

The Impact of Covid-19 Pandemic on Child Routine Immunization Programs: A Systematic Review

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Abstract

Immunization is one of the most successful, most accepted and proven cost-effective public health preventive interventions in the world and has saved 2 to 3 million children from immunization-preventable diseases. The COVID-19 outbreak and the effort being made to overcome the outbreak could cause negative impacts on the utilization of basic immunization services. During the outbreak, basic immunization coverage rate in various regions had decreased. This article conducted a comprehensive and systematic literature search in electronic databases (PubMed, ScienceDirect, Sage Journal, SpringerLink, ClinicalKey, and Oxford Academic) with articles published in the last 5 years and adjusted according to inclusion and exclusion criteria. This systematic review use PRISMA (Preferred, Reporting Items for Systematic Review and Meta-analysis). There were 2 studies that met the final inclusion criteria. The results showed a significant reduction of basic immunization coverage happen especially during the early period of pandemic. Six themes are identified related to the decrease: 1) Covid-19 lockdown; (2) motivation for childhood immunization; (3) availability of biosafety procedures and personal protective equipment (PPE); (4) service adjustments and guidelines during the pandemic; (5) the availability of vaccines; and (6) the resilience of the immunization program in view of COVID-19. Childhood routine immunization coverage rate significantly decreased during the early period of the pandemic. Interventions for providers and parents is required to ensure adequate catch-up of delayed/missed immunizations in order to prevent potential outbreaks of vaccine-preventable diseases.

Keywords: Covid-19 Pandemic, Routine Immunization Program, Children

1. Introduction

Vaccine are one of the crucial components of disease control and prevention measures and are considered to be one of the most economical investments in health and economic growth. Immunization is one of the most successful, most accepted and proven cost-effective public health preventive interventions in the world and has saved 2 to 3 million children from immunization-preventable diseases. A person is resistant to an infectious disease through immunization, which is commonly accomplished through the administration of a vaccine. A vaccine is a non-pathogenic antigen that prompts the immune system to generate

an antibody to defend the recipient against a subsequent illness. It is the most economical public health measure that can prevent and treat infectious diseases that are life-threatening.^{1,2,3}

Each year, vaccines save millions of lives. For example, the measles vaccination has prevented 25.5 million lives since 2000, and polio vaccine has reduced polio cases worldwide by 99% since 1988 where 350,000 children were paralysed by the disease each year. It has been predicted that, between 2000 and 2030, vaccination will prevent 120 million deaths, 56 million of which will be in children less than five years of age.¹

On March 11th 2020, the World Health Organization (WHO) proclaimed COVID-19 as a global epidemic. Since the beginning of the COVID-19 pandemic, there have been 278 million cases of SARS-CoV-2, resulting in 5.4 million recorded deaths as of December 26th 2021. The world's health systems have collapsed as a result of the sudden COVID-19 pandemic outbreak. The pandemic has disrupted essential health services, including the child routine immunization program such as preventive vaccination campaigns, outbreak response, routine immunization, and vaccine-preventable disease (VPD) surveillance activities.^{4,5}

Approximately 125 mass immunization efforts had been postponed by June 2020 in more than 68 nations. An estimated 80 million children under the age of one will likely be impacted by this postponement. During the COVID-19 outbreak, immunization coverage rates in the United States have been shown to decrease. This is due to parents' concerns about the possibility of their children being exposed to the COVID-19 virus during visits to health services. While another study in Africa reported that there is a greater benefit to maintaining routine immunizations than the risk of dying from COVID-19 in immunization health services. Similar to the Ebola outbreak in west Africa, where resource reallocation decreased vaccination coverage and led to disease outbreaks, significant missed or delayed routine immunizations might cause secondary outbreaks of vaccine-preventable diseases and associated death.^{6,7}

The Center for Disease Control and Prevention (CDC) emphasizes the importance of immunizing children aged ≤ 24 months during the COVID-19 outbreak. The World Health Organization (WHO) warns that immunization service delay, even for a short period of time, will cause many vulnerable individuals and increase the likelihood of

vaccine-preventable diseases. This can lead to an increase in child mortality. This is a hidden problem that has the potential to be much more threatening to the health situation.^{7,8}

This systematic review will provide further evidence to assess the impact of Covid-19 pandemic on child routine immunization programs.

