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ORIGINAL ARTICLE

Effect of COVID-19 Pandemic on Vaccination of Children Under Two Years of Age

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ABSTRACT

Objective: To determine the impact of COVID-19 pandemic on vaccination of the children under two years of age.

Study Design: An analytical cross-sectional study.

Place and Duration of Study: A multi-center study conducted at the Children's Hospital Lahore, Allama Iqbal Teaching Hospital, Sialkot and Idress Teaching Hospital, Sialkot over a period of 2 weeks.

Material and Methods: We used a structured questionnaire to interview 345 participants, selected through non-probability convenience sampling.

Results: A total of 345 children were enrolled, mean age was 7.74 ± 4.48 (range 1-24) months. In 158 (45.8%) children, vaccination during pandemic was complete, It was delayed in 117 (33.9%) and 70 (20.3%) children missed their vaccination. 14 (4%) participants missed BCG and OPV at birth, 31 (9%) missed first and 21 (6%) missed second dose of pneumococcal, pentavalent, rotavirus vaccine and oral polio vaccine (OPV). Whereas 19 (5.5 %) missed third dose of pneumococcal, pentavalent and OPV as well IPV, while 16(4.6 %) and 12 (3.4 %) missed first and second dose of measles vaccine. Fear of getting infected with COVID-19 was the major reason for missing and a transportation issue during lockdown was the commonest reason for delaying vaccination. Univariate analysis showed lower educational status of father, low monthly income and distance from vaccination center had significant impact on missing the vaccination.

Conclusion: The COVID-19 pandemic had a negative impact on routine immunization in Pakistan with a delay in one third and missed vaccination in 20% of children less than 2 years of age. The major factors responsible were the fear of getting COVID-19 infection and logistic issues.

Key Words: *Effect, COVID-19, Vaccination, Children*

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INTRODUCTION

The first case of the Corona Virus Disease - 19 (COVID-19) was reported in late December 2019 from Wuhan, China.¹ It turned out to be such a

rapidly communicable disease that ultimately World Health Organization (WHO) declared it as a pandemic on 11th March, 2020.² This has adversely affected global politics, economy and

developmental projects as all the resources have been diverted to combat pandemic. Moreover worldwide, the health care system is overwhelmed managing COVID-19 cases to such an extent that it is very difficult to provide standard care to patients suffering from other ailments. The routine care of children as well pregnant females has also been disrupted including provision of their essential vaccine.³

The number of children being seriously infected and dying of COVID-19 is far less compared to adults,⁴ yet it indirectly may cause increase in childhood mortality due to lack of routine health care provision and access to food.⁵ The vaccination programs are one of the most cost-effective public health intervention to reduce the childhood mortality especially in developing countries.⁶ The ongoing COVID-19 pandemic has had a negative impact on immunization campaigns all over the world in particular in middle and low-income countries including Pakistan. Though one of the major reasons is diversion of health care resources towards COVID-19, parents are also reluctant to visit hospitals for regular vaccination of their children due to fear of catching infection. There is also shortage of some vaccines in many parts of world because of discontinuation of flights, closure of borders and lock down. The immunization campaign could have contributed to the spread of COVID-19, hence UNICEF also initially recommended to suspend such campaigns.⁷

During 2014 Ebola outbreak, discontinuity of immunization services lead to post-Ebola epidemic of measles, and number of children who died of measles was double compared to Ebola itself.^{7,8} Pakistan is already far behind in immunization, many vaccine preventable disease (VPD) that have been eliminated from most other countries, especially Polio and measles are still a challenge for Pakistan.⁹ According to Global Vaccine Alliance, due to poor immunization coverage every 1 out of 4 children in Pakistan is already vulnerable to VPD.¹⁰ This pandemic has further caused drop in immunization,⁷ and as at present nobody can predict when this pandemic will end. This study was planned to assess effect of COVID-19 pandemic on routine childhood vaccination and identify factors leading to failure of immunization programs so that effective catch-

up vaccination campaigns be planned accordingly.

MATERIAL AND METHODS

An analytical cross-sectional study was conducted at pediatric departments of three hospitals, two public sector i.e. Children's Hospital (CHL) Lahore and Allama Iqbal Memorial Teaching Hospital (AIMTH), Sialkot and one private sector i.e. Idress Teaching Hospital (ITH), Sialkot. A sample size of 345 participants (115 participants each from every hospital) was calculated through open-epi statistical calculator with 95% confidence level, 5% absolute precision and anticipated % frequency (66%) of immunization coverage according to Pakistan demographic and health survey 2017-2018.¹¹ Sampling was done through non-probability convenience technique. Study was conducted over a period of 2 weeks (25th July -7th August 2020). Children less than two years of age whose vaccination was due during COVID-19 pandemic and parents who were willing to give informed consent were included in the study. Children whose vaccination was missed due to social and medical issues not related to pandemic or whose vaccination card was not available at time of interview were excluded from study. We validated questionnaire by getting it reviewed by three expert members of Internal review board of Khawaja Safdar Medical College, Sialkot and then it was tried out on 15 parents whom we subsequently did not include in our final analysis. After minor changes advised by experts, the participants were interviewed using a questionnaire that included socio-demographic information of child and educational status, monthly income and occupation of parents. The immunization status of children before and during pandemic was inquired including the reason of missed or delayed vaccination during pandemic. Hence if according to EPI schedule any vaccine was missed or delayed (administered after two weeks of due date) it was documented.

