

ORIGINAL ARTICLE

Adherence towards Different Vaccines of Childhood Immunization of Under Five Year Old Children

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ABSTRACT

Introduction: Adherence towards childhood immunization (completeness and timeliness), with consideration of age-dependent-seroconversion, is the basis for children protection. Despite high global and national immunization coverage, vaccine preventable diseases are rising. This study aimed to determine adherence (completeness and timeliness) towards different vaccines of childhood immunization and associated factors among mothers of under five children. **Methods:** Cross-sectional study design was conducted at a health clinic in Seremban. Total of 320 mothers of under five children attending child health clinic selected via systematic random sampling. Data collection was via validated self-administered questionnaires and proforma, analysed using SPSS version 22. Associations between categorical variables determined by chi-square tests. **Results:** Consented respondents were 314; resulting in response rate of 98.1%. Adherence (completeness) was 98.09% but only 56.5% - 97.1% of respondents adhered in terms of timeliness. Types of transportation was significantly associated with adherence (completeness), $p=0.041$. Employment status was significantly associated with adherence (timeliness) towards BCG ($p=0.008$), Hepatitis B dose one ($p=0.018$) and dose two ($p=0.040$) vaccines. Education level was significantly associated with adherence (timeliness) towards DTaP/IPV/HiB dose four ($p=0.019$). Maternal age and usage of government clinic were significantly associated with adherence (timeliness) of MMR dose one, $p=0.030$ and $p=0.017$ respectively. **Conclusion:** Adherence (completeness) was high but varying adherence towards vaccine timeliness. Transportation types associated with completeness. Employment status associated with BCG, first and second doses of Hepatitis B vaccines' timeliness. Education level associated with fourth dose of DTaP/IPV/HiB. Maternal age and usage of government clinic associated with timeliness of first dose MMR.

Keywords: Adherence, Childhood immunization, Under five children, Completeness, Timeliness

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INTRODUCTION

An essential health indicator for Malaysia is the coverage of immunization. Denominators included live births estimation from two sources namely; the National Tuberculosis Information System Manual, and Department of Statistics, Malaysia (1). In 2015, the immunization coverage globally was; Bacille Calmette-Guerin (BCG) 88%, Hepatitis B (Hep B) 84%, Diphtheria/Tetanus/Pertussis dose one (DTP1) 91%, Diphtheria/Tetanus/Pertussis dose three (DTP3) 86%, Haemophilus Influenza type B (HIB) 64%, Polio 86%, Measles-containing-vaccine-first-dose (MCV1) 85% and Measles-containing-vaccine-second-dose (MCV2) 61% (2) and immunization coverage for the nation was; BCG 98.53%, Hep B dose three 99.27%, DPT-Hib dose three 99.04%, Polio dose three 99.04% and MMR 93.07% (3).

Completeness with timeliness adherence is important to prevent vaccine preventable diseases (4). Non-timely, non-adhered immunization lead to unprotected children (5) against vaccine preventable diseases (6), despite high immunization coverage (7,8,9). In 2015, the incidence rate of vaccine preventable disease per 100,000 population were; 12.65 for Hepatitis B, 4.32 for Measles, 3.08 for Pertussis and 0.01 for Diphtheria (3). In 2016, there were more than twenty diphtheria cases with five deaths that lead to a strong advice for immunization completeness for vaccine preventable diseases prevention (10). Infants must obtain protection as young as possible since seroconversion is age-dependent (11). The intensification of susceptibility period among children is a result of non-adherence towards immunization schedule (12).

Definition of adherence includes "the extