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Impact of COVID-19 pandemic on routine immunization services in a tertiary care hospital of Rajasthan, India

Purpose: Globally, 25 million children were either unvaccinated or under-vaccinated in year 2021. Among them, India had the highest number of children unvaccinated. Studies have shown impact of coronavirus disease 2019 (COVID-19) pandemic on routine health-care services. Present study aimed to estimate the impact of COVID-19 on utilization of routine immunization services during years 2020 and 2021 in tertiary-care facility.

Materials and Methods: Record based descriptive analytic study was conducted at pediatric tertiary-care hospital, Jaipur. Data of children vaccinated as per the National Immunization Schedule for the period January 2019 to December 2021 were retrieved from the immunization records. Doses administered were assessed as a proxy measure of vaccine coverage. The vaccination trends of 2020 and 2021 were compared assuming base year 2019. Unpaired t-test of significance and Pearson correlation was used for correlation analysis.

Results: There was significant drop in the vaccine counts after emergence of COVID-19 pandemic. In year 2020 and 2021, mean monthly vaccine count was $2,190 \pm 715.1$ and $2,305 \pm 393.2$, respectively, in which maximum drop was in April 2020 (-79.12%) and May 2021 (-57.16%) when it was compared with matched month of base year. There was negative correlation between percent change in vaccine count and COVID-19 cases in 2020 ($r = -0.057$, $p = 0.861$) and 2021 ($r = -0.827$, $p = 0.001$) as compared to year 2019.

Conclusion: Study concludes that there was a significant gap in utilization of routine immunization services during the COVID-19 pandemic. This necessitates planning and management of routine immunization services in-case of future pandemics to avoid resurgence of vaccine-preventable diseases in the Rajasthan.

Keywords: COVID-19, Immunization, Vaccination

Introduction

Coronavirus disease 2019 (COVID-19) pandemic represents the most challenging public health crisis since the global influenza pandemic of 1918–1919. It has created a mayhem in all sectors of life. The pandemic had been unparalleled in its magnitude and impact and dictated measures such as regional or country-wide lockdowns, travel restrictions, and social distancing [1]. Many policy decisions in response to COVID-19 pandemic were made which led to disruption of many services including routine immunization. According to a pulse survey conducted in 105 countries by World Health Organization (WHO), 90% countries reported disruptions to essential health services amongst which routine immunization services were most frequently disrupted [2]. A

survey done in 19 countries reported 95% (18/19 countries) vaccine delivery disruption experienced by both private and public sectors [3]. Globally, 25 million children were either unvaccinated or under-vaccinated by year 2020, which marks the largest sustained decline in childhood vaccinations in last 30 years [4]. WHO South-East Asian Region was the most affected with a drop of 9% in the coverage of essential immunization service in first 2 years of the pandemic [4]. The low- and middle-income countries especially in the Africa and South-East Asia were the most affected amongst which India reported the highest number of children (2.7 million) completely unvaccinated [4].

Disruption of routine immunization services can have serious health impacts especially when it has been proven that it is one of the most cost-effective methods to reduce the burden of vaccine preventable diseases [5-7]. Evidence from previous epidemics reveal that even temporary interruptions of routine immunization services can result in outbreaks of measles, rotavirus, and tetanus, thereby causing a secondary public health crisis [8]. Approximately twice the children died of measles rather than Ebola during the Ebola outbreak [5,8].

As per the National Family Health Survey (NFHS-5), full immunization drive among children aged 12–23 months has recorded substantial improvement from 62% to 76% at all-India level [9]. In Rajasthan, the fully immunized child aged 12–23 months has recorded improvement from 54.8% (NFHS-4) [10] to 80.4% (NFHS-5) [9]. Those receiving vaccinations in a public health facility increased from 94.4% (NFHS-4) [10] to 98% (NFHS-5) [9]. However, this data is only till April 2021 and does not explore the complete impact of the COVID-19 pandemic. Majority of studies, nationally [11-13] as well as internationally [14-16] report the impact of the pandemic in the year 2020 or only till the start of the second wave of the pandemic without covering the entire year 2021 [17].

With the aim to cover this gap in evidence, the present study was conducted to determine the impact of COVID-19 pandemic on routine immunization services during the years 2020 and 2021 at a busy tertiary-care pediatric hospital in Jaipur, Rajasthan, India.

Materials and Methods

This record-based observational study was conducted at an immunization center of a tertiary-care pediatric hospital attached to a government medical college in Jaipur, Rajasthan. For total vaccine counts, the records of all vaccinated children

as per the Universal Immunization Program between 0 and 16 years of age were included. The data were retrieved from the records of Immunization Centre for a period of 3 years from January 1, 2019 to December 31, 2021. This was done to compare the vaccine counts in pandemic period (years 2020 and 2021) with matched months of the pre-pandemic year-2019. Data were collected manually while going through the routine immunization data record and entered meticulously into MS Excel (Microsoft Corp., Redmond, WA, USA). Vaccination coverage is the ideal method used to assess vaccine usage; however, the assessment of total doses administered represents an immediately available proxy method.

Data for number of COVID-19 cases from the period (March 2020 till December 2021) were collected from the Center for Systems Science and Engineering at Johns Hopkins University COVID-19 Data and website of Government of Rajasthan (<http://rajswasthya.nic.in/Index.htm>). Since cumulative data on number of COVID cases were available for Rajasthan as entirety, the average positivity rate for Jaipur was calculated and monthly COVID-19 cases were calculated for the same period. Preliminary adjustments for calendar variations were made to eliminate spurious differences in both the datasets.

Statistical analysis

Percentage change was used to compare the total vaccine counts in pandemic period (year 2020 & 2021) with pre-pandemic period (2019). Significance of difference of means was inferred by unpaired t-test. Linear correlation between two continuous variables was explored using Pearson's correlation. A p-value <0.05 was considered significant. IBM SPSS trial ver. 26.0 (IBM Corp., Armonk, NY, USA) was used for the data analysis.

Ethics statement

There were no ethical issues involved in the conduct of this study. Informed consent was not necessary because only anonymized routine record-based data were analyzed retrospectively.

Results

The timeline of COVID-19 in Rajasthan, India and subsequent actions taken by the Rajasthan Government to combat its spread during both first wave and second wave of the pandemic is depicted in Fig. 1.



Fig. 1. Timeline of coronavirus disease 2019 (COVID-19) and various protective measures taken by Rajasthan Government during years 2020 and 2021.

There was a significant drop in the vaccine counts after emergence of COVID-19 pandemic. In the years 2020 and 2021, mean monthly vaccine count was $2,190 \pm 715.1$ and $2,305 \pm 393.2$, respectively. On comparing with the mean monthly vaccine count of year 2019 ($2,975 \pm 314.3$), a significant decrease was observed in year 2020 ($p=0.002$) as well as in year 2021 ($p<0.001$) from year 2019 (Fig. 2).

For the year 2020, maximum drop in vaccine count was seen in April (-79.12%) followed by November (-43.72%) and March (-43.08%) (Fig. 3).

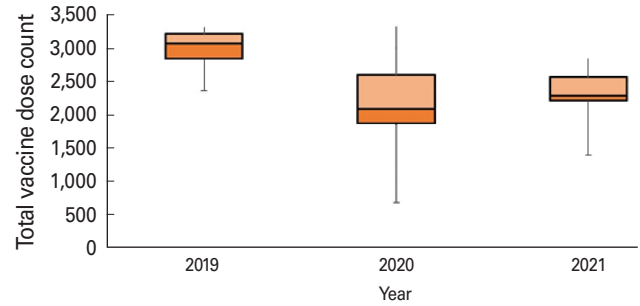


Fig. 2. Comparison of variation in distribution of vaccine counts in years 2019, 2020 & 2021 depicted by box and whisker plot.

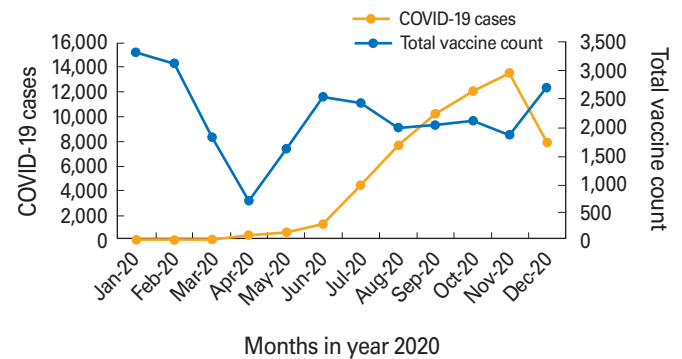


Fig. 3. Timeline of coronavirus disease 2019 (COVID-19) cases and total vaccine counts in the year 2020.

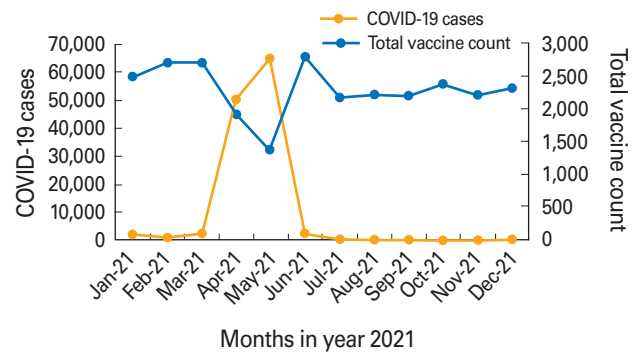


Fig. 4. Timeline of coronavirus disease 2019 (COVID-19) cases and total vaccine counts in the year 2021.

For the year 2021, maximum drop in vaccine count was seen in May (-57.16%) followed by April (-39.33%). The maximum number of COVID-19 cases were reported in May 2021 ($n=64,972$) (Fig. 4).

There was negative correlation between percent change in total vaccine counts and number of COVID-19 cases in year 2020 ($r=-0.057$, $p=0.861$, R^2 linear=0.003) (Fig. 5) as well as in year 2021 ($r=-0.827$, $p=0.001$, statistically significant, R^2 linear=0.684) (Fig. 6).

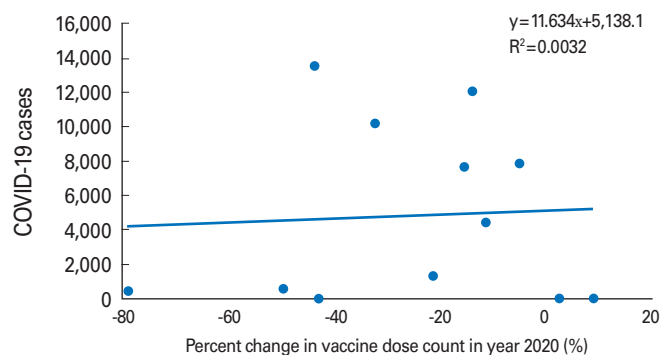


Fig. 5. Scatterplot depicting the correlation between percent change in total vaccine counts and number of coronavirus disease 2019 (COVID-19) cases in year 2020.

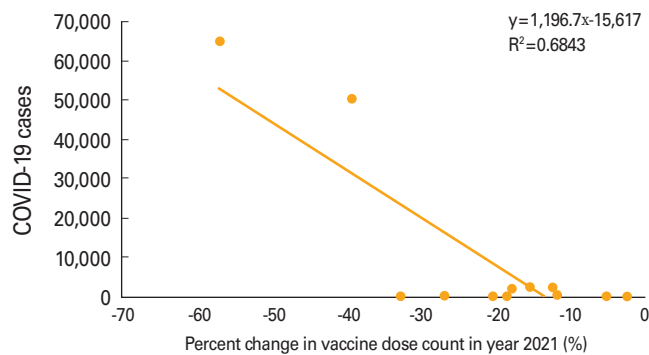


Fig. 6. Scatterplot depicting the correlation between percent change in total vaccine counts and number of coronavirus disease 2019 (COVID-19) cases in year 2021.

Discussion

The first case of COVID-19 pandemic in Jaipur (Rajasthan) was reported on 2nd March 2020. The first lockdown was imposed by the Rajasthan government from 22nd March 2020 till 14th April 2020, which was then extended in a phased manner till 30th June 2020. In the present study, a sharp fall in the total doses of vaccines administered was reported in April 2020 (-79.12%). Another study in Rajasthan by Jain et al. [11] reported a decline in the monthly full immunizations in April to -87% and estimated the levels in May and June to be +23% and -4%, respectively, after the government’s administrative Health Management Information System data was corrected for historical trends and seasonal fluctuations. This was slightly different than the present study where after steep declination in vaccination in April, a negative trend in vaccination levels were observed throughout the year. Chakrabarti et al. [17] studied the immunization trends in children up till the start of the second wave of COVID-19 in India and reported an extremely large declination in vaccination in April 2020 that subsequently increased but was still below the pre-pandemic levels. This was almost similar to the present study except for November 2020 where another fall in vaccine count (-43.72%) was observed which coincided with the increase in number of COVID-19 cases in Jaipur at that time. Kumar et al. [12] in Gwalior reported drop in fully immunized child coverage rate to approximately 70% from the average of 90%. Other studies in India by Khan et al. [13] in New Delhi and Patel et al. [18] in Ahmedabad also reported a fall in the month of April 2020. This is probably because of the nation-wide lockdown placed by the government. Garg et al. [19] in their study across India in year 2020 reported a significant disruption in