Data analysis: The data was analyzed using SPSS version 20. Descriptive statistics of socio-demographic characteristics and variable regarding vaccination were presented as mean, standard deviation or frequency percentages. Chi-square test was employed and p value less than 0.05 were considered significant.

RESULTS

A total of 345 children were enrolled in the study. The mean age was 7.74 ± 4.48 (range 1- 24) months. Among participants' 181 (52.4%) children

were male and 204 (59.1%) belonged to rural area (table 1). EPI vaccination status of 251 (72.8%) children was up to date and 22.3% (n=77) were not born before pandemic.

TABLE1: Socio-demographic characteristics (n=345)

Variable	Frequency (n)		Percentage		p-value	
Age (months)						
0-4	102		29.6		0.87	
5-12	198		57.4		0.005	
13-24	45		13.0		0.016	
Gender						
Male	181		52.5		0.023	
Female	164		47.5			
Area						
Rural	204		59.1		0.048	
Urban	141		40.9			
Monthly Income(rupees)						
< 20000	100		29.0		0.023	
20000-50000	130		37.7			
50000-100000	77		22.3			
>100000	38		11.0			
Vaccination centre distance						
1-5 kilometre	108		31.3		0.018	
>5 kilometre	131		38.0			
>10 kilometre	106		30.7			
Literacy level	Mother	Father	Mother	Father	Mother	Father
Illiterate	82	54	23.8	15.7	0.082	0.006
Primary	43	38	12.5	11.0		
Secondary	126	107	36.6	31.1		
Graduate	51	72	14.8	20.9		
Masters	22	22	6.4	6.4		
Professional degree	21	52	6.1	15.1		
Place of vaccination						
Government sector	294		85.2			
Private sector	33		9.6			
Both	11		3.2			
Did not get vaccinated	7		2.0			

In 158 (45.8%) children, vaccination was completed during pandemic, another 117 (33.9%) had delayed and 70 (20.3%) missed their vaccination. In 54 (47%) participants of Children's Hospital, Lahore (CHL) and 8 (7%) each from Allama Iqbal Memorial Teaching Hospital (AIMTH) and Idress Teaching Hospital (ITH) vaccination was missed (fig 1). Overall, 14 (4%) participants missed BCG and OPV 0, 31 (9%) missed 1st dose of pneumococcal, pentavalent, rotavirus and OPV 1, 21 (6%) missed 2nd dose of pneumococcal, pentavalent, rotavirus and OPV 2, 19 (5.5%) missed 3rd dose of Pneumococcal and Pentavalent as well IPV and OPV 3, 16 (4.6%)

and 12(3.4%) missed their 1st and 2nd dose of Measles vaccine (table 2).

TABLE 2: Vaccination status during pandemic

Hospital ITH Sialkot	Vaccination Status		
	Missed n (%)	Delayed n (%)	Complete n (%)
Birth	1(0.9)	4(3.4)	77 (66.9)
6 weeks	6(5.2)	9(7.8)	
10 weeks	2(1.7)	6(5.2)	
14 weeks	4(3.4)	10(8.7)	
9 month	2(1.7)	2(1.7)	
15 month	0(0.0)	0(0.0)	

AIMTH, Sialkot			
Birth		2(1.7)	60 (52.1)
6 weeks			
10 weeks	2(1.7)	7(6.1)	
14 weeks	1(0.9)	25(21.7)	
9 month	1(0.9)	10(8.7)	
15 month	4(3.4)	5(4.3)	
CHL			
Birth	13(11.3)	5(4.3)	21 (18.2)
6 weeks	23(20.0)	9(7.8)	
10 weeks	17(14.7)	13(11.3)	
14 weeks	14(12.1)	8(6.9)	
9 month	13(11.3)	8(6.9)	
15 month	8(6.9)	6(5.2)	

ITH = Idrees Teaching Hospital,
 AIMTH = Allama Iqbal Memorial Teaching Hospital,
 CHL = Children's Hospital, Lahore.
 Birth = BCG, OPV 0
 6 week = (pneumococcal 1, pentavalent 1, OPV 1, rotavirus 1)
 10 week = (pneumococcal2, pentavalent 2, OPV 2, rotavirus 2),
 14 week = (pneumococcal 3, pentavalent 3, OPV 3, IPV), 9 Months = Measles 1, 15 months = Measles 2

Overall, fear of getting infected after visiting vaccination center during pandemic was the major reason for missing vaccination (n=35 - 50%) and transportation issues during lockdown was the most common reason for delaying vaccination (n=51-43.6%). The fear of side effect and misconception about vaccination were also significant factor affecting routine vaccination. (table3).

