Does BCG Or MMR Or Routine Vaccination Coverage Protect Against COVID Infection and Mortality in India?

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ABSTRACT

Background: The routine vaccinations and acquired immunity by other viral infections were believed to be acting as a protective factor against severe COVID-19 outbreaks in some countries.

Objective: This study is overviewing the relationship of routine BCG, MMR vaccinations and reported MMR disease outbreak with reported COVID-19 infection across the Indian states.

Methods: The data on vaccination coverage and respiratory disease infection was obtained from Universal immunization program and Integrated disease surveillance project reports. Spearman rank correlation has been used to assess the relationship of routine vaccination and COVID-19 infection.

Results: The result did not find any relationship of routine vaccination with BCG and MMR or exposure to MMR infection on COVID-19 infections in India.

Conclusion: The exposure to BCG or MMR vaccination did not have a non-specific protection against COVID-19 infection. The results imply that a larger proportion of the Indian population is still vulnerable to COVID-19 infection.

Keywords: COVID-19, BCG vaccine, measles mumps rubella vaccine, routine vaccination

INTRODUCTION

The explosion of information on the COVID-19 pandemic is at a crossroads, with varying degrees of agreement and disagreement among researchers. There is an argument on the repurposing of available routine vaccines like Bacillus Calmette-Guérin (BCG) and Measles Mumps Rubella (MMR/MR).[1] Global data have shown a relationship between MMR vaccination rate and decreased COVID-19 mortality.[2] Some studies disprove this finding.[3] It is documented that infection with Mumps or Rubella virus leads to lifetime immunity.[4]

The spectrum of publications reports the pediatric vaccine coverage and COVID-19 outbreak at various degree of association. There is no sufficient comparison from either a small county or a larger state, based on the available vaccination data and the respiratory infection outbreak such as MMR and linking it to COVID-19. For a country like India with its large population and geographic variation uniform data availability is challenging. However, Universal immunization program (UIP) of government of India has successfully increased the pediatric vaccination coverage and it is documented regularly. Also, IDSP (Integrated disease surveillance project) monitors and documents the respiratory infection outbreaks along with other data for surveillance. This study assesses the relationship of COVID-19 infection with respiratory infectious disease outbreaks (Measles, Mumps and Rubella) and overall pediatric vaccination coverage as documented in UIP and IDSP reports.

MATERIALS AND METHODS

In India routine pediatric vaccination is the common practice through Universal Immunization Program (UIP) and the progress in coverage is documented by a dedicated government agency apart from this periodic survey to measure the achievements is done through National Family Health Survey (NFHS). The communicable disease outbreak is documented in the syntactic program under Integrated Disease Surveillance Program (IDSP). The data on the MMR disease outbreaks from 2009 to 2020 in the states and Union Territories (UTs) of India is obtained from the official website of the IDSP (https://idsp.nic.in/). The cumulative frequency of COVID-19 infection and death due to COVID-19 infection till 19th July 2021 is obtained from the website of the Ministry of Health and Family Welfare (https://www.mohfw.gov.in/). The data on the BCG, MMR and routine vaccination coverage in the states/UTs of India is obtained from the NFHS reports.[5-7] NFHS collects the vaccination coverage independent of UIP in a uniform standard tool, also the data is cumulative evidence from the last two decades. The participants of these surveys will form the current adult cohort. Information on projected state-wise population for the recent year, 2016 is obtained from the report of the technical group on population projections.[8] The final data consist of 29 observations that represent either states or UTs of India. The values for some of the smaller states or UTs were available as combined with others concerning the region. Spearman rank correlation coefficient was used to find the relationship of routine vaccination and MMR infection with COVID-19 infection and associated mortality.

RESULTS

The data on the infection of measles, mumps, and rubella are combined for the states from the IDSP. The median number of MMR infections in Indian states is reported as 1534 ranging from 22 to 9158. Chandigarh was reported with the lowest MMR infection and West Bengal was reported with the highest number of infections during 2009 and 2020. However, West Bengal had 76.55% of MMR vaccine coverage as per the NFHS-2 reports of 1999. The state had achieved more than 90% coverage by 2005 NFHS-3 reports. The average vaccine coverage in Indian states was reported as 93.30% (SD=5.03%) which was 79.38% as per NFHS-2 reports (1998-1999). As per the NFHS -4(2015-2016) reports all states had at least 80% BCG vaccination coverage. However, as per the NFHS-2 report Bihar had only 16.60% MMR and 37.70% BCG vaccination coverage.

