

The Determinants of Parental Uptake of Childhood Immunization in Peri-Urban Areas of Karachi, Pakistan - A Cross-Sectional Study

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ABSTRACT

Background: Immunization is one of the simplest and cost-effective ways to protect a child from infectious diseases and mortality worldwide, and while global immunization coverage has increased dramatically the impact is low in developing countries like Pakistan, where many children remain unvaccinated or partially vaccinated.

Aim: To determine the potential factors related to parents that impact the uptake of immunization in children living in the peri-urban area of Karachi, Pakistan.

Methodology: An analytical cross-sectional study was conducted between Oct 2020 to May 2021. Purposive sampling technique based on the inclusion and exclusion criteria was used and a total of 100 parents of children were interviewed using the self-developed structured questionnaire focusing on factors like socio-demographic, parental health-seeking behavior, parental knowledge and perception of immunization and the reasons why a child is partially immunized. The data was collected from two EPI centers from the peri-urban area of Karachi to determine the parental factors associated with child immunization.

Results: The results of the study show association between Child immunization and father occupation ($p=0.000$), parental education ($p=0.000$) and household income ($p\text{-value}=0.000$). history of sibling's complete vaccination 35(70%), frequency of maternal antenatal visits 41(82%) accompanied by the husband 37 (74%) and have delivered the child in hospital 50(100%) by an obstetrician 50 (100) and for medical treatment child is always taken to a hospital 47(94%). Parents who consider vaccination important 48 (86%) with the significance of ($p=0.001$) and they have awareness regarding the total number of immunizations 38(76%) have fully immunized children.

Conclusion: According to the study, parental education, occupation, income, health-seeking behavior, father's involvement, child birth-related factors, parental awareness on immunization, perception of immunization

Keywords: Immunization coverage, EPI, Parental factors, Peri-Urban, Sindh, Fully Immunized, Partially Immunized

INTRODUCTION

According to WHO, children are considered fully immunized when they present to have received one dose of BCG at birth to protect against tuberculosis, three vaccination doses to protect against diphtheria, pertussis, and tetanus (DPT), three vaccination doses to protect against poliomyelitis and one dose of measles vaccine¹. All the children should receive the suggested number of doses during their first year of life^{2,3}. Similarly the children who are Partially immunized are defined as the ones that are in the ages between 12–23 months and who have had received at least one vaccine, but not all the Expanded Program of Immunization (EPI) recommended vaccines⁴. In line with the other categories defined for immunization Unimmunized children are the ones with ages 12–23 months old who did not receive any of the EPI vaccines, they are also known as Zero Dose children⁴.

The impact of Vaccine-preventable diseases are still a big complication in countries like Pakistan where people have limited healthcare resources and fragile health systems. Pakistan is taking account on number seven for contributing to the 67% of neonatal deaths, and has the specific death rate of 51 per 1000 live births. The estimates show that about seventy per cent of the children in Pakistan are dying every year due to infectious diseases⁵ because still around 58% of the children are unimmunized and are prone to infectious disease⁵.

In Pakistan, children who have not turned five have a population of 15% and according to the most recent information provided by the World Bank states that the mortality rate is 81%⁶ and it is not possible for Pakistan to reach the Millennium Development Goal if they fail to reduce the death rate of children about 45%⁷. The major role in the deaths of the children is played by the infectious diseases⁵ and every year, 12 thousand children in Pakistan die from Measles due to low vaccine coverage compared to other vaccines. However, TB and Tetanus also cause a large number of deaths⁸.

According to studies the reasons can be easily dealt by educating the parents of the children regarding health behaviors, and by improving the socioeconomic status of the family so they can afford quality care for their children while in sickness⁹. and there is a great number of studies that can be found documenting maternal factors, parental education and knowledge of the vaccination schedule and timeliness importance plays a vital role in the vaccination status of children¹⁰.

In recent years, wide-ranging evidence have been witnessed within public health literature representing that suboptimal immunization coverage is dependent on several determinants¹¹ and those become the cause of improved or low immunization coverage. The determinants are mostly related to child parental determinants¹². Many parents usually give up on the cycle of immunization as the parents are too busy to bring the child for vaccination¹³ maternal education¹⁴ and health seeking behavior of mothers¹⁵, compliance with interventions to increase the vaccination uptake by the health departments¹⁶ ethnic, social determinants and poverty¹⁷, lack of parental information about immunization¹⁸ lack of knowledge regarding the dangers of no immunization¹⁵ lack of knowledge regarding the number of doses¹³ child's gender as in Pakistan girls are least likely to obtain all elementary vaccines than boys¹⁹, distance between house to immunization facility²⁰, parental lack of knowledge and unawareness of benefits of immunization²¹, and incorrect ideas about vaccination were also significant for fail immunization coverage²².