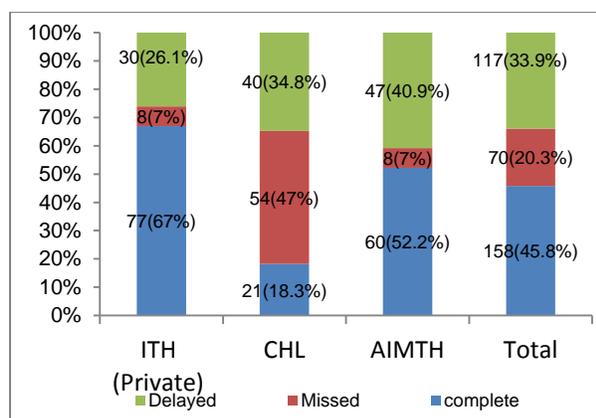


Fig 1: Vaccination Status

ITH = Idress Teaching Hospital, CHL = Children's Hospital Lahore, AIMTH = Allama Iqbal Memorial Teaching Hospital

TABLE 3: Factors affecting vaccination status during pandemic

Factors	Missed n=70 (%)	Delayed n=117 (%)	p value
Fear of getting infected due to COVID-19 during visit	35(50.0)	28(23.9)	0.001
Non availability of health care professional	17(24.2)	25(21.4)	0.12
Transportation issues during lockdown	12(17.1)	51(43.6)	0.005
Child neglect due to parental stress because of pandemic	11(15.7)	26(22.2)	0.23
Financial issues faced during pandemic	7(10.0)	1(0.85)	0.002
Lack of knowledge of vaccination schedule	4(5.7)	5(4.3)	0.34
Fear of side effect of vaccine	12(10.4)	13(11.1)	0.00
Misconception about vaccination	2(2.9)	2(1.7)	0.01

Among 115 people visiting CHL, fear of getting infection was the most common reason for missing or delaying their child vaccination (n=41-35.6%) while transportation issues during lockdown was the most common factor affecting vaccination among people visiting AIMTH and private hospital Sialkot(n=20 - 17.3%).

In AIMTH, 8 participants missed the vaccine and most frequently missed vaccine was second dose of measles at 15 months (n=4 - 3.5%) while in CHL and private hospital Sialkot it was the 6th week vaccination (pneumococcal 1, pentavalent 1, rotavirus 1 and OPV 1) (n=23 - 20%) and (n=6 - 5.2%) respectively. BCG and OPV at birth were significantly missed by participants of CHL compared to private and government hospital of Sialkot (p value =0.001 and 0.00 respectively). Similarly 10th week vaccine (pneumococcal 2, pentavalent 2, OPV 2 and rotavirus 2) was also missed significantly among CHL participants compared to private and government hospital of Sialkot (p value = 0.006 and 0.001 respectively). Many children had delayed their vaccination at 14 weeks (pneumococcal 3, pentavalent 3, IPV and OPV 3) in AIMTH (n=25 - 21.7%) and private

hospital Sialkot (n=10 - 8.7%) and majority (n=13 - 11.3%) had delayed vaccination at 10 weeks (pneumococcal 2, pentavalent 2, rotavirus 2 and OPV 2) in CHL. In our study only 8.1% (n=28) parents got their children vaccinated other than EPI schedule whereas 91.9% (n=317) did not have any additional vaccine shot. Out of those vaccinated other than EPI, 71.4% (n=20) were from private hospital Sialkot and 14.3% (n=4) each from CHL and AIMTH. Similarly only 7.8% (n=27) children got flu vaccine. Among these majority 85.2% (n=23) were from private sector (p value=0.03), 11.1% (n=3) from CHL and 3.7% (n=1) from AIMTH.

The univariate analysis showed that the low educational status of father, low monthly income and distance from vaccination center had significant impact on missing the vaccination during COVID 19 pandemic (p value=0.006, 0.023 and 0.018 respectively). Whereas maternal education level had no such significance regarding missed vaccine (p value = 0.082) (table 1).

