Novelty Journals

ISSN 2394-7330

International Journal of Novel Research in Healthcare and Nursing
Vol. 2, Issue 3, pp: (77-85), Month: September-December 2015, Available at: www.noveltyjournals.com

Factors affecting improper immunization coverage of children between two – five years of age in Colombo District, Sri Lanka 2014

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Abstract: **This study has explored the hypothesis that predisposing and enabling factors of households influence the immunization status of the children among age of two - five in Colombo District, Sri Lanka. The study was a cross-sectional survey among a representative sample of 400 male and female children under two - five years of age from households with varying socio-economic status and mothers with varying levels of education, from urban, urban slum and rural localities in the Colombo District. The proper immunization coverage rate for children was found to be low. Children in urban and urban slum areas differed substantially in their proper immunization rates and their receipt of each vaccine separately. The immunization rate decreased with an increase in the age of the children and immunization rate decreased with a decrease in the education level of the mother. A strong relationship with the immunization status of their children was showed with mothers' knowledge of and attitudes to immunization. Private sector contribution was found to be very low and most immunizations occurred in government sector. Private sector immunization service was preferred by the people who lived in urban areas rather than the people who lived in rural and urban slum areas. The large differences found in immunization coverage mere by place of residence, level of education and level of knowledge about vaccines, working status of the mother suggested that much greater efforts are required if better rates of proper immunization are to be achieved in urban slum areas.**

Keywords: **Child Immunization, Expanded Programme on Immunization (EPI), Proper Immunization, Improper Immunization, Urban Slum Areas.**

1. INTRODUCTION

Vaccines, "With the exception of safe water, no other modality, not even antibiotics, has had such a major effect on mortality reduction…" (Plotkin S, 2008).

Immunization is the process whereby a person is made immune or resistant to an infection, typically by the administration of a vaccine (WHO Immunization, 2012). Vaccines are highly regulated, complex biologic products designed to induce a protective immune response both effectively and safely (BC (British Columbians) Center for Disease Control, 2010).

Vaccination is the administration of a vaccine to stimulate a protective immune response that will prevent disease in the vaccinated person if contact with the corresponding infectious agent occurs subsequently. Thus vaccination, if successful, results in immunization: the vaccinated person has been immunized. In practice, the terms "vaccination" and "immunization" are often used interchangeably (BETA Bloodindex Health Diary, 2007). Immunization is a proven tool for controlling and eliminating and eradicating life-threatening infectious diseases and is estimated to avert over 2 million deaths each year. It is considered as one of the most cost-effective health investments (WHO Immunization, 2012).

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The word "vaccine" comes from the Latin word vaccines, which means "pertaining to cows." What do cows have to do with vaccines? The first vaccine was based on the relatively mild cowpox virus, which infected cows as well as people. This vaccine protected people against the related, but much more dangerous, smallpox virus. More than 200 years ago, Edward Jenner, a country physician practicing in England, noticed that milkmaids rarely suffered from smallpox. The milkmaids often did get cowpox, a related but far less serious disease, and they never became ill with smallpox. In an experiment that laid the foundation for modern vaccines, Jenner took a few drops of fluid from a skin sore of a woman who had cowpox and injected the fluid into the arm of a healthy young boy who had never had cowpox or smallpox. Six weeks later, Jenner injected the boy with fluid from smallpox sore, but the boy remained free of smallpox. Dr. Jenner had discovered one of the fundamental principles of immunization. A relatively harmless foreign substance had been used to evoke an immune response that protected someone from an infectious disease. His discovery eased the suffering of people around the world and eventually led to eradication of small pox, a disease that killed a million people, mostly children. By the beginning of the twentieth century, vaccines were in use for diseases that had nothing to do with cows [rabies, diphtheria, typhoid fever, and plague] but the name stuck (National Institute of Allergy and Infectious Diseases, 2009).

Palihawadana, P. et al (2012) found today, there are many vaccines available to prevent nearly 30 communicable diseases. Indeed, vaccination has become one of the most important preventive health care interventions of all time. Every year millions of children and adults receive vaccinations that protect them from a host of infectious diseases; meanwhile, the arsenal of vaccines is growing rapidly through bio-medical research.

