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Original Article

Paediatrics Section

# Impact of COVID-19 Pandemic on Routine Children Immunisation: Experience from a Tertiary Care Centre, in New Delhi, India

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## ABSTRACT

**Introduction:** Coronavirus Disease-2019 (COVID-19) pandemic was a global emergency in 2019 with multiphasic national lockdowns in most countries. Poor accessibility to travel and disease scare led to major fall in routine children vaccination.

**Aim:** To study the impact of COVID-19 pandemic on routine children immunisation at a tertiary care centre in New Delhi, India.

**Materials and Methods:** This retrospective cross-sectional study was carried out in May and June 2022, by collecting retrospective data from Immunisation Clinic of Paediatric Department of Dr. Ram Manohar Lohia hospital, a tertiary care public hospital in New Delhi from January 2018 to December 2021. The data of routine immunisation was further analysed to know the impact of the COVID-19 pandemic in children from birth to 5 years of age in 2019 i.e., before the lockdown versus the first and second major waves of COVID-19 in 2020 and 2021, respectively. The data was entered in an Ms Excel chart and statistical testing was conducted with Statistical Package for the Social Sciences (SPSS) version 27.0. Unpaired t-test of equal variance was used for data analysis and p-value <0.05 was considered as statistically significant.

**Results:** There was a sharp fall in children receiving routine immunisation during COVID-19 pandemic in 2020 (30.5%) and 2021 (24.9%) as compared to pre COVID-19 period (2019). The overall vaccination coverage was significantly lower (p-value <0.001) in postlockdown-1 phase (July/Aug 2020; n=521) and postlockdown-2 phase (July/Aug 2021; n=735) in comparison to pre COVID-19 period (July/Aug 2019; n=899). Significant fall in vaccination (p<0.05) was seen in postlockdown phase 1 for birth dose vaccines, primary doses of combination vaccines, Measles-Rubella (MR-1) vaccine 1st dose, MR-2 and booster doses of Diphtheria, Pertussis, Tetanus (DPT) and for primary doses of combination vaccines, MR-1 vaccine 1st dose, MR-2 for postlockdown phase 2 (p-value <0.05).

**Conclusion:** Routine immunisation for all vaccines had a major setback during unlockdown period in 2020 and 2021. There is an urge for national drive for routine Vaccine Preventable Diseases (VPD) to prevent their re-surgence.


**Keywords:** Children, Coronavirus disease-2019, Lockdown, Severe acute respiratory syndrome-coronavirus-2, Vaccination

## INTRODUCTION

COVID-19 pandemic has left a huge impact at individual, national and global level especially in health sectors. Immunisation in children is an important intervention in healthcare to control Vaccine Preventable Diseases (VPDs) and decrease neonatal, infant and under 5 year mortality. Experience across the globe has shown a huge decline in routine childhood immunisation during COVID-19 pandemic. The worldwide data from World Health Organisation [1] and United Nations Children's Emergency Fund (UNICEF) [2], it was concluded that a total of 23 million children were missing basic childhood vaccines in 2020 of whom approximately 17 million children did not receive even a single vaccine. Of these 23 million children, more than 60 percent were from 10 countries (India, Nigeria, Democratic Republic of the Congo, Pakistan, Indonesia, Ethiopia, Brazil, Philippines, Angola and Mexico. Similar data has been received from other countries in world like Canada [3], Japan [4], Singapore [5], Netherlands [6], United Kingdom (UK) [7], United States [8].

Various reasons for setback of childhood immunisation may be reluctance of people to leave homes, non availability of transport services, economic hardships, movement restrictions, fear of contact with COVID-19 positive cases, lack of protective equipment's, insufficient availability of information of these regular services and re-deployment of health workers for COVID-19 related services [9,10]. A recent report from Nepal on factors causing fall in immunisation services concluded that disruptions faced by service providers and parental delay are the most important factors. Despite high determination by service providers, migration of population from urban to rural areas, lack of adequate guidance and non availability of personal protective equipment' are mostly implicated [11].