Among all the states of India, four states which had the lowest and highest vaccination coverage as per NFHS-2 are presented in Table 1 to understand the distribution of vaccine coverage. The results do not indicate an effect of BCG or MMR vaccination on the COVID-19 infection. Despite Bihar being the state with high population density in India and lower coverage of vaccination, the state reported less COVID-19 infection compared to states with the highest coverage of BCG and MMR vaccination. The states with severe COVID-19 outbreaks such as Maharashtra and Kerala had more than 90% BCG vaccination coverage and more than 80% MMR vaccine coverage as NFHS -2 report itself. The most populous state UP which had lower coverage of vaccination was observed with a smaller number of infections compared with states like Maharashtra, Tamil Nadu or Karnataka which had higher vaccination coverage. Apart from infection, the mortality among COVID-19 patients was also high among these states.

The natural MMR infection induces immunity with non-specific protection against other viral infections. Also, the MMR and BCG vaccination is believed to be building immunity against COVID-19 infection.[9]

Table 1: Distribution of vaccination coverage, MMR and COVID-19 infection in India

Variable	States with the lowest vaccine coverage				States with highest vaccine coverage				India
	UP	Rajasthan	Assam	Bihar	TN	Kerala	HP	MH	
No. of COVID-19 infection	1706585	952888	529468	723220	2507505	3035402	203384	6107381	30308456
No. of COVID-19 Death	22719	8950	4999	9629	33724	15350	3507	127031	414108
No. of MMR infection	4757	1534	2071	5982	519	1706	359	2828	51448
Population density (per Km²)	897	217	423	1213	574	890	129	386	362
Total Population ('000)	216087	74240	33168	114176	74635	34578	7158	118727	1290235
NFHS-2									
BCG vaccination (%)	57.5	53.9	53.5	37.7	98.6	96.2	94.6	93.7	71.6
MMR vaccination (%)	34.6	27.1	24.6	16.6	90.2	84.6	89.1	84.3	50.7
All vaccination (%)	21.2	17.3	17	11	88.8	79.7	83.4	78.4	42.0
No vaccination (%)	29.5	22.5	33.2	16.8	0.3	2.2	2.8	2.2	14.4
NFHS-3									
BCG vaccination (%)	61	68.5	62.4	64.7	99.5	96.3	97.2	95.3	78.1
MMR vaccination (%)	37.7	42.7	37.4	40.4	92.5	82.1	86.3	84.7	58.8
All vaccination (%)	23.3	26.5	31.4	32.8	80.9	75.3	74.2	58.8	43.5
No vaccination (%)	2.7	5.5	15.2	7	0	1.8	1.9	2.8	5.1
NFHS-4									
BCG vaccination (%)	87.6	88.8	82.3	91.6	94.9	98.1	94.8	90	91.9
MMR vaccination (%)	70.8	78.1	71.4	79.4	82.3	89.4	87.5	82.8	81.1
All vaccination (%)	51.1	54.8	47.1	61.7	69.7	82.1	69.5	56.2	62.0
No vaccination (%)	2.7	7.4	15.2	7	3.4	1.7	2.7	8.2	6.0

UP-Uttar Pradesh, TN-Tamil Nadu, HP-Himachal Pradesh, MH- Maharashtra

Table 2: Spearman rank correlation coefficient to assess the relationship of COVID-19 infection with vaccination coverage and MMR infection across 29 states/UTs of India