Palihawadana, P. et al (2012) found today all countries have national immunization programmes, and in most developing countries, children under five years are immunized with the standard WHO recommended vaccines that protect against eight diseases – tuberculosis, diphtheria, tetanus (including neonatal tetanus through immunization of mothers), pertussis, polio, measles, hepatitis B, and Hib. These vaccines are preventing more than 2.5 million child deaths globally each year.

In the year 1798, Edward Jenner first demonstrated that vaccination offered protection against smallpox. He used cowpox (poxvirus bovis) for the immunization of man against the smallpox virus (poxvirus varialae). For the last 200 years, the use of vaccines has continued to reduce the burden of many bacterial and viral diseases. Smallpox itself has been eradicated, and poliomyelitis no longer occurs in the Americas. In Sri Lanka, the last case of virologically confirmed poliomyelitis patient was reported in 1993 (Palihawadana, P. et al., 2012). In Sri Lanka, the introduction of routine immunization has been generally reduced the incidence of several vaccine preventable diseases. Similar success in disease reduction has been demonstrated by immunization programmes in many other countries. The World Health Organization's (WHO) Expanded Programme on Immunization (EPI), with assistance from the United Nations Children's Fund (UNICEF) and other donors, has made great strides in extending these benefits to developing countries. Immunizations permitted the global eradication of smallpox, and may do the same for poliomyelitis and some other diseases (Epidemiology Unit, 2011).

Promotion of maternal and child health is one of the key objectives of the Expanded Programme on Immunization (EPI), department of health service and epidemiology unit, ministry of health in Sri Lanka. The government of Sri Lanka is making considerable efforts in improving the equality and access of maternal, new born and child care as well as immunization services.

Immunizing a child not only protects that child but also other children by increasing the general level of immunity and minimizing the spread of infection.

2. RESEARCH PROBLEM

Morbidity and mortality caused by diseases that are preventable by vaccine are still very high in many developing countries across the world. 15% of deaths in children fewer than five years of age are attributed to these diseases (WHO, 2001). The situation is similar in Sri Lanka.

In Sri Lanka Expanded Programme on Immunization (EPI) was launched in 1978 which was intensified nationwide in 1979. A great success has been achieved with collaborative efforts from the government, donors, NGO and civil society within 20 years in the programme. The immunization coverage of the children has reached to 80 percent in 1989/90 which was only lower vaccination coverage in 1978.

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However Both routine and survey data on immunization coverage showed that the coverage for EPI vaccines during the first two years of life was above 90% and for most districts it was near 100%. In addition to the government sector, private sector also has provided immunization services, particularly in urban areas. Reporting from the private sector was poor. However, it has been noticed that the coverage for vaccines slightly decreases with increasing of age (Table 1).

Table 1: National level EPI vaccine coverage for year 2010

Vaccine	# target group	# doses given	Coverage%
BCG	364,565	353,278	96.9
DPT1/Penta1	361,466	340,319	94.1
DPT3/Penta1	361,466	334,153	92.4
OPV3	361,466	336,097	93.0
HepB3/Penta3	361,466	332,684	92.0

Source: Epidemiology Unit

Relatively poor coverage when compared to the first year of life was reported for tetanus toxoid/ adult diphtheria tetanus (aTd) vaccine among 10 – 15 years old, and rubella among females aged 15 – 44 years. Poor coverage of vaccines administered at school going age was partly due to improper planning of school health activities at the divisional level and inadequate support from some school authorities. It clearly indicated that there was no marked difference in immunization coverage at district level. Existence of pockets of relatively low coverage in some districts has been revealed by the analysis of the divisional level data on coverage obtained from both routine surveillance and surveys. These low coverage pockets were mainly located in the estate sector, previously conflict zones in North and East Provinces and Colombo district in Western Province (Table 2).