DISCUSSION

The recent COVID-19 pandemic has proved to be one of the most challenging global health crises. The reasons include, no definitive treatment, vaccination for COVID-19 is still under trial, resources reserved for routine medical care were diverted for COVID-19, restriction in transportation and lockdown. Along with other fields, vaccination programs of children got compromised worldwide.¹² The COVID-19 proved to be less severe among children compared to elderly.¹³ In Pakistan mortality rate is reported to be almost 0.3% for children ≤ 10 years of age.¹⁴ Although, most of children are having smooth recovery from COVID-19 yet it is expected to have detrimental effects because of disruption of routine childhood care and immunization. This is already observed by increased number of cases of polio, diphtheria and measles being reported across Pakistan.¹⁰ This multicenter study assessed impact of COVID-19 pandemic on immunization status of children less than 2 years of age and identified reasons of missed or delayed vaccination.

The study was conducted when around 700 to 1000 new cases of COVID-19 were being diagnosed daily.¹⁵ It was observed that only 4.9%

children included in our study had incomplete vaccination status before pandemic. Whereas 33.9% participants' vaccination was delayed and 20.3% missed their vaccination due to various reasons related to COVID-19 pandemic. The major reason for missed vaccine was fear of getting infected with COVID-19 during vaccination (50%). Similar results were observed in a study conducted in Saudi Arabia, where 60.9% parents were reluctant to get their children vaccinated due to fear of COVID-19.¹⁶ This was also identified as potential reason of avoiding vaccination during the COVID-19 pandemic in United States.¹⁷ Various studies related to Ebola outbreak in Africa during 2016 also observed significantly reduced rate of tuberculosis, polio, measles and pentavalent vaccines and its one of major reason was fear of catching Ebola infection during visit to health care facility.¹⁸⁻²⁰ Later on far more number of African children died because of measles outbreak as compared to that of Ebola. Hence, it is need of hour that during such pandemic, government and health care professional must emphasize and convince parents to get their children vaccinated.

The vaccination can be managed at some separate health care facilities for well-baby visits or on Sundays (when other OPD services are off). It was also of significant importance that among participants visiting private hospitals, financial issues and lack of vaccination schedule or misconception about vaccine was not the reason of missing vaccine as compared to participants of public hospitals where these factors accounted for 3.4%, 3.9% and 1.7 % respectively. This may be due to the reason that in public vaccination centers usually paramedics perform vaccination whereas in private sector mostly doctors vaccinate and especially guide parents and address their concerns regarding vaccination. Hence, we suggest that to improve immunization rate in Pakistan either doctors should be deputed at vaccination center where possible, else they must guide parents properly about vaccination during their hospital outdoor or indoor visits.

Another major reason for delayed vaccination was transportation issues during the lockdown (43.1%) whereas it was reported as a reason of delayed vaccination only in 1.8% participants of study conducted in Saudi Arabia.¹⁶ Overall 7% participants each at private and public hospital of

Sialkot missed their vaccination compared to 52.2% (n=54) participants of CHL. This might be due to the reason that Sialkot is considered to be a city with limited health care facilities and usually only local residents visit these hospitals whereas the CHL is the largest pediatric hospital of Pakistan where patients are referred from all over Pakistan and hence participants of this hospital are more likely to represent overall population. It was also noted that only 8.1% participants had vaccination other than EPI and 7.8% had flu vaccine. This points out that despite available vaccines against many other preventable diseases like hepatitis A, meningococcal disease, mumps, rubella and influenza; Pakistanis are not getting vaccinated against these communicable diseases that might be due to affordability or lack of guidance.

It was noticed that literacy rate was somewhat better among fathers compared to mothers. Lower education status of father, low monthly income and increased distance from health care facilities had significant association with rate of missed vaccine that is also suggested by two previous studies conducted in Pakistan.^{21,22} This might be due to the reason that in our culture usually males are decision makers in family matters and findings of our study suggest that we need to focus on fathers equally to improve immunization coverage.

A study conducted by Abbas et al in Africa showed that if proper preventive measures are taken the benefit of getting children vaccinated outweigh the additional risk of deaths due to COVID-19 associated with vaccination centers visit.²³ Therefore we suggest that considering higher mortality rate of vaccine preventable disease in Pakistan, reasons of missed and delayed vaccine during COVID-19 pandemic, as highlighted by our study, can guide policy makers to improve vaccination campaign during this and any future pandemic.

The limitation of our study is that it is a hospital based study and might have included people with better access to health care facilities and might not be true representative of entire population but still it is multicenter study involving public and private sector of different cities that provides reasonably good understanding of the impact of COVID-19 on childhood immunization in Pakistan.

CONCLUSION

The COVID-19 pandemic had a negative impact on routine immunization in Pakistan with a delay in one third and missed vaccination in 20% of children less than 2 years of age. The fear of getting COVID-19 infection was the commonest reason at Children's Hospital Lahore and logistic issues were the major factors responsible for this decline at both hospitals in Sialkot. We identified obstacles to timely vaccination. It is suggested that during pandemic childhood routine immunization should still be a priority that shall require implementation of well-defined strategies to attain a remarkable and sustained increase in immunization to avoid outbreaks of vaccine preventable diseases during pandemic.

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