There was only one report from India to the best of our knowledge documenting fall in routine immunisation data besides World Health Organisation (WHO) and UNICEF reports [12]. Hence, the aim of the study is to evaluate the impact of COVID-19 pandemic on routine childhood immunisation in a tertiary care centre in Delhi. The primary objective was to compare the routine childhood immunisation administered in children from birth to 5 years of age before COVID-19 and after first and second major waves of COVID-19 during various phases of unlockdown.

## MATERIALS AND METHODS

This retrospective cross-sectional study was carried out in May and June 2022 at Dr. Ram Manohar Lohia Hospital, a tertiary care hospital in North India catering to COVID-19 as well as non COVID-19 patients during the current pandemic after obtaining approval from Institutional Ethics Committee (Approval No. IEC 795).

### Procedure

Records of all children attending immunisation clinic of Paediatric Outpatient Department (OPD) upto 5 years of age from January 2018

to December 2021 were analysed. Data was collected from hospital records on vaccines administered at different time cohorts as per national immunisation programme.

The data was further analysed for the population in 3 phases across the same time period and for an equal duration of 2 months each:

- Pre COVID-19 phase: 1st July-31st Aug 2019
- Postlockdown-1 phase: 1st July-31st Aug 2020
- Postlockdown-2 phase: 1st July-31st Aug 2021

The hospital follows National immunisation schedule [13] which targets 11 VPDs beginning at birth and subsequently at 6, 10 and 14 weeks, 9 months, 16-24 months and 5 years. The vaccines administered are against tuberculosis, hepatitis B, diphtheria, tetanus, pertussis, polio, haemophilus influenza Type B, rotavirus, pneumococcus, measles, and rubella. Children receiving these vaccines were divided into 7 groups as described below.

**Group 1:** Children receiving birth dose vaccine include Bacille Calmette-Guerin (BCG), Hepatitis B and Oral Polio Vaccine (OPV) dose.

**Group 2/3/4:** Children receiving primary doses of combination vaccine at 6 weeks, 10 weeks and 14 weeks include pentavalent, OPV, Injectable Polio Vaccine (IPV) Pneumococcal Conjugate Vaccine (PCV) and rotavirus vaccine were considered as 3 separate groups.

**Group 5:** Children receiving MR-1 vaccine 1st dose and vitamin A at 9-12 months of age.

**Group 6:** Children receiving MR-2 with DPT 1 booster and vitamin A at 16-24 months of age.

**Group 7:** Children receiving DPT booster 2 and vitamin A at 5-6 years of age.

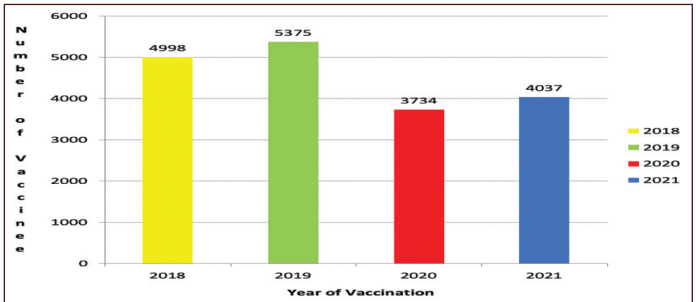
Comparisons were made between July, August 2019 and July, August 2020 data corresponding with pre COVID-19 phase and postlockdown-1 phase and July, August 2021 matching with postlockdown-2 phase. Data from 2018 was collected to see the trends in pre COVID-19 years so as to avoid any bias. For final comparisons, 2019 data was taken as reference for pre COVID-19.

## STATISTICAL ANALYSIS

The data was entered in an Ms Excel chart and statistical testing was conducted with the International Business Management (IBM) SPSS version 27.0. Continuous variables were presented as Mean±SD. Categorical variables were expressed as frequencies and percentages. Unpaired t-test of equal variance was used to see trends in total number of children receiving vaccines and trends in individual vaccines. For all statistical tests, p-value <0.05 was taken as statistically significant.

## RESULTS

The results of the study showed that in pre COVID-19 period total 4998 (2018) and 5375 (2019) children upto 5 years of age received immunisation. After the start of the COVID-19 pandemic, the immunisation declined markedly in 2020 (n=3734) and 2021 (n=4037) [Table/Fig-1].