the outpatient services with maximum reduction in operation of clinics for immunization and non-communicable diseases ($p < 0.0001$).

At international level, Shet et al. [14] reported declination in vaccine doses administered in 170 countries in the first half of 2020 with the lowest in April. Abid et al. [15] in their study in Afghanistan reported 21.4% significant ($p < 0.01$) decline in the total immunization coverage during April-July 2020. A study in South Region of Ethiopia by Wale Tegegne et al. [20] reported 62.2% prevalence of incomplete immunization (95% confidence interval, 59.5 to 64.8). Even studies conducted in high-income countries have reported similar findings in disruption in routine vaccination services. Santoli et al. [21] in the United States, McDonald et al. [22] in England, and Silveira et al. [16] in Brazil reported reduction in routine vaccinations in children during 2020. Alsuhaibani and Alaqeel [23] in their study in Saudi Arabia reported 24% vaccination delay in children during the first 3 months of the pandemic. DeSilva et al. [24] studied the association of COVID-19 with routine childhood vaccination rates and proportion of those who were up to date with vaccinations across eight US health systems till September 2020 and reported the levels to be lower than 2019 levels.

The second lockdown period was from 17th April to 8th June 2021 in Rajasthan. Despite the launch of Intensified Mission “Indradhanush 3.0” [25] to focus on those that have missed their vaccination in the pandemic, the present study reported drop in vaccine count percentage throughout the year 2021, when compared to matched time period in 2019. The maximum drop was seen in May (-57.6%) along with maximum number of COVID-19 cases diagnosed ($n = 64,972$). This was probably because of the second wave of the pandemic was

more severe than the first. There are very few studies that have explored the impact of the second wave of the pandemic on routine immunization. Pawar et al. [26] in their cross-sectional study in Pune for the period January 2017 till December 2021 reported delayed vaccinations in both years 2020 and 2021 due to COVID-19 pandemic. Though the report of WHO assessed the impact of COVID-19 region-wise, there is a further need to assess the impact on routine immunization services during the year 2021 nationally as well as internationally by other researchers and add the evidence in order to give a more holistic view of the impact in their respective countries [4].

Strengths

The present study determines the impact of COVID-19 pandemic on routine immunization services not only limited to the first and second wave period but covers the entire year 2020 and 2021.

Recommendations

Short-term action include identifying children with missed doses and offering catch-up vaccinations. The long-term action includes preparation of the health system for such pandemics. Apart from management of medical emergencies, the health system should ensure that routine services like immunization are not disrupted.

Limitations

Firstly, the vaccine usage was assessed based on vaccine administration which is a proxy-indicator of vaccination coverage, rather than the latter itself. Secondly, comparison of vaccination counts in years 2020 and 2021 to year 2019 could also be affected by any changes in vaccine coverage in year 2019.

Conclusion

There has been a significant decrease in utilization of routine immunization services during the COVID-19 pandemic. The maximum effects were seen in the months of April 2020 and May 2021. Despite the fall in the diagnosed COVID cases in Jaipur during the second half of the year 2021, there was still a negative percent change in the total doses of vaccines administered. This implies that the pre-pandemic level recovery in routine vaccination services could not be reached even by December 2021. This necessitates planning and management of routine immunization services in-case of any future pandemics as well as to avoid resurgence of vaccine-preventable diseases in Rajasthan. Measures that can be taken in-

clude identifying children with missed doses and offering catch-up vaccinations. The sensitization and recruitment of the health workers from the grass root level to the tertiary level of healthcare is required to accomplish this. Also, raising awareness among the general public via media; information, education and communication; health talks; and campaigns is a necessary long-term action that should be a continuous process rather than a periodic one, especially till few years after the pandemic has subsided.

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