
Original Article

Assessment of EPI (Expanded program of immunization) vaccine coverage in a peri-urban area

Nazish Siddiqi^{1,3}, Altaf Khan^{2,3}, Nighat Nisar³, Azfar-e-Alam Siddiqi¹

Department of Epidemiology, Michigan State University¹, USA, Institute of Environmental Studies, University of Karachi², Department of Community Medicine, Baqai Medical University,³ Karachi.

Abstract

Objective: To determine the age-appropriate EPI coverage of under one year old children and Tetanus Toxoid (TT) coverage of their mothers (15-49 years) in peri-urban Karachi and to determine the factors associated with low coverage.

Methods: A cross-sectional study was carried out by utilizing WHO thirty-cluster sampling technique, seven households with infants, were randomly selected per cluster. Child's mother was interviewed by using a structured pre-tested questionnaire, regarding the EPI coverage of her child, her own T.T. coverage and other demographic and potential risk factors for low vaccination coverage.

Results: Forty five percent of the infants were age-appropriately vaccinated. The T.T coverage of mothers for the index pregnancy was 57.3% for both doses of the vaccine. In the multivariate model four factors i.e., type of house construction (proxy indicator of socio-economic status), mother's TT vaccination status, years since marriage and parents' educational status were found to be significantly associated with children's immunization status.

Conclusions: We concluded that the EPI coverage of Gadap town, Karachi is quite low. Education of both parents plays a significant role in child's immunization coverage. Improving the educational status of parents can potentially improve the immunization coverage (JPMA 57:391:2007).

Introduction

Expanded program on immunization (EPI) was launched in 1976 by WHO and UNICEF with the aim of controlling six childhood diseases: tuberculosis, diphtheria, pertussis (whooping cough), tetanus, polio and measles.¹ Immunization is the most cost effective health intervention in existence.² It takes about US \$ 15 to fully immunize a child, but by significantly reducing the cost of treating

diseases it offers opportunities for poverty reduction and social and economic development of the country.¹

Immunization coverage in South Asia has increased from about five percent in the 1970s to nearly 50 percent at present but still half of the children remain un-immunized. All over the world vaccine-preventable diseases still account for about two million deaths per year. Measles is the major killer of children accounting for 455,000 deaths every year despite a 48 percent reduction over the past six

years, with most of these deaths occurring in the developing countries.³

Accelerated efforts are needed to increase EPI coverage. Immunization coverage surveys are conducted to monitor the existing coverage and identify problems faced by the service recipients.⁴

Immunization coverage studies have been conducted in Belgium, Bangladesh, Ethiopia, Thailand and Cambodia⁵⁻⁹ and have found various factors associated with faulty coverage. Among these factors were; carelessness on either parents' or physician's part, attitude of the physician, lack of identification of target age groups, social problems, lack of parents' knowledge about immunization, maternal illiteracy, vaccine cost, low socioeconomic status and refusal due to child sickness and other issues.

Pakistan is a developing country with a population of 150 million and estimated infant mortality rate (IMR) of 80/1000 live births. The EPI coverage is 80% for BCG, 65% for DPT3 and polio3 and a mere 67% for measles (10). The Tetanus Toxoid (TT) coverage of pregnant women is 56%-57% which is quite low.¹⁰⁻¹¹ Tetanus neonatorum is prevalent in Pakistan mostly in the rural areas due to low TT coverage, the practice of cow-dung application on the umbilical cord of newborns and wrapping them in sheep-skin wraps.¹² In a verbal autopsy study conducted in two provinces of Pakistan, the three main causes of infant deaths were reported as diarrhoea syndrome (21.6%), tetanus (11.7%) and acute respiratory infections (11.6%).

A study conducted in North West Frontier province of Pakistan reported only 65% of under three year olds as fully immunized. The reasons for non-compliance with the EPI schedule were: mother too busy, absence of vaccinator and inconvenient places being utilized as EPI centers.¹³ EPI target diseases that contribute significantly to the infant mortality, therefore, enhancing the EPI vaccination coverage can reduce this mortality rate.¹

The objective of this study was to determine the age appropriate EPI coverage of under one year old children and tetanus toxoid coverage of their mothers (15-49 years) in peri-urban Karachi and to determine the factors associated with low coverage.