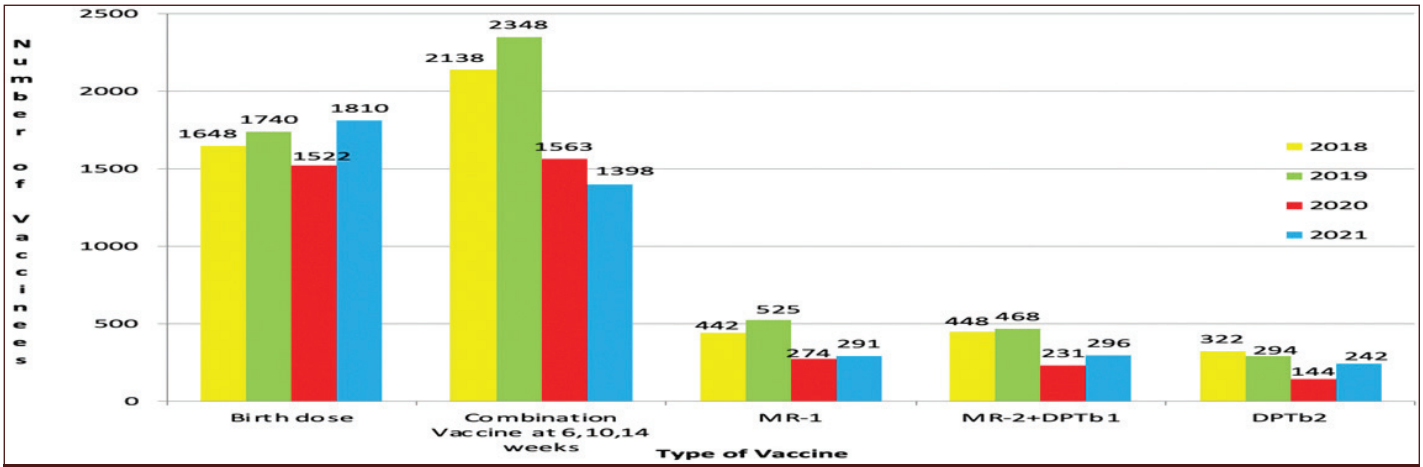

**[Table/Fig-1]:** Total immunisation during pre COVID-19 years (2018, 2019) and COVID-19 pandemic (2020, 2021).

During COVID-19 pandemic, a reduction of one-third (30.5%) in 2020 and one-fourth (24.9%) in 2021 was observed in comparison to pre COVID-19 pandemic year 2019. [Table/Fig-2] shows the comparison of vaccinations administered in 2020 and 2021 in comparison to pre pandemic times in 2018 and 2019.

There was significant percentage reduction in birth immunisation (12.5%), combination vaccines at 6 weeks (25.4%), 10 weeks (35.6%), and 14 weeks (42.3%), MR 1st dose vaccine at 9 months (47.8%), MR 2nd dose and booster doses of DPT at 16-24 months (50.6%) and secondary DPT booster at 5-6 years (51%) in 2020 as compared to 2019 (pre COVID-19 period).

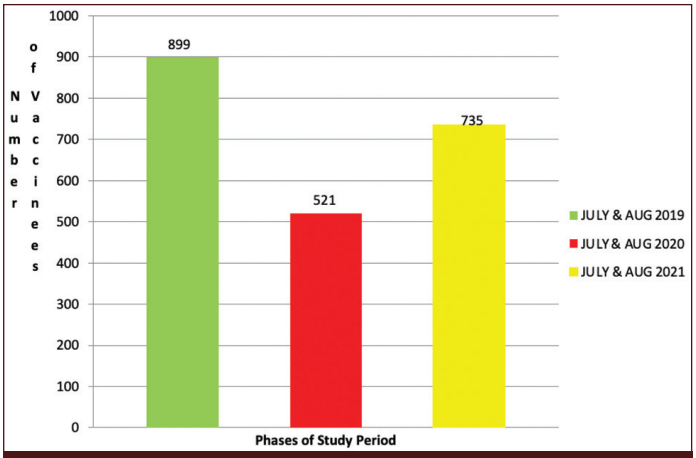
In 2021 birth immunisation caught up well (n=1810, 0.4% increase) to pre COVID-19 targets (n=1740) in 2019. In 2020, there was massive decline in children immunised with combination vaccines at 6 weeks (37.2%), 10 weeks (31.4%), and 14 weeks (50.6%), MR 1st dose vaccine at 9 months (44.5%), MR 2nd dose and booster doses of DPT at 16-24 months (36.8%) and secondary DPT booster at 5-6 years (17.7%) as compared to 2019 (pre COVID-19).

In the present study, the absolute number of children receiving routine immunisation was lower in postlockdown-1 phase (July/Aug 2020) and in postlockdown-2 phase (July/Aug 2021) as compared to the pre COVID-19 period (July/Aug 2019); which was




**[Table/Fig-2]:** Immunisation at different time cohorts in pre COVID-19 (2018, 2019) and COVID-19 (2020, 2021).

statistically significant (p-value <0.001). Although more children were immunised during postlockdown-2 phase (n=735) as compared to postlockdown-1 (n=521) the numbers were far below the pre COVID-19 targets (n=899) [Table/Fig-3].




**[Table/Fig-3]:** Total number of vaccines during the three phases of study period.

[Table/Fig-4,5] shows the trends in number of vaccines for each vaccine groups in 2020 (postlockdown-1) and 2021 (postlockdown-2) in comparison to pre pandemic times 2019. Birth dose immunisation declined by 30.2% during postlockdown-1 phase in 2020 with slight increase of 10.2% during postlockdown-2 phase in 2021 (n=365, p-value=0.882). Primary doses of combination vaccines showed significant decline during postlockdown-1 phase in 2020 (6 weeks: 36.6%, 10 weeks: 67.1%, 14 weeks: 41.3%) with persistent lag during postlockdown-2 phase in 2021 (6 weeks: 37.9%; 10 weeks: 26.6% and 14 weeks: 48.1%), which was statistically significant [Table/Fig-4,5]. MR 1st dose immunisation declined by half (50.1%) during postlockdown-1 phase as compared to pre COVID-19 phase (p-value <0.001). Similar trends were also observed during postlockdown-2 phase, with one-third reduction (36.3%) in MR-1 beneficiaries as compared to pre COVID-19 phase which was statistically significant (p-value=0.0072). The study also showed a significant reduction in administration of MR-2 and booster doses of DPT at 16-24 months, which declined by almost half (51.3%, p-value=0.0026) in 2020 and one third (p-value=0.012) in 2021. Secondary doses of DPT booster vaccine at 5-6 years showed almost 2/3rd decline (64.8%, p-value=0.0022) during postlockdown-1 phase in 2020 but caught up during postlockdown-2 phase in 2021, with slight reduction of 0.9% (p-value=0.6796).

| | 2019 (July+August) | 2020 (July+August) | % change -ve | p-value# |
|---|---|---|---|---|
| Birth dose* | 331 | 231 | 30.2 | **0.0057** |
| Combination vaccine** 6 weeks | 153 | 97 | 36.6 | **0.0005** |
| Combination vaccine** 10 weeks | 79 | 26 | 67.1 | **0.0001** |
| Combination vaccine** 14 weeks | 104 | 61 | 41.3 | **0.0019** |
| MR-1 | 102 | 50 | 50.1 | **<0.001**** |
| DPTb1+MR-2 | 76 | 37 | 51.3 | **0.0026** |
| DPTb2 | 54 | 19 | 64.8 | **0.0022** |
| Total | 899 | 521 | 42.1 | **<0.001**** |

**[Table/Fig-4]:** Comparison of number of vaccines between July and August 2019 as compared to the same period in 2020.
*Birth dose includes Bacillus Calmette Guerin (BCG), Oral Polio Vaccine (OPV) and Hepatitis B; **Combination Vaccine includes Pentavalent, Injectable Polio Vaccine (IPV), OPV, Rota Virus vaccines; #p-value determined by unpaired t test of equal variance p-value <0.05 considered significant

| | 2019 (July+August) | 2021 (July+August) | % change | p-value# |
|---|---|---|---|---|
| Birth dose# | 331 | 365 | +10.2 | 0.882 |
| Combination vaccine** 6 weeks | 153 | 95 | -37.9 | **0.002*** |
| Combination vaccine** 10 weeks | 79 | 58 | -26.6 | **0.049** |
| Combination vaccine** 14 weeks | 104 | 54 | -48.1 | **<0.001**** |
| MR-1 | 102 | 65 | -36.3 | **0.007*** |
| DPTb1+MR-2 | 76 | 49 | -35.5 | **0.012** |
| DPTb2 | 54 | 49 | -0.92 | 0.679 |
| Total | 899 | 735 | 18.3 | **<0.001**** |