Table 2: District level EPI vaccines coverage for year 2010

District	BCG%	DPT1%	DPT3%	OPV3%
Colombo	**97.7**	**87.2**	**84.6**	**87.2**
Gampaha	94.8	90.4	92.1	91.5
Kalutara	93.0	92.8	93.2	92.7
Kandy	94.7	95.9	93.9	92.8
Galle	90.7	93.9	91.7	91.0
Hambanthota	97.5	95.3	93.7	93.6
Matara	95.8	91.9	89.7	87.6
Jaffna	100.0	95.7	94.6	92.9
Kilinochchi	**26.1**	**95.6**	**95.5**	**94.1**
Mannar	**85.2**	**84.0**	**88.2**	**88.7**
Vavuniya	**74.9**	**86.0**	**85.0**	**80.6**
Mulativu	**9.7**	**95.6**	**89.1**	**91.1**
Batticaloa	**100.0**	**89.4**	**87.0**	**83.4**
Sri Lanka	96.8	93.3	92.7	92.2

Source: Epidemiology Unit (selected districts only)

So it appeared that apart from some maternal factors and socioeconomic factors of parents there were also some programme factors which had direct impact on the immunization coverage of children. To understand about the factors affecting the immunization coverage of children (in low coverage area) all these factors needed to be addressed.

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3. OBJECTIVES OF THE STUDY

General Objective of the Study:

The general objective was to analyze the impact of factors affecting improper immunization coverage of children under two-five years of age in Colombo district, Sri Lanka.

Specific Objectives of the Study:

- ✓ Assess the immunization coverage among children under the age of five in the Colombo district, Sri Lanka.
- ✓ To determine the association among some selected socioeconomic and demographic characteristics of mothers and immunization status of children in Colombo district, Sri Lanka.
- ✓ Examine the factors that affect for the less chanelling for immunization in private sector.

4. RESEARCH METHODOLOGY

The study was a cross-sectional survey among a representative sample of 400 male and female children under five years of age from households with varying socio-economic status and mothers with varying levels of education, from both urban and rural localities in the Colombo district. A sample questionnaire was used by the study to mothers and caretakers on the immunization status of children aged 2-5 years. The method was adapted Disproportionate Stratified Random Sampling Technique for collecting the sample. Bivariate (cross-tabulation and chi-square tests) and logistic regression analysis were used for the analysis of the data.

Fieldwork & Data Collection:

Data on the immunization status of the children were collected from married women of reproductive age who had at least one child. In this study, a pre-structured questionnaire was used to collect primary data in the interviews with the mothers.

Child Immunization Coverage Questionnaire:

- ✓ *Background characteristics (Child's profile and respondent's profile):* included respondent's age, child's age, living sector, education status, working status, birth order of the child and family income.
- ✓ *Knowledge and awareness of immunizations:* questions covered knowledge of different vaccines given to the child by age 1, number of doses and age at which first dose was given, knowledge of source of vaccination and perceived importance of vaccinating a child.
- ✓ *Routine immunization coverage:* questions included coverage by different antigens and age at which these vaccinations were given, source of vaccination, and reasons for no or partial immunization.
- ✓ *Accessibility of immunization services:* was covered availability and accessibility to the nearest place for immunization, midwife's visit to the village/ area, holding routine immunization sessions and their satisfaction with immunization sessions.

Dependent Variable:

Dependent variable in this study would be the coverage status of immunization of 2-5 years old children. Children up to 24 month were not considered, as nine months and eighteen months were needed for a child to be immunized completely and programme encourages mothers to complete their children's immunization by one year of age. Though children's age 2-5 years was better to find the immunization coverage, but as this study concentrates more on factors affecting the immunization coverage so maximum age limit covered by the survey was considered. Coverage was categorized into two groups; proper immunization and improper immunization.

- ✓ ***Proper immunization***

If a child received all the necessary doses at the appropriate age then the coverage was called 'valid'; otherwise (Different doses) it was called 'crude'. In this study both 'valid' and 'crude' coverage were considered as proper immunization coverage of children of 2-5 years of age.

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ISSN 2394-7330

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✓ ***Improper immunization***

Refers to the immunization status when, a child did not receive all vaccines completely or even any vaccine at all as recommended by, the EPI programme.