Subjects and Methods

This study was conducted in Karachi; the largest city and the industrial capital of Pakistan with a population of about 10 million. Karachi is administratively divided into eighteen towns, which are further divided into Union Councils (UCs). This study was conducted in Gadap town, Karachi which has a mixture of urban and semi-urban villages. The total population of Gadap town is about 287,564.¹⁴

A cross-sectional survey was conducted utilizing the 30 cluster sampling technique.¹⁵ Seven children and seven women were included per cluster, which comes to 210 women and 210 children. As Gadap town is divided into eight union councils, we randomly selected four clusters each from six U Cs, and three clusters each from the two least populated U Cs. Random numbers list was utilized to select villages and in each village, seven households (with at least one infant) were chosen by systematic sampling.

A structured questionnaire was utilized to collect data. The mothers were consented for an interview regarding the immunization status of their infant and their own tetanus toxoid vaccination status. In case of refusal, we approached the next closest household. EPI cards were checked wherever available and if not, the subjects were inquired verbally and BCG scars were checked in children.

We gathered information on characteristics such as basic demographics, socio-economic status, reproductive history, health services utilization, immunization coverage of mother and child and reasons for non-compliance with the EPI schedule.

The data collected was entered using Epi-info software. Analysis was performed in Statistical Package for Social Sciences (SPSS) software. Initially, the proportion of children receiving appropriate vaccination for age was calculated with its 95% confidence interval. Later, multiple logistic regression analysis was done to identify the factors independently associated with low coverage.

Results

The basic demographic information of the families studied is summarized in Table 1.

Out of the 210 families interviewed, two families had twin infants. The mean age of the infants was 6.3±3.34 months. Majority of the mothers had been married for less than ten years (63.3%). The total number of living children ranged from 1-12 children per family. About 77% of the families had less than five children.

Sixty eight percent of mothers had received one dose of T.T. Vaccine in the index pregnancy (68.1%, 95% C.I.= 61.27 - 74.25) and second dose after a month was received by 83.9% of them (95% CI= 76.6-89.3). Therefore, 57.3% (95% CI=76.6- 89.3) of the mothers received both T.T. doses during index pregnancy and were regarded as appropriately covered.

When inquired about the total number of T.T doses received in lifetime by the mothers, we learnt that 51 mothers had never received T.T vaccination. There were 12 women who had received just one dose. The rest of the women (64.8%) had received between 2-5 doses of TT.

Table 1. Demographic information of the families surveyed to determine EPI coverage, Gadap Town, Karachi(n = 210).

Characteristic	Number of subjects
	No. (%)
Fathers' occupation	
Unskilled labor	57 (27.1)
Government service	40 (19.0)
Private service	22 (10.0)
Driving	21 (10.0)
Business	20 (9.5)
Skilled labor	20 (9.5)
Unemployed	13 (6.1)
Farming	9 (4.2)
Landlord	8 (3.8)
Fathers' education	
Illiterate	69 (32.9)
1 to 10 years schooling	99 (47.1)
Greater than 10 years schooling	42 (20.0)
Fathers' ethnicity	
Sindhi	88 (41.9)
Urdu speakers	44 (21.0)
Balochi	36 (17.4)
Punjabi	26 (12.4)
Pathan	6 (2.9)
Afghan	6 (2.9)
Others	4 (1.9)
Mothers' occupation	
Housewives	198 (94.2)
Skilled labor	6 (2.8)
Government service	5 (2.3)
Labour	1 (0.7)
Mothers' education	
Illiterate	117 (55.7)
1 to 10 years schooling	73 (34.8)
Greater than 10 years schooling	20 (9.5)
Mothers' ethnicity	
Sindhi	86 (41.0)
Urdu speakers	45 (21.4)
Balochi	38 (18.1)
Punjabi	26 (12.4)
Pathan	6 (2.9)
Afghan	6 (2.9)
Others	3 (1.4)
Monthly income	
Less than 5000 rupees	153 (72.9)
Greater than or equal to 5000 rupees	57 (27.1)
Family composition	
Nuclear	88 (41.9)
Joint	105 (50.0)
Extended joint	17 (8.1)
House construction	
Mud structure	33 (15.7)
Concrete	177 (84.3)

Table 2. EPI Coverage of under one-year-old children, Gadap Town, Karachi.