**[Table/Fig-5]:** Comparison of number of vaccines between July and August 2019 as compared to the same period in 2021.
#Birth dose includes BCG, OPV and Hepatitis B; **Combination Vaccine includes Pentavalent, IPV, OPV, Rota Virus vaccines; #p-value determined by unpaired t-test of equal variance; p-value <0.05 considered significant

## DISCUSSION

COVID-19 pandemic has shaken the world in all dimensions of economy and health. Globally at all national levels, the immunisation drives suffered. As per WHO/UNICEF report, India is among one of the top affected countries where routine vaccination programme had a setback [2]. The present study shows that during unlockdown period there was significant reduction in number of children vaccinated during postpostlockdown-1 as well as postlockdown-2 phase as compared to the same time of the year during pre COVID-19 phase (p-value <0.001). Results were comparable with available Indian studies [12,14,15]. Singh AK et al., concluded the fall in immunisation from March to June in 2020 in comparison to same time period in 2019 from all community and block-level primary health centre's in a district in Uttar Pradesh [12].

In the present study, there was a significant decline (30.2%, p-value=0.0057) in birth immunisation during the postlockdown-1 phase (July/August 2020) as compared to the pre-pandemic phase (July/August 2019); whereas during the postlockdown-2 phase (July/August 2021) there was slight increase by 10.2% which was insignificant (p-value=0.882) which may be explained as this hospital caters to both COVID-19 and non COVID-19 patients, hence the number of deliveries conducted were not affected much. Also, many private and government facilities were catering to only COVID-19 patients during this time period hence many pregnant women were referred to this centre during this period.

There was also a massive decline in children administered primary doses of combination vaccine at 6 weeks, 10 weeks and 14 weeks during the postlockdown-1 phase as well as postlockdown-2 phase which was statistically significant. This was in coherence to the findings in a study conducted by Singh AK et al., in Uttar Pradesh [12] in which percentage reduction was reported for BCG (12.24%), combination vaccine including OPV, pentavalent, and rotavirus vaccines at 6 weeks, 10 weeks, and 14 weeks (24.57%), MR 1st dose vaccine (27.96%), MR 2nd dose (31.56%), Tetanus and Diphtheria (20.76%) and for Japanese Encephalitis (JE) 1st dose (28.28%) and JE 2nd dose (30.69%) also.

Another study by Rukmini S, from India showed a similar decline in vaccination [14]. Alarming decline in number of children vaccinated with MR-1 at 9 months, MR-2 and booster doses of DPT at 16-24 months during postlockdown-1 phase and postlockdown-2 phase as compared to pre COVID-19 phase was similar to study by Patel P et al., in Gujarat where reduction of MR vaccination count by 78.57% in the month of May 2020 compared to 2019 [15].

Internationally, also most countries reported a fall in childhood immunisation. Data from Michigan, United States (US) showed nation coverage declined in all milestone age cohorts (1,3,5,7,16,19, 24 months) in May 2020 in comparison to 2019, except for birth-dose (hepatitis B) [16]). The decline at different time points (5 months: 67.9% to 49.7%; 16-month: 76.1% to 70.9%; non influenza vaccine in ≤18 years: decreased 21.5%; and decline in children aged ≤24 months: 15.5%). Another report from California, US concluded significant decline in vaccination coverage among most milestone age cohorts in <2 years and older children during the pandemic and reopening period in 2020 compared to previous year (2019) [17].