The emerging concern nowadays are the determinants behind the resistance and acceptance in the uptake of childhood immunizations. Parents who are getting their children completely immunized without the help of external interventions by health departments are a great source for future improved health development in the country.

This study is highly significant for general public health as it provides information regarding the basic parental behaviors that are having an impact on a child's immunizations. Fathers' role in the study has been highlighted so well that health professionals can use the information and make fathers part of all the visits, for the future betterment of the child.

METHODS

We conducted an analytical cross-sectional study design, where the exposure and outcome status was ascertained at a single point in time. This study was conducted with parents of children exposed to the outcome of complete immunization by the age of one year and non-exposed with the outcome of partial immunization, to determine the parental factors that were associated with the uptake of immunization a selected town in Karachi from March 1st till Apr 30th, 2021. The study was carried out in two vaccination centers of selected towns, of the largest Peri-Urban²³ towns in Karachi, Pakistan. The two towns were selected based on their location, multi-ethnic population and monthly income between low to medium.

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The interviews were taken from both parents (mother & father) who accompanied the child for vaccination to one of the study sites for a purpose of vaccinating the child with Measles-1 vaccine before the age of 12 months and Penta-3 / Measles-1 between the age of 12-23 months. The parents were chosen based on their child's age and the vaccine administration request they presented with.

A minimum sample size of 86 study participants (43 each group) was calculated by using EPI INFO using the cross-sectional study sample calculator keeping 80% power and the confidence interval of 95%. Mothers with no education and low immunization coverage of the children (48%) were taken as the unexposed group, whereas and mothers with higher education and high immunization coverage of children (82%) were taken as the exposed group keeping the exposed and unexposed ratio of 1:1²⁵.

We have used the purposive sampling technique for the selection of participants in the study based on the inclusion and exclusion criteria. Each of the eligible participating parents were given a brief introduction of the study objectives before the interview and the eligible parents were requested to sign a consent form for the approval of voluntary participation.

The inclusion criteria for the study was such that the child appeared on EPI centre for administration of Measles-1 vaccine before the age of 12 months, the child appeared on EPI centre for administration of Penta-3 / Measles-1 vaccine between the age of 12-23 months, parents of children with no physical and mental disorder, children appeared with the EPI card, and parents of children appeared with the CNIC and parents who were resident in the study site for more than a year. Parents who refused to provide consent for the interview, parents with no contact details were excluded. Also children with a single parent, zero dose children and children who were not accompanied by a biological parent were also excluded.

Data was gathered on immunization status as fully immunized children and partially immunized. Information about parents socio-demographic factors was taken. Information on Child gender, birth order and age was recorded. Age was recorded in months from their EPI card. Parent's age was captured using their CNIC cards. Information on their qualification, occupation and years of employment, family system, mother tongue, area of residence and household income was also taken. Data was also collected on number of children, factors related to parental health-seeking behavior, vaccination status of sibling, maternal antenatal care visits, vaccination history and husband's involvement. Place of child birth and birth attendant: was also asked from mothers. The data from the parents of eligible children were gathered using a structured questionnaire.

Participant's data which was captured at the field site was entered in Microsoft Access 2017 form and kept stored in an electronic device protected with a password. The data was analyzed using SPSS 21. The descriptive analysis, reported means and standard deviation for the continuous variable along with the numbers and percentages (proportion) for categorical variables. For the inferential Analysis t-test was performed for continuous variables and Pearson's Chi-Square and Fisher Exact test was performed for categorical variables (keeping the alpha value = 0.05 for evaluating statistical significance). Ethical approval was obtained by the District Health Officer in the selected districts of the EPI, centers.

RESULTS

The mean age of the children in the study was 15.9 (± 3.82) months of whom 59% were females and 41% were males. The study consisted of 39% of children being firstborn in the family. The inferential statistics showed an association between Child's age ($p=0.000$) and immunization status but no association was found between the child's immunization status with gender ($p=0.839$), and the birth order ($p=0.237$). The mean age of the participating fathers was 32.6 years (± 4.8) and mothers were 27.8 years (± 4.2). T-Test indicates no association between father's age ($p=0.276$) and mother's age ($p=0.746$) with the child immunization. Fathers of fully immunized children in the study were mostly office workers 32(64%) and most of the fathers of partially immunized children reported having skilled job 43(83%). The literacy level of 'graduate and above' for the participating Fathers 34(68%) and mother 24 (48%) in the study, had their children fully immunized. Household income of >30,000 monthly was found in 30(60%) fully immunized children but partially immunized group had 31(62%) families with monthly income <18000. There was no difference observed between fully and partially immunized children

whose parents reported having ≤ 3 offspring and who lives in the nuclear/ joint family.

Table 1: Socio-Demographic Characteristics of study children and parents (N=100)

	Fully Immunized (n=50)	Partially Immunized (n=50)	P value
Child Age (in months)			0.000
9-18 months	49 (98%)	31 (62%)	
19+months	1(2%)	19 (38%)	
Child's mean age (SD)	13.6 \pm 3.17	18.16 \pm 2.83	
Child Gender			0.839
Male	21(42%)	20(40%)	
Female	29(58%)	30(60%)	
Birth order			0.237
First born	15 (30%)	24 (48%)	
Other	35 (70%)	26 (52%)	
Father's age (years)			0.276
20-35	39 (78%)	40 (80%)	
35+	11 (22%)	10 (20%)	
Father's mean age (SD)	33.14 \pm 5.4	32.08 \pm 4.17	
Father's occupation			0.000
Unemployed	0(0%)	3 (6%)	
Office job	32(64%)	4 (8%)	
Skilled workers	18(36%)	43 (86%)	
Father's education			0.000
Primary	0 (0%)	12 (24%)	
Secondary	0 (0%)	20 (40%)	
Intermediate	16 (32%)	15 (30%)	
Graduate & above	34 (68%)	3 (6%)	
Mother's age (years)			0.746
20-30	43 (86%)	42 (84%)	
31+	7 (14%)	80 (16%)	
Mother's mean age (SD)	28.02 \pm 4.6	27.74 \pm 3.87	
Mother's occupation			0.039
Housewife	26 (52%)	36 (72%)	
Working	24 (48%)	14 (28%)	
Mother's education			0.000
Primary	0 (0%)	6 (12%)	
Secondary	3 (6%)	25(50%)	
Intermediate	23 (46%)	14 (28%)	
Graduate & above	24 (48%)	5 (10%)	
Monthly Household Income			0.000
Less than 18000	3 (6%)	31 (62%)	
18000 to 30000	17 (34%)	17 (34%)	
More than 30000	30 (60%)	2 (4%)	
Family system			0.523
Nuclear	15 (30%)	18 (36%)	
Joint	35 (70%)	32 (64%)	
Total offspring			0.766
1-3	44 (88%)	44 (88%)	
3+	6 (12%)	6 (12%)	

-Mean, SD and T-test have been calculated for the continuous variables

-Chi-Square have been calculated for categorical variables, and for variables valued less than 5 Fisher's Exact test have been carried out.

Further analyses reported having a significant association of Child's immunization and father's occupation ($p=0.000$), father's education ($p=0.000$), mother's education ($p=0.000$) and household income ($p=0.000$) whereas the study shows no association between the child's immunization status and family system ($p=0.523$) and the number of children in the household ($p=0.766$) (Table 1).

Parental Health Seeking Behavior and Immunization Outcome: The results revealed that 61% of the children in the study had siblings but the highest number of the fully immunized children had their siblings vaccinated 35(70%). Most of the fully immunized children in the study belong to mothers who reported doing more than 6 antenatal visits 41(82%) and have completed their Tetanus Toxoid (TT) vaccination course 45 (90%). Similarly, the study has also revealed that most of the fully immunized children belong to families where mothers are always 37(74%) accompanied with child's father during their antenatal visits as compared to partially immunized children whose fathers have rarely 29(58%) accompanied the mothers during antenatal visits. It has been observed through the study that the children who were fully immunized were born in hospitals 50(100%) by an obstetrician 50(100%) and most of them have reported being brought to the hospital for treatment when they get sick 47(94%) accompanied by both of the parents 46(92%).

Chi-square test have shown a significant association between Child's immunization status and following the factors of parental health-seeking behavior: Completion of sibling's vaccination ($p=0.000$), Number maternal Antenatal visits($p=0.000$), with Completion of mother Tetanus Toxoid (TT) vaccination course($p=0.000$), Husband's involvement during antenatal visits ($p=0.000$), Place of Child birth ($p=0.000$), who delivered the child ($p=0.000$), who brought the child to hospital when he/she gets sick ($p=0.000$) and where the child is taken

for treatment in sickness ($p=0.000$). The results indicate that maternal health-seeking behavior has an impact on a child's immunization (Table 2).