Variables	Appropriate for Age /total	Percent %
BCG and OPV 0	160/210	76.2 %
DPT 1 and OPV 1	118/194	60.82 %
DPT 2 and OPV 2	89/181	49.17 %
DPT 3 and OPV 3	75/165	45.45 %
Measles	23/86	26.74%
Hepatitis B	43/181	23.75%
Appropriate Child 1	94/210	44.8 %
Appropriate Child 2	1/2	50.0 %

Table 3. Univariate and Multivariate logistic regression models to identify risk factors for inappropriate EPI coverage, Gadap town, Karachi.

Characteristic	Univariate	Multivariate
	Odds ratio (95% Confidence Interval)	Adjusted Odds ratio (95% Confidence Interval)
Type of house construction		
Brick	1.00 (reference)	1.00 (reference)
Mud	4.45 (1.75 - 11.30)	2.31 (0.83 - 6.46)
Mother's Tetanus vaccination status		
Vaccinated	1.00 (reference)	1.00 (reference)
Non-vaccinated	3.22 (1.80 - 5.76)	2.24 (1.16 - 7.2)
Parents' literacy		
Both parents' literate	1.00 (reference)	1.00 (reference)
Illiterate father and literate mother	1.66 (0.39 - 7.10)	1.42 (0.32 - 6.40)
Illiterate mother and literate father	2.56 (1.28 - 5.12)	1.71 (0.78 - 3.74)
Both parents illiterate	5.08 (2.45 - 10.53)	3.61 (1.64 - 4.32)
Years since marriage		
< 5 years	1.00 (reference)	1.00 (reference)
5 - 9 years	1.37 (0.68 - 2.75)	0.99 (0.45 - 2.21)
10 - 14 years	2.41 (1.07 - 5.40)	2.10 (0.87 - 4.97)
15 - 19 years	3.85 (1.22 - 12.14)	2.21 (0.67 - 7.88)
> 20 years	8.25 (1.69 - 40.32)	4.95 (0.93 - 26.252)
Sex of the child		
Male	1.00 (reference)	
Female	1.02 (0.59 - 1.76)	
Monthly Income (quartiles)		
> \$50 ²	1.00 (reference)	
Up to \$50	1.81 (1.04-3.15)	
Still birth or child deaths		
No	1.00 (reference)	
Yes	1.63 (0.93 - 2.83)	
Knowledge score		
≥10	1.00 (reference)	
5-9	1.09 (0.43 - 2.75)	
<5	2.39 (1.01 - 5.65)	
Number of Children alive		
<5	1.00 (reference)	
≥5	3.41 (1.41 - 8.30)	

There were 11 women (5.2%) who reported receiving more than 5 doses of T.T vaccine.

The EPI coverage of infants residing in Gadap town was 44.8% (95% C.I. =37.96-51.76).

The reasons for not receiving TT vaccination were reported as no benefit (37.5%), distant vaccination centers (32.2%), and pain due to vaccine (12.5%), social problems (11%) and fear of harm to foetus (5.4%).

Table 2 summarized the EPI coverage of the children studied and gives the percentage of children that were appropriately vaccinated for their age.

Reasons for not getting the child appropriately vaccinated were also investigated. About 37% of the mothers complained about the facility being far off, 6% blamed the absence of mobile teams, 13.7% had improper knowledge of EPI schedule and 10% complained about non-availability of vaccine at the center.

There were 39 instances of conscious refusal to vaccination (33.3%). Out of these mothers 31% perceived vaccination as unnecessary, 25.6% reported child sickness on the due date, 25.6% thought that vaccine makes their child sick and 10% considered their child too weak to receive vaccination.

All biologically important variables and those variables that were found significant in uni-variate analysis were further evaluated in the multivariate model.

Four factors were thus identified, namely type of house construction, mother's TT vaccination status, years since marriage and the combined parental educational status.

The incompletely vaccinated children were more likely to have mothers who did not receive TT vaccination in index pregnancy (AOR 2.24, 95% CI 1.16 - 7.92).

We evaluated the effect of parents' literacy in two ways, first mother's and father's literacy was assessed separately and then in a pooled variable with four levels, both parents literate (reference group), father illiterate, mother illiterate and both illiterate.