Recent report estimating decline in routine childhood vaccination in 2020 and showed similar numbers as by WHO/UNICEF report [18,19]. It estimated huge number of children missing doses of DPT3 (30.0 million, 27.6-33.1) and Measles conjugate vaccine 1st dose (27.2 million, 23.4-32.5) in 2020 (January to December). Worldwide, most affected month was April 2020 (4.6 million children missing doses of DPT3 and 4.4 million children missing doses of Measles conjugate vaccine 1st dose). Most severe annual decline were seen in North Africa, Middle East, South Asia, and Latin America and the Caribbean; and least in Sub-Saharan Africa. In South-East Asia, East Asia, and Oceania for both DPT3 and Meningococcal Vaccine (MCV)1, the data concluded same or higher monthly doses delivered during the second half of 2020.

Data from UNICEF in South East Asia concluded fall in childrens' vaccination rates by 6 percent (2019 to 2020) with 5.3 million children missing vaccines through routine health services (2020) which was highest since 2014. Between 2019 and 2020, the children in South Asia region showed a high reduction in three doses of the DPT3 vaccine (90% to 84%) [20]. Country-wise distribution in South Asia region showed high drop rates for DPT3 in Nepal (reduced by 9%); Pakistan (7%); India (6%); Sri Lanka (3%), Bhutan (2%) and Afghanistan (2%). Hence, worldwide 10 countries contributed for 62 percent of all under or unvaccinated children.

Data from India (2020) showed that during COVID-19 pandemic, there were highest number of unprotected children (3.5 million, total increase of 1.4 million) closely followed by Pakistan (1.3 million unprotected children, increase of 0.4 million). In South Asia of 4.4 million children who did not receive any routine vaccination; 3 million lived in India. Among the individual vaccines, Measles and outbreaks of diseases like diphtheria and yellow fever outbreaks which may spread quickly are a concern. Data show that in South Asia, coverage for measles (1st dose vaccine) reduced from 92 percent in 2019 to 88 percent in 2020. which is below the WHO recommendations for protection (95%). Hence, COVID-19 reversed the progress achieved over decades of efforts in childhood vaccinations in South Asia [20].

Similar reports conclude poor utilisation of vaccination services at the national level (13% decline in Llebanon) and in private sector (46.9% decline) mostly between February and April 2020 [21]. The highest decrease decline rates were observed for OPV vaccine and hepatitis A, followed by measles and Pneumococcal Conjugate Vaccines (PCVs). The number of vaccine doses administered in the public sector decreased by 20% (most for OPV and measles vaccines) mostly during October 2019 and March 2020.

Recent Indian Academy of Paediatrics (IAP) recommendations in 2020 and 2021 advocates for routine immunisation of SARS-CoV-2 suspect and positive children, and for the logistics to be followed for immunisation services [22,23]. The major changes that have been recommended considering the gaps created due to the pandemic include a booster dose of IPV at 4-6 years for children who have already received the initial IPV doses as per the Advisory Committee on Vaccines and Immunisation Practices (ACVIP)/IAP schedule, re-emphasising the importance of IPV in the primary immunisation schedule, preferred timing of second dose of varicella vaccine at 3-6 months after the administration of first dose and uniform dosing recommendation of 0.5 mL (15 µg Hemagglutinin (HA) for inactivated influenza vaccines [22,23].

### Limitation(s)

The present study was conducted at a tertiary level referral centre for both COVID-19 as well as non COVID-19 patients, so parents might have been afraid of catching COVID-19 infection and so could have diverted to some other periphery centres for vaccination.

## CONCLUSION(S)

There was marked decline in routine immunisation services after the start of COVID-19 pandemic in 2020 and 2021 as compared to pre COVID-19 period in 2019. Also, even when lockdown was removed, there was a significant decline in routine immunisation coverage in postlockdown-1 (July/Aug 2020) as well as after postlockdown-2 phase (July/Aug 2021) as compared to the same time of the year during pre COVID-19 phase (July/Aug 2019). It is a well-known fact that COVID-19 severely disrupted immunisation during lockdown period. Present study concludes that there was significant negative impact of COVID-19 pandemic on routine immunisation services even during unlockdown period raising significant concerns for public health. The need of the hour is that nationwide and routine immunisation should be strengthened and catch-up vaccination services to prevent outbreaks of vaccine preventable diseases, particularly polio and measles, is urgently required to prevent a global resurgence of these deadly diseases.

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