Variable	COVID-19 infection		COVID-19 mortality		MMR infection	
	r	p value	r	p value	r	p value
MMR infection	0.312	0.129	0.378	0.062	1	-
NFHS-4 (Vaccination coverage)						
BCG	-0.022	0.909	-0.019	0.922	-0.464*	0.02
MMR	-0.058	0.764	-0.016	0.934	-0.554*	0.004
All vaccination	-0.197	0.305	-0.173	0.37	-0.457*	0.022
No vaccination	0.022	0.911	0.017	0.928	0.440*	0.028
NFHS-3 (Vaccination coverage)						
BCG	0.206	0.347	0.2	0.361	-0.473*	0.023
MMR	0.1	0.62	0.163	0.457	-0.492*	0.017
All vaccination	0.002	0.993	0.053	0.809	-0.498*	0.016
No vaccination	-0.235	0.28	-0.176	0.422	0.252	0.247
NFHS-2 (Vaccination coverage)						
BCG	0.165	0.488	0.159	0.502	-0.653*	0.002
MMR	0.154	0.516	0.189	0.425	-0.578*	0.008
All vaccination	0.146	0.539	0.2	0.398	-0.580*	0.007
No vaccination	-0.288	0.218	-0.246	0.298	0.523*	0.018

*Significant at 5% level of significance

Spearman rank correlation coefficients were calculated to assess the relationship of MMR infection, MMR and BCG vaccination with COVID-19 infection over the states of India. The results presented in Table 2 indicated that COVID-19 infection is neither related to the MMR infection nor the routine vaccinations. MMR vaccination is having a significant negative correlation with MMR infection (r = -0.578, p value = 0.002). Though the BCG vaccination did not show a significant relationship with COVID-19 infection it was negatively correlated with MMR infection (r = -0.653, p value = 0.008). The vaccinations or MMR infection did not show any relationship with mortality associated with COVID-19 infection.

DISCUSSION

Variability is the dictum for vital statistics and the variability for a country like India is huge. Inspite of this the centralized data collection system gives some uniform data for comparison like the one used in this study from UIP and IDSP. Based on these data one of the important outcomes of this study is the staggering difference in the number of infections and population density. Highly populous states like UP and Bihar having high density and reported lower vaccine coverage have less COVID-19 infection compared to high vaccine coverage states like Maharashtra and Karnataka. The protection from the natural infection of these viruses is documented to be a lifetime, and the overall vaccine coverage of BCG, MMR was accounted along with the natural outbreak of disease which is documented in the national health portal which did not give any conclusive and specific relation with COVID-19 infection and mortality due to COVID-19.

The findings from Fidal P et.al. 2020 of the correlation of epidemiological data of MMR and COVID-19 mortality could not be established in the Indian context with the available data.[2] Unlike the study from Japan which had proven a negative correlation between routine BCG vaccination and COVID-19 mortality, the Indian data did not show any relationship.[1]

The much severe second wave of outbreak observed across the states of India from April to June 2021 also hints at the vulnerability of the population to the COVID-19 infection. The higher proportion of COVID-19 infection in the younger age group (<20, 20-39 years) in the second wave also indicted the negligible effect of previous routine BCG and MMR vaccinations on COVID-19 infection.[10]

The prediction from this study holds mirror to the increased number of susceptible who became positive in subsequent waves of COVID-19 pandemic again strengthening the findings presented mentioning about the non-existence of statistical correlation between the said vaccine coverage, respiratory infections of MMR and COVID-19 infection and associated morbidity or mortality.

The variables defined in the Indian context should be viewed in the backdrop of the massive migrants' movement which happened across Indian states which changed the demographic setting for the huge population of at least 18 million which also changed their risk of getting infected at the same time. Second, the measures of detection and isolation of cases, tracking of contacts of the diagnosed cases varied across the states and scaling up of diagnostic facility was a continuous process in many states. This leads to reporting bias leading to the missing calculation of actual cases diagnosed and death due to COVID-19 disease.

CONCLUSION

Prediction of possibility of causes and variability in the disease is important part of epidemiological stud-

ies as a part of public health system. Also, the quality of data required for the prediction is challenging at the time of pandemic like COVID-19. With the existing documented variables, this manuscript described the routine vaccinations and acquired immunity by other viral infections are observed to be not protective against COVID-19. The findings from existing documented data show that the uninfected Indian cohort is highly vulnerable to COVID-19 infection hence the faster implementation of COVID-19 specific vaccines is much needed to avoid further waves of outbreaks of COVID-19 in near future. This study is an effort based on the available data with different perspective. Further detailed clinical studies are needed to unravel the true relationship between live vaccines used in UIP and COVID-19 infection/disease development.

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