After adjusting for the other variables in the model, parents' literacy emerged as a strong determinant of vaccination. Children with incomplete vaccination coverage, were about 50% more likely to have illiterate father only, 71% more likely to have illiterate mother only and more than 3 ½ times as likely to have both parents illiterate.

Inappropriately vaccinated children were also more likely to have parents who had been married for a longer period than children with age-appropriate vaccination as shown in Table 3.

Discussion

The age-appropriate vaccination coverage for infants in our study was 44.8%. A study conducted in Chicago, USA, among inner city pre-school children reported coverage of 47% but in this study, the age of the children was between 19 to 35 months.¹⁶ Another study conducted in Gondar, Ethiopia among 12-24 months old children reported 47.4% as fully immunized.⁷ A baseline study done in four regions of Pakistan showed EPI coverage of 48%.¹⁷ In another study in the North West Frontier Province (NWFP) of Pakistan, 65% of children were fully immunized by three years of age.¹³ Fasih et al reported EPI coverage of 26.5% by age 2 years in Karachi, Pakistan.¹⁸ In our study, despite using relatively strict criteria by enrolling only under one year old children and counting a vaccine delay of more than a week as inappropriate, comparable or better coverage has been found.

The coverage of individual vaccines was 76% for BCG, 61% for DPT 1, 49% for DPT 2, 45% for DPT 3 and about 27% for measles. UNICEF in State of the World Children 2004 reports BCG coverage as 67%, DPT 3 as 63% and measles as 57%. The BCG coverage in our study is a little more than that reported by UNICEF, but our DPT3 and measles coverage is far below that. In another study conducted in Hyderabad, Pakistan in 1-3 year olds BCG coverage was reported as 71.6%, DPT 1-3 as 64.8% and Measles as 40.8%.¹⁹

The causes of missing or low vaccination in our study are consistent with studies conducted in other regions of Pakistan which reported mother being busy, laziness of parents, minor illnesses in children, absence of vaccinators, inconvenient EPI centers, poor quality care, fear of side effects and lack of faith in immunization program.¹⁷⁻¹⁹ A qualitative study conducted in Karachi, reported similar causes along with other cases like forgetting scheduled dates, low quality services and inaccessibility of government dispensaries, vaccine cost and prevailing myths about immunization.²⁰

The TT coverage in our study was 57.3% for the index pregnancy. UNICEF in the State of the World's Children reported TT coverage of 56% which is comparable to our finding. A study conducted by Afridi et al in Peshawar reports TT coverage of 65% among women of reproductive age.²¹ The reasons for not getting TT vaccination in our study were similar to those reported by Mansuri et al, as lack of ante-natal care, fear of side effects, lack of local and especially female vaccinators, social problems, and poor record keeping by the recipients.²⁰

We studied association of various factors with delayed or non-vaccination by multiple logistic regression

analysis. Similar factors have been identified as significantly associated with low coverage in other studies.^{18,22-24} Bolder initiatives and cost-effective interventions are required to improve health service accessibility and utilization in Pakistan in order to reduce maternal and child mortality comparable to that in Sri Lanka and some other parts of Southeast Asia.²⁵

Conclusions

We concluded that education of both parents plays a significant role in child's immunization coverage. Type of house construction reflects the socio-economic status of the family and was an important factor in determining coverage. Mothers' TT coverage status was significantly related with child's EPI coverage status, which reflects the health seeking behaviour of a more conscious mother making good health choices for herself as well as for her child.

Acknowledgement

This investigation received technical and financial support from the joint WHO Eastern Mediterranean Region (EMRO), Division of communicable Diseases (DCD) and the WHO Special Program for Research and Training in Tropical Diseases (TDR): The EMRO/TDR Small Grants Scheme for Operational Research in Tropical and other Communicable Diseases.

We are thankful to the staff and faculty of Baqai Medical University for their support in conducting this study.