Table 2: Factors related to Parental health-seeking behavior (N=100)

	Fully Immunized (n=50)	Partially Immunized (n=50)	P value
Child Siblings			0.237
Yes	35 (70%)	26 (52%)	
No	15 (30%)	24 (48%)	
Siblings vaccinated*			0.000
Yes	35 (70%)	8 (16%)	
No	0 (0%)	18 (36%)	
Maternal Antenatal Visits			0.000
Less than 6 visits	9 (18%)	47 (94%)	
6 + visits	41 (82%)	3 (6%)	
Maternal Tetanus Toxoid vaccine			0.000
Yes	45 (90%)	18 (36%)	
No	5 (10%)	32 (64%)	
Husband accompany during Antenatal visits			0.000
Always	37 (74%)	7 (14%)	
Often	8 (16%)	14 (28%)	
Rarely	5 (10%)	29 (58%)	
Birth place of the child			0.000
Home	0 (0%)	14 (28%)	
Hospital	50 (100%)	36 (72%)	
Birth attendant			0.000
Obstetrician	50 (100%)	36 (72%)	
Other skilled Birth Attendants (Nurse, Midwife)	0 (0%)	14 (28%)	
Accompany child to the treatment facility			0.000
Mother	3 (6%)	30 (60%)	
Father	1 (2%)	9 (18%)	
Both	46 (92%)	11 (22%)	
Medical Treatment facility			0.000
Hospital	47 (94%)	21 (42%)	
Health facilitation center	3 (6%)	6 (12%)	
Self-medication	0 (0%)	23 (46%)	

*39 children do not have siblings

-Chi-Square have been calculated for categorical variables, and for variables valued less than 5 Fisher's Exact test have been carried out.

Table 3: Parental responses regarding child vaccination (N=100)

	Fully Immunized	Partially Immunized	P value
Accompany child for vaccination			0.052
Mother	13 (26%)	15 (30%)	
Father	6 (12%)	4 (8%)	
Both	31 (62%)	31 (62%)	
Decides to vaccinate the child			0.006
Mother	32 (64%)	20 (40%)	
Father	18 (36%)	24 (48%)	
Both	0 (0%)	6 (12%)	
Recalls vaccination due date			0.000
Mother	4 (8%)	23 (46%)	
Father	6 (12%)	5 (10%)	
Both	40 (80%)	22 (44%)	
Method used to recall vaccine due date			0.096
EPI card	42 (84%)	35 (70%)	
Own memory	8 (16%)	15 (30%)	
Consider vaccination important			0.001
Yes	48 (96%)	36 (72%)	
No	2 (4%)	14 (28%)	
Knowledge of complete immunization visits			0.000
Yes	38 (76%)	14 (28%)	
No	12 (24%)	36 (72%)	
Reasons to vaccinate the child			0.000
Prevent diseases	39 (78%)	22 (44%)	
Beneficial for child	11 (22%)	19 (38%)	
Free of cost	0 (0%)	9 (18%)	
Recommend vaccination to others			0.022
Yes	50 (100%)	45 (90%)	
No	0 (0%)	5 (10%)	
Heard regarding vaccination camps			0.023
Yes	37 (74%)	26 (52%)	
No	13 (26%)	24 (48%)	

-Chi-Square have been calculated for categorical variables, and for variables valued less than 5 Fisher's Exact test have been carried out.

Parental factors associated with child vaccination outcome: Our results show that 31(62%) who were fully immunized in the study were taken for vaccination by both parents. Almost 40(80%) parents of fully immunized children in the study reported to remember the vaccination due date of the child. About 48(96%) parents of fully immunized children have reported that they consider vaccination important for their and they believe it helps prevent diseases (Table 3).

Parental reasons for the partial immunization of the child: The parents of partially immunized children (n=50) provided reasons for not getting the child vaccinated timely and fully (Table 4) Among all the least common reasons reported by the participating parents were misconceptions of adverse events of vaccination 2(4%), the child was not well they brought but the vaccinator did not give the dose 2(4%), few of the parents reported that they lost the epi card and was unable to determine the date of next visit for vaccination 1(2%), immunization center too far from their residence 1 (2%), and timings of EPI centers were not convenient for the parents to manage to come for vaccination 1(2%).