5. RESULTS AND FINDINGS

H1: There is an association between improper immunization status and selected variable.

Table 3: Hypothesis of model

Hypothesis	P	Conclusion
H_{1a}:	0	There is a significance association between improper immunization status and living sector
H_{1b}:	0.435	There is not a significance association between improper immunization status and gender of child
H_{1c}:	0.908	There is not a significance association between improper immunization status and no: of child under 2-5 years
H_{1d}:	0.702	There is not a significance association between improper immunization status and birth order of the child
H_{1e}:	0.038	There is a significance association between improper immunization status and mother's age at first child's birth
H_{1f}:	0	There is a significance association between improper immunization status and education level of the mother
H_{1g}:	0	There is a significance association between improper immunization status and working status of the mother
H_{1h}:	0	There is a significance association between improper immunization status and level of knowledge about what vaccines an infant should get before he/she attains age of one year
H_{1i}:	0.012	There is a significance association between improper immunization status and knowledge about the private sector immunization

Source: Sample Survey Data Set (Immunization.sav)

To see this, consider as the final fitted model for improper immunization status this study can see that people lived in urban areas less likely to improper immunization status, compared to rural area. The exponent of the coefficient of urban has given an odds ratio of 0.027. This means that the odds of improper immunization status whose their living in the urban areas were 0.027 times the odds of improper immunization status whose their living in the rural areas. The odds of child in improper or improper immunization status whose their living in the urban area were 12%, lower than the odds of child in improper or improper immunization status whose their living in the rural area. Similarly people lived in urban slum areas more likely to improper immunization status, compared to rural area. The odds of child in improper immunization status whose their living in the urban slum area were 100%, higher than the odds of child in improper immunization status whose their living in the rural area.

$$\text{logit}\,(\hat{\pi}) = 1.562 + 2.844\,\text{w} + 2.319\,\text{hk} - 3.6\,\text{urb}$$

Table 4: Final fitted model

Parameter	B	S.E.	Wald	df	Sig.	Exp(B)
Work	2.84	.66	18.6	1	.000	17.19
1st Year Vac			11.1	4	.026	
Very Low	3.58	2.3E6	.00	1	1.000	35.72
Low	16.97	4.6E5	.00	1	.997	2.3E9
Moderate	19.71	2.6E5	.00	1	.994	3.6E9
High	2.32	.69	11.1	1	.001	10.17
Living Sect			10.6	2	.005	
Urban	-3.60	1.11	10.6	1	.001	.08
Urban Slum	13.22	2.9E5	.00	1	.996	5.5E7
Constant	1.56	1.129	1.91	1	.166	4.769

Source: Sample Survey Data Set (Immunization.sav)

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ISSN 2394-7330

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Consider as the final fitted model for improper immunization status this study can see that mothers who worked more likely to improper immunization status, compared to mothers who not worked. The exponent of the coefficient of work has given an odds ratio of 17.185. This means that the odds of improper immunization status whose their mothers worked were 17.185 times the odds of improper immunization status whose their mothers not worked. The odds of child in improper immunization status whose their mothers worked were 99%, higher than the odds of child in improper immunization status whose their mothers worked. Consider as the final fitted model for Level of knowledge about what vaccines an infant should get before he/ she attains age of one year this study can see that mothers' level of knowledge about what vaccines an infant should get before he/ she attains age of one year (high) was more likely to improper immunization status, compared to mothers' level of knowledge about what vaccines an infant should get before he/ she attains age of one year (very high). The exponent of the coefficient of high has given an odds ratio of 10.166.