References

1. World Health Organization. Immunization, Vaccines and Biologicals. Available from: <http://www.who.int/vaccines&diseases/history.shtml>
2. World Health Organization Media Center. Global Alliance for Vaccines and Immunization (GAVI): available from: <http://www.who.int/entity/mediacentre/factsheets/en>. Accessed on 16-07-2004.
3. World Health Report 1999. Making a Difference. Available from: <http://www.who.int/whr/1999/en/>
4. Henderson RH, Keja J. Global control of vaccine-preventable diseases: How progress can be evaluated. *Rev Infect Dis* 1989; 11: 649-54.
5. Vellinga A, Depoorter A, Van Damme P. Vaccination coverage estimates by EPI cluster sampling survey of children (18-24months) in Flanders, Belgium. *Acta Paediatr* 2002; 91: 599-603.
6. Rahman M, Islam MA, Mahalanabis D. Mothers' knowledge about vaccine

- preventable diseases and immunization coverage in a population with a high rate of illiteracy. *J Trop Pediatr* 1995; 41: 376-8.
7. Gedlu E, Tesemma T. Immunization coverage and identification of problems associated with vaccination delivery in Gondar, northwest Ethiopia. *East Afr Med J* 1997; 74: 239-41.
8. Bhunbhu T. Expanded Programme on Immunization in Thailand. *Rev Infect Dis* 1989; 11:514-7.
9. Main B, Lower T, James R, Rouse I. Changes in Expanded Program for Immunization coverage for mother and child in Krakor, Cambodia 1996-1998. *Trop Med Int Health* 2001; 6: 526-8.
10. UNICEF, State of the world Children, 2004, Oxford University Press, New York.
11. World Health Organization. Country Profile. Available from: <http://www.emro.who.int/emrinfo/CountryProfiles-pak.htm>
12. Fikree FF, Azam SI, Bernendes HW. Time to focus child survival programs on the newborn: Assessment of levels and causes of infant mortality in rural Pakistan. *Bull World Health Organ*, 2002; 80: 759-60
13. Ahmad N, Akhtar T, Roghani MT, Ilyas HM, Ahmad M. Immunization coverage in three districts of North West Frontier Province (NWFP). *J Pak Med Assoc* 1999; 49: 301-5.
14. Government of Sindh, The Sindh Government Gazette: Notification Karachi, 21st May 2001. 1218.
15. World Health Organization. Description and Comparison of the methods of Cluster Sampling and Lot Quality Assurance Sampling to assess immunization coverage 2001. WHO/V&B/01.26.
16. Kenyon AT, Matuck MA, Stroh G. Persistent low immunization coverage among inner city pre-school children despite access to free vaccine. *Pediatrics* 1998; 101: 612-6.
17. Tarin E, Khalil M, Mustafa T, Alvi ZM, Sy FS, Thomson SJ et al: Impact of community-based intervention on immunization coverage against vaccine-preventable diseases in Pakistan. *Pakistan J Health* 1999;36:53-6.
18. Anjum Q, Omair A, Inam SNB, Ahmed Y, Usman Y, Shaikh S. Improving Vaccination Status of children under five through Health Education. *J Pak Med Assoc* 2004;54:610-13.
19. Shaikh S. Immunization status and reasons for low vaccination in children, attending O.P.D. at Liaquat University Hospital. *Pakistan Ped J* 2003; 27: 81-6.
20. Mansuri FA, Baig LA. Assessment of immunization services in perspective of both the recipients and the providers: A reflection from focus group discussions. *J Ayub Med Coll Abbotabad* 2003; 15:14-8.
21. Afridi NK, Hatcher J, Mahmud S, Nanan D. Coverage and factors associated with tetanus toxoid vaccination status among females of reproductive age in Peshawar. *J Coll Physicians Surg Pak* 2005;15: 391-5.
22. Sultana A, Jahan S, Ahmad I. Knowledge, Attitude and Practice of immunization in an urban population. *Pak Armed Forces Med J* 2001; 51: 177-81.
23. Fasih Z, Hussain E, Ali Z. Risk Factors for complete un-immunization & under immunization of children under 2 years of age in third world countries. *J Pak Pediatr Assoc* 2000; 24:145-52.
24. Browne EN, Bonney AA, Agyapong FA, Essegbey IT. Factors influencing participation in National immunization days in Kumasi, Ghana. *Ann Trop Med Parasitol* 2002; 96: 93-104.
25. Bhutta ZA, Gupta I, de'Silva H, Manandhar D, Awasthi S, Hossein SMM et al. Maternal and child health: Is South Asia ready for change? *BMJ* 2004;328:816-9.