2. Methods

2.1 Protocol and Registration

This systematic review was made following the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 checklist guidelines.¹⁵

2.2 Eligibility Criteria

The study with the title "The Impact of Covid-19 Pandemic on Routine Immunization Programs" became the topic analyzed in the writing of this systematic review. Eligibility criteria for an article to be selected must meet the inclusion criteria and exclusion criteria. Inclusion criteria include: 1) Articles must be accessible; 2) Available in full text and there is an abstract; 3) Written in English; 4) Articles were published within the last 5 years period starting from the writing of this systematic review. While the exclusion criteria are: 1) Editorial letters, review articles, and clinical trials; 2) Research subjects other than human; 3) Studies that do not have DOI and PMID.

2.3 Search Strategy

A systematic review study search was performed in September 11th 2022 across six databases: PubMed, ScienceDirect, Sage Journal, SpringerLink, ClinicalKey, and Oxford Academic with a search strategy using keywords ("Impact") AND ("Covid-19 Pandemic") AND ("Routine Immunization") AND ("Children").

Table 1. Study search strategy of this systematic review

Database	Search Query	Hits
PubMed	("Impact") AND ("Covid-19 Pandemic") AND ("Routine Immunization") AND ("Children")	55
ScienceDirect	("Impact") AND ("Covid-19 Pandemic") AND ("Routine Immunization") AND ("Children")	119
Sage Journals	("Impact") AND ("Covid-19 Pandemic") AND ("Routine Immunization") AND ("Children")	10
SpringerLink	("Impact") AND ("Covid-19 Pandemic") AND ("Routine Immunization") AND ("Children")	406
ClinicalKey	("Impact") AND ("Covid-19 Pandemic") AND ("Routine Immunization") AND ("Children")	221
Oxford Academic	("Impact") AND ("Covid-19 Pandemic") AND ("Routine Immunization") AND ("Children")	593

2.4 Data Collection

Data collection begins with scanning the titles and abstracts of existing studies. Appropriate studies were resorted based on inclusion and exclusion criterias. Studies that meet the criteria are included in this systematic review. Information that can be obtained in each study is in the form of title, author, time of publication, origin of study location, research study design, and research variables.

2.5 Quality Assessment and Data Synthesis

The authors independently reviewed some of the studies found from the titles and abstract in the articles to identify potentially eligible studies. Next, the eligible studies will be read in full order to decide which studies are eligible to serve as final inclusions for inclusion in a systematic review.

3. Results

3.1 Study Selection

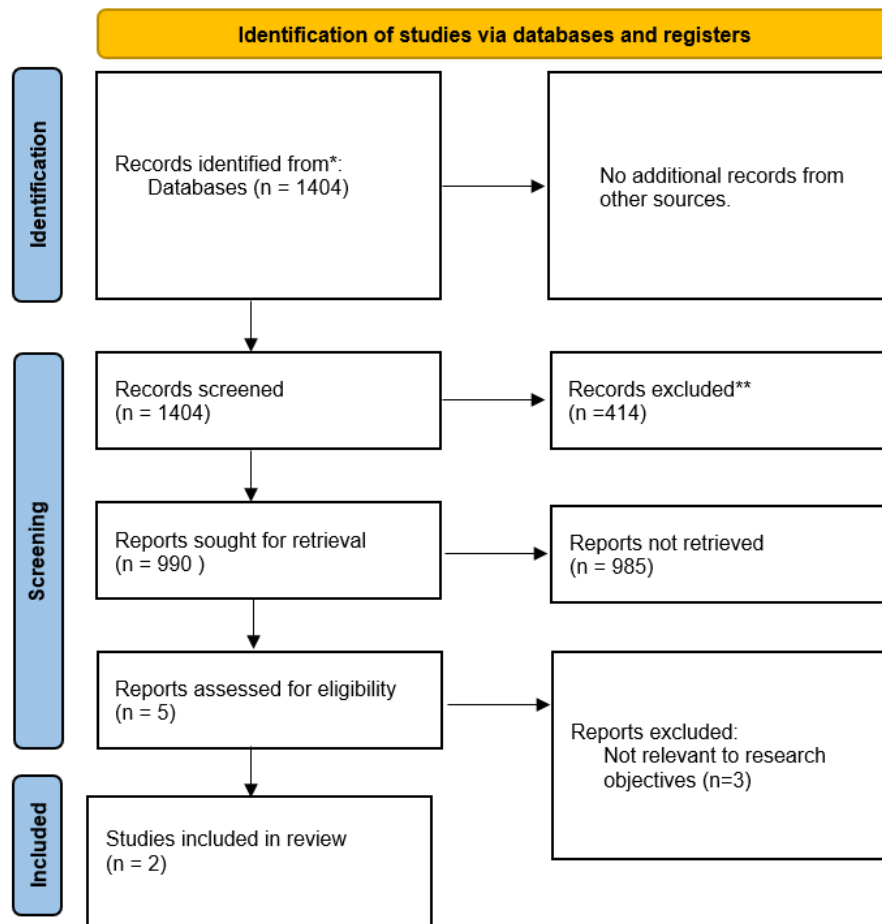
After conducting a study search using a search strategy through six different database sources, namely PubMed, ScienceDirect, Sage