Table 4: Parental reasons for partial immunization of child (n=50)

Reasons for partial immunization	n
lost EPI card and unable to determine next visit	1 (2%)
misconceptions of adverse events	2 (4%)
immunization centre too far	1 (2%)
timings of EPI centres were not convenient	1 (2%)
transportation issues	4 (8%)
parents too busy	19 (38%)
family problem (mother illness)	4 (8%)
the child was not well (not brought)	15 (30%)
the child was not well (brought but not given dose)	2 (4%)
Other	1 (2%)

DISCUSSION

This is the only study that has captured parental determinants for the uptake of immunization from the Peri-Urban area in Karachi and has focused not only on mothers but the factors related to father's involvement in child care as well. The study results have found a significant association between most of the parental socio-demographic determinants and child immunization uptake.

The results of the study indicated that children with parental education level graduate or above living a lifestyle where the household income is sufficient are likely to have full immunization status. A similar study was conducted for six countries where it was presented that parental education and occupation is the most significant and independent predictor of child's immunization²⁶ whereas if mothers are illiterate and have lack of awareness their children end up delaying vaccination²⁷ so it is contributed that maternal education status is highly associated with immunization, the more educated mothers will have more fully immunized children. Fathers of the study have also supported that socio-demographic characteristic and their relationship with child, their educational level and involvement in vaccination process can lead to more successfully immunized children as compared to illiterate and uninvolved fathers^{28,29} so we reject the null hypothesis for these factors in our study. The study have supported the literature by concluding that there is a significant association between poverty and immunization status^{4,30}. Family monthly income is associated with immunization status of the child. It has been seen that higher-income families have more children vaccinated^{11,29,31}

The study failed to find association between child's immunization status and child's gender, birth order, father's and mother's age, family system and number of children in household. Information on the gender impact of a child's immunization has mixed results^{32,33}, some studies have found a gender impact on immunization, others have found that there is no gender-wise association with immunization status³⁴.

The factors related to the health-seeking behaviour of parents and their relationship with the child's immunization status expressed notable association. Studies have shown that maternal health-seeking behaviors are one of the main factors that are linked with child immunization. It has also reported in India and Bangladesh also^{35,36} that the mothers' TT vaccination coverage is a positive factor for assessing child's immunization because the mothers who are fully vaccinated have more fully immunized children as compared to mothers who do not get vaccinated during pregnancy or in the childbearing age³⁷.

The study has highlighted father's role and have shown a significant association between a child's immunization status and the fathers who accompanied mother's during antenatal visits and have their involvement during the antenatal period³⁸. A research study conducted back in 2018 on husband's involvement in antenatal care found that a strong link lies between husband's involvement and mother's use of more expert birth helpers³⁹ and the children who delivered at the hospital are more fully immunized as compared to

children who delivered at home⁴⁰ and the children who are usually taken to the hospital for seeking medical care for any purpose and are accompanied by both parents have seen to have complete immunizations¹².

Children who belong to the parents who usually seeks EPI vaccination card help to recall the due date of a particular vaccination are mostly immunized. Other studies have shown similar outcomes that if the parents have insufficient knowledge and have the wrong perception of vaccine they are probably not vaccinating the child completely^{10,41}. Parents of fully immunized children in the study were aware regarding the total number of immunization visits till the child is fully vaccinated, and it has also seen that if the parents are considering vaccinating a child important they are going to take the child for getting the dose but unlike with the parents of partially immunized children⁴¹ suggestions have been made on this issue prior also that improving awareness about immunization can enhance the coverage^{42,43}.

The sample size of our study was small, and the study was conducted in a peri-urban population so the results cannot be generalized for Karachi. We were not able to collect information from the multiethnic group as the study participants were mostly Urdu speaking and the cultural factors were largely missing. The information and data should have been collected from urban and rural communities for better comparison so the determinants of parents of children who are Zero-dose would have added more clarity in the picture. The strength of this study is that it gives comparison of fully and partially immunized children in detail.

CONCLUSION

The study concluded that Parental education, father's occupation, household income, maternal antenatal visits frequency, child birthplace and attendant, vaccination completion of maternal TT vaccine, vaccination completion of siblings, involvement of child's father in child's health whether immunization or other medical care, parental awareness regarding the number of doses and visits, good perception of immunization and will to recommend it to others, knowledge regarding the reason they are immunizing the child for, awareness regarding immunization outreach campaigns in the area are the strong predictors of fully immunized children.

Conflict of interest: Nil

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