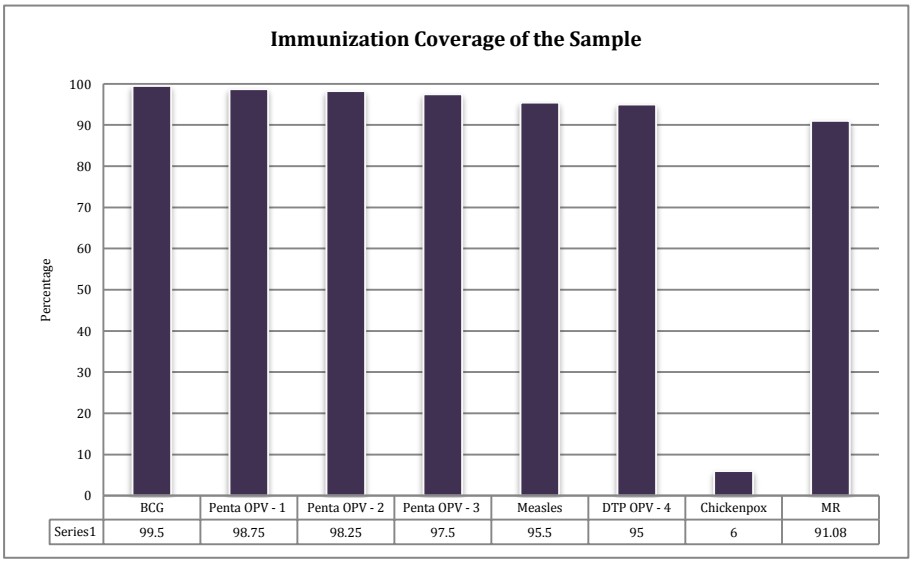
This means that the odds of improper immunization status whose their mothers' level of knowledge about what vaccines an infant should get before he/ she attains age of one year were (high) was 10.166 times the odds of improper immunization status whose their mothers' level of knowledge about what vaccines an infant should get before he/ she attains age of one year (very high). The odds of child in improper immunization status whose their mothers' level of knowledge about what vaccines an infant should get before he/ she attains age of one year were (high) were 98%, higher than the odds of child in improper immunization status whose their mothers' level of knowledge about what vaccines an infant should get before he/ she attains age of one year were (very high). Similarly mothers who have moderate or low level of knowledge about what vaccines an infant should get before he/ she attains age of one year has been effect for improper immunization status very highly.

Table 5: Sources of offer diseases preventable vaccines

Source	Coverage (%)
Government	94
Private	4
Both	2

Source: Sample Survey Data Set (Immunization.sav)

Sources of the diseases preventable vaccines have been illustrated in the above table. Approximately 95% of the total respondents, which was the dominated response was government sector and remainder were private sector and both private & government sectors. Among the mothers who took their diseases preventable vaccines not only in government sector, approximately 2/3 of the mothers took their diseases preventable vaccines only in private sector and others took their diseases preventable vaccines in both private & government sectors.



Source: Sample Survey Data Set (Immunization.sav)

Figure 1: Child's Immunization Coverage of the Sample

Sri Lanka has a well-established national level information system to assess the EPI vaccine coverage. Both routine and survey data on immunization coverage showed that the coverage for EPI vaccine during the first years of life was above 90% and it was near 100% for Colombo district. However, it has been noticed that the coverage for vaccine slightly decreases with increasing of age. Relatively poor coverage when compared to the first year of life was reported for MR vaccine among 3-5 years old. This result clearly indicated that there was marked difference (6%) in immunization coverage in children vaccine. Reasons for this result was that only private sector was provided chickenpox vaccine and poor coverage of vaccines administered at school going age was partly due to improper planning of school health activities at the divisional level and inadequate support from some school authorities.

Table 6: immunization coverage

Immunization Coverage (%)			
Vaccine	**Living Sector**		
	Rural	**Urban**	**Slum**
BCG	100	100	98.31
Penta OPV 1	100	100	95.76
Penta OPV 2	100	100	94.07
Penta OPV 3	100	100	91.53
Measles	100	100	84.75
DTP OPV 4	99.37	100	83.96
Chickenpox	0.63	18.7	0
MR	95.24	95.56	81.63

Source: Sample Survey Data Set (Immunization.sav)