Journals, SpringerLink, ClinicalKey, and Oxford Academic, 1404 articles were found. After that the articles resorted based on inclusion and exclusion criterias, the selected articles amounted to 990 articles. Then it was eliminated by getting rid of duplicate and irrelevant articles to 5 articles. There were 5 articles which were then read in full and checked for eligibility. 3 articles were then excluded because of not relevant to the research objective. Of the 2 articles, selected based on the inclusion and exclusion criteria, it was concluded that there were 2 studies that included for this systematic review. The following is a flow chart of data selection by PRISMA (Figure 1).

3.2 Study Characteristic

The studies that were included as systematic reviews took data from Canada and Nepal. The studies taken were studies with a retrospective cohort and qualitative research. The findings of the 2 selected studies are summarized and the characteristics of the selected studies, including their content and findings, can be seen in Table 2.

PRISMA 2020 flow diagram for new systematic reviews which included searches of data



* PubMed, ScienceDirect, Sage Journal, SpringerLink, ClinicalKey, and Oxford Academic

** Inclusion criteria: 1) Articles must be accessible; 2) Available in full text and there is an abstract; 3) Written in English; 4) Articles were published within the last 5 years period starting from the writing of this systematic review. Exclusion criteria: 1) Editorial letters, review articles, and clinical trials; 2) Research subjects other than human; 3) Studies that do not have DOI and PMID.

Figure 1. PRISMA 2020 Flow Diagram of search and data extraction

4. Discussion

This systematic review updates and confirms existing evidence about the impact of Covid-19 pandemic on child routine immunization programs. Based on the studies that included in this systematic review, routine immunization coverage rates in children under 2 years old decreased significantly in the early months of the COVID-19 pandemic, especially in children aged 15 and 18-months old. The coverage rates recovered in the second half of 2020 but remained lower overall compared to pre-pandemic rates.

A significant reduction of basic immunization coverage happen during the early period of pandemic based on the study in Canada and other similar reports from other countries.⁹

During the COVID-19 pandemic, the total number of vaccines given across all study regions started to fall sharply. The WHO declaration describing the COVID-19 outbreak discovered in Wuhan, China, as a pandemic on March 11, 2020, and the decline in vaccinations given coincide with each other.¹¹

Table 2. Data extracted from eligible studies

First Authors (Year)	Country	Study Design	Sample Size & Characteristics	Findings
Catherine Ji, Pierre-Phillippe PR, Jemisha A, Ellen S, Milena F, Jeremy NF, Michelle S, Stanley Z, Shaun KM, Karren Tu (2022) ⁹	Canada	Retrospective Cohort	Data from the University of Toronto Practice-Based Research Network (UTOPIAN) database were used for the primary care electronic medical record study from January 2019 to December 2020. Children under the age of two who had at least two UTOPIAN visits documented were included. We assessed the overall and type-specific rates of up-to-date (UTD) immunization coverage (DTaP-IPV-Hib, PCV13, Rota, Men-C-C, MMR, Var), as well as the on-time immunization coverage rates by age milestone (2, 4, 6, 12, 15, 18 months). Three time periods—January 2019–March 2020 (T1); March–July 2020 (T2); and August–December 2020—were compared for average coverage rates (T3).	12,313 children included. All children's overall UTD coverage was 71.0% in T1, decreased by 5.7% (95% CI: 6.2, 5.1) in T2, and then increased somewhat in T3 but stayed below T1 levels. In T2 and T3, MMR vaccine UTD coverage marginally declined by about 2%. The biggest losses in on-time coverage were observed at the ages of 15 and 18 months, with reductions of 14.7% (95% CI: 18.7, 10.6) and 16.4% (95% CI: 20.0, 12.8), respectively, during T2. No particular subgroup of children was discovered to have been differently affected by the epidemic when grouped by sociodemographic traits.
Asmita PK, Smriti M, Nistha S, Sunil S, Saval K, Bhuvan KC, Vibhu P (2021) ¹⁰	Nepal	Qualitative Research	Parents of children from the Kathmandu valley in Nepal who used and provided childhood immunization services were interviewed in semi-structured qualitative interviews. All interviews were place over the phone or online using programs like Zoom, WhatsApp, and chat. Every interview was recorded, transcribed, and then subjected to theme-based content analysis in an Excel spreadsheet.	There were 15 participants (7 service providers and 8 service users). Six themes were identified: (1) the impact of COVID-19 and lockdown on childhood immunization services; (2) motivation for childhood immunization; (3) availability of biosafety procedures and personal protective equipment (PPE) during the COVID-19 pandemic; (4) service adjustments and guidelines during the pandemic; (5) the availability of vaccines; and (6) the resilience of the immunization program in view of COVID-19.

