vaccines and the other vaccines administered at 2,4,6 months after birth. Decreased vaccination coverage may leave young children vulnerable to diseases such as measles. The results of the present study are consistent with reports of reduced vaccination coverage in other countries, including Saudi Arabia **[15]**, the United States **[17]** and [**18]**, Britain **[19],** and Pakistan **[12]**.

In agreement with the current study, **Muhammad et al.** showed a significant association between vaccination status, parental educational level, and household income. However, in contrast to our results, they also revealed a significant association between vaccination status, gender, and residence **[20].** Also, **Pandey et al.** revealed that there was a significant association between immunization status and the educational level of parents. Still, there was no significant association between immunization status and gender **[21].** Also, in concordance with the present study, **Singh & Lal** showed a significant association between immunization status and the educational level of parents and family income [**22].** However, **Faisal et al.** revealed significant associations between vaccination status, mother's education, wealth status, and child gender ($p < 0.05$). While immunization status is not associated with their residential area ($p = 0.248$) **[23].**

Conclusion:

Our results showed no significant relation between COVID-19 infection and incomplete vaccination; however, neonatal problems were associated with a higher vaccination rate. This can be explained by the fact that neonatal problems require higher medical care and follow-up, resulting in higher vaccination compliance, and COVID-19 had minimal effect on vaccination compliance in children.

Recommendations:

- Obligatory childhood vaccination programs must be kept up since they are crucial to the child's health and must be prioritized and maintained even during pandemics.
- During the epidemic, the concerned authorities should increase their efforts to educate parents about the importance of vaccinating children and not to delay or neglect them to avoid diseases such as measles and others.

References:

1. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 - March 11, 2020. Geneva: World Health Organization; 2020.
2. Zhu N, Zhang D, Wang W, et al. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020;382(8):727-33.
3. Emanuel EJ, Persad G, Upshur R, et al. Fair allocation of scarce medical resources in the time of Covid-19. N Engl J Med. 2020;382(21):2049-55.
4. Ministero della Salute. Piano nazionale prevenzione vaccinale 2017-2019. Rome: Ministero della Salute; 2017.
5. World Health Organization. Guiding principles for immunization activities during the COVID-19 pandemic: interim guidance, March 26, 2020. Geneva: World Health Organization; 2020.
6. Santoli JM, Lindley MC, DeSilva MB, et al. Effects of the COVID-19 pandemic on routine pediatric vaccine ordering and administration - United States, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(19):591-3.

7. Hoffman J. Vaccine rates drop dangerously as parents avoid doctor's visits. The New York Times. 2020 Apr 23.
8. El-Gilany AH, El-Wehady A, El-Wasify M. Updating and validation of the socio-economic status scale for health research in Egypt. East Mediterr Health J. 2012;18(9):962-8.
9. AlSohime F, Temsah MH, Al-Eyadhy A, et al. COVID-19 infection prevalence in pediatric population: Etiology, clinical presentation, and outcome. J Infect Public Health. 2020;13(12):1791-6.
10. Jackson WM, Price JC, Eisler L, et al. COVID-19 in pediatric patients: a systematic review. J Neurosurg Anesthesiol. 2022;34(1):141-7.
11. Alsuhaibani M, Alaqeel A. Impact of the COVID-19 pandemic on routine childhood immunization in Saudi Arabia. Vaccines (Basel). 2020;8(4):581.
12. Chandir S, Siddiqi DA, Setayesh H, et al. Impact of COVID-19 lockdown on routine immunisation in Karachi, Pakistan. Lancet Glob Health. 2020;8(9):e1118-20.
13. DeSilva MB, Haapala J, Vazquez-Benitez G, et al. Association of the COVID-19 pandemic with routine childhood vaccination rates and proportion up to date with vaccinations across 8 US health systems in the Vaccine Safety Datalink. JAMA Pediatr. 2022;176(1):68-77.
14. Hill HA, Yankey D, Elam-Evans LD, et al. Vaccination coverage by age 24 months among children born in 2016 and 2017 - National Immunization Survey-Child, United States, 2017-2019. MMWR Morb Mortal Wkly Rep. 2020;69(42):1505-11.
15. Alrabiaah AA, Alshaer AH, Estrella S, et al. Effects of the Coronavirus disease 2019 pandemic on routine pediatric immunization coverage rates at the main University Hospital in Saudi Arabia. Saudi Med J. 2020;41(11):1197-203.
16. Ackerson BK, Sy LS, Glenn SC, et al. Pediatric vaccination during the COVID-19 pandemic. Pediatrics. 2021;148(1): e2020047092.
17. McMorrow S, Gates JA. Urgent action needed to address children's unmet health care needs during the pandemic. Washington, DC: Urban Institute; 2020.
18. Bramer CA, Kimmins LM, Swanson R, et al. Decline in child vaccination coverage during the COVID-19 pandemic - Michigan Care Improvement Registry, May 2016-May 2020. Am J Transplant. 2020;20(7):1930-1.
19. McDonald HI, Tessier E, White JM, et al. Early impact of the coronavirus disease (COVID-19) pandemic and physical distancing measures on routine childhood vaccinations in England, January to April 2020. Euro Surveill. 2020;25(19):2000848.
20. Muhammad A, Siddiqui AA, Khan NA, et al. Relationship between child immunisation and household socio-demographic characteristic in Pakistan. J Appl Stat. 2014;4(7):82-9.
21. Pandey S, Karki S. Socio-demographic determinants of childhood immunization coverage in rural population of Bhojpur district of Bihar, India. J Family Med Prim Care. 2019;8(7):2484-9.
22. Singh G, Lal M. Socio-demographic determinants of Primary Immunization: A longitudinal study in a rural area of Amritsar, Punjab. Indian J Community Med. 2015;40(4):227-31.
23. Faisal S, Khan A, Khan A, et al. Modeling the Factors Associated with Incomplete Immunization among Children. Math Probl Eng. 2022; 2022:8636580.