Similarly that has been noticed that the coverage for vaccine slightly decreases with increasing of age in urban slum areas not in urban areas and rural areas in Colombo district. According to these results we can see children who immunized chickenpox vaccine mainly lived in urban areas. Sometime this may happen because private sector immunization services were mainly located in urban areas in Colombo district. Both routine and survey data on immunization coverage shows that the coverage for EPI vaccine during the first years of life was above 90% and it was near 100% for Colombo districts' urban areas and rural areas not in urban slum areas. In urban slum areas coverage for EPI vaccine during the first years of life is vary in between 80% to 98%. It clearly indicates that there was marked difference in immunization coverage at level of living sector. However, analysis of the divisional level data on coverage obtained from both routine surveillance and surveys have revealed existence of pockets of relatively low coverage areas in some areas. These low coverage pockets were mainly located in the urban slum areas in Colombo.

Table 7: Respondent's knowledge and awareness of immunization

Description	**Number of Respondents**					**Avg.**
	Criteria					
	1	**2**	**3**	**4**	**5**	
Benefits of immunization	3	51	119	171	56	4
What vaccines an infant should get first year of life	3	50	153	158	36	3
Recording of vaccination	135	69	152	42	2	2
Target diseases immunization under five years of age	136	79	131	47	7	2

Source: Sample Survey Data Set (Immunization.sav)

Table 7 shows the common knowledge encountered with the existing procedure of the immunization service and the respondents' rating for each problem, where the scale of 5 means very high while the scale 1 refers to very poor. Generally the total respondents' level of knowledge about the benefits of immunization was high while only 13% poor knowledge. Almost half (48%) of the total respondents' level of knowledge about what vaccines an infant should get first year of life was high while only 13% poor knowledge. A vast majority (88%) of the sample population' level of knowledge about the recording of vaccination and the level of knowledge about the target diseases of immunization under five years of age was low while only 12% high knowledge.The table clearly shows that a vast majority of the respondents' knowledge and awareness of immunization was low to the problems encountered with the level of knowledge and awareness of immunization procedure.

6. SUMMARY

In addition to malnutrition, the major cause of childhood mortality in world and also in Sri Lanka is vaccine preventable diseases. Childhood mortality could be significantly lowered if routine immunization was completed. There were several aggregate country level studies exploring child immunization coverage in Sri Lanka. However, many of those did not look at community level data to make assessments on immunization coverage and disparities across the living sector. The objective of this study was to identify family factors that might contribute to child immunization defaulting in Sri Lanka (The design of this study was to evaluate some of the factors related to immunization coverage of children. Objective was to find the association of the factors among themselves on the coverage). The second objective of the study was to explore the depth of disparities between those with high immunization and those with low immunization rate. The third objective of this study was to find out whether the rates of private sector immunization were similar or different from government sector immunization. The third objective was helpful in providing a clear picture as to which dimension of immunization was a bigger issue in Sri Lanka. In this research, examined a number of predisposing, enabling and needed factors that influenced the acceptance of complete/ proper immunization coverage for children younger than five years of age in Colombo district, Sri Lanka Inadequate/ Improper full immunization coverage in Colombo district, Sri Lanka was highlighted by the study. In the present study, the improper immunization coverage rate among children under five years of age in the Colombo district, Sri Lanka, was found to be 94.5%. The principal factors affecting the immunization status of these children in terms of magnitude were education attainment of mothers, working status of mothers, area of residence and level of knowledge about what vaccines an infant should get before he/ she attains age of one year.

7. RECOMMENDATIONS

To attain higher coverage in childhood immunization and also to sustain the improvement some recommendations can be made based on the study findings.

- ✓ As mothers with no education have higher probability not to immunize their children, so EPI programme should find ways to address this group of mothers more intensively.
- ✓ Mass media, especially television and radio should be given more importance by EPI in addressing the programme. Beside the existing programmes being used in the mass media EPI should introduce more new and innovative programmes especially to address the illiterate and poor people.
- ✓ Midwives were the key force for the immunization programme. They should be made more accountable for their jobs; especially the field visit should be reflected by the immunization coverage of the target children of each worker. Effective monitoring and supervision should be ensured by the government mechanism to improve and sustain the improvement in immunization coverage.

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