According to WHO, it is estimated that 80 million children in 68 countries are at risk of outbreaks such as measles, diphtheria, and polio due to disruption of routine immunization services during the COVID-19 outbreak. History has proven that there is an indirect effect of the Ebola epidemic in West Africa which exacerbates morbidity and mortality. In 2015, during the Ebola outbreak, there was a measles outbreak in Guinea, West Africa due to interruptions in the implementation of measles immunization. If the COVID-19 outbreak is left unchecked, it will trigger similar problem, that child mortality caused by immunization-preventable disease outbreaks will increase significantly.¹²

The increase in the number of COVID-19 cases will encourage the government to implement several strategies to prevent this exponential increase, such as implementing self-isolation programs and restrictions on movement outside the home. This not only limits the movement of people, but also health workers to access health facilities.^{12,13}

An increase in the number of COVID-19 cases will also reduce the availability of health services, including immunization services. If the number of COVID-19 cases increases, there will be a decrease in the number of health workers available to provide routine immunization services because they will be directed to cases related to COVID-19. Similarly, it will reduce the available health facilities, as hospitals and clinics will be converted into COVID-19 treatment and isolation centers. In addition, immunization funding will be reduced because funds will be diverted for the COVID-19 response.^{12,13}

With the increasing number of COVID-19 cases, the government will issue a policy to require restrictions on routine health services. On May 22, 2020, WHO reported that 68 low-income countries had postponed routine childhood vaccinations, due to lack of medical

personnel who could serve and lack of transportation of vaccinations between countries so that countries lacked the amount of vaccine supply that should be given. It has affected more than 80 million children under the age of 1 year.¹⁴

In addition, WHO also recommended the suspension of mass vaccination campaigns to prevent worsening of COVID-19 transmission in the community. This can affect the attitude of the patient's parents not to carry out routine immunizations for their children.¹²

Lack of education about the importance of vaccination due to delays in vaccination campaigns coupled with many parents who are worried about going to health care centers for fear of being infected with the COVID-19 virus are the reasons for the decline in immunization coverage rates during this outbreak. Santoli, et al reported that the number of non-influenza vaccination coverage in the US had decreased significantly as parents were worried about bringing their children to health services during the COVID-19 outbreak.^{8,12,15}

The number of primary health facilities that are closed due to the inability to optimally control infection, coupled with parental concerns about bringing their children for immunization, has led to widespread delays in child vaccination. This increases the risk of future outbreaks.¹⁴

Due to the COVID-19 outbreak, there is a possibility that immunizations cannot be carried out according to the schedule. Immunization delays can cause antibody levels produced to be still below the protective level or have not reached antibody levels that can provide protection for a long period of time (life long immunity) as if immunization is complete and scheduled.¹⁶

The global pandemic may have an impact on the immunization program by reducing financial, human, and other

resources, causing civil unrest, limiting governmental attention, and lowering the nation's health priorities. The immediate needs of healthcare facilities must be met, and routine medical services must restart with the proper COVID-19 preventive measures in place. To protect people and lessen the effects of the outbreak, it is essential to design an integrated strategy that may include all parties.^{11,17}

5. Conclusion

Childhood routine immunization coverage rate significantly decreased during COVID-19 pandemic, especially during the early period of the pandemic. Implementation of public health and primary care interventions for providers and parents is required to ensure adequate catch-up of delayed/missed immunizations in order to prevent potential outbreaks of vaccine-preventable diseases as these children enter daycare or kindergarten. Service guidance needs to be developed to address any disruptions in future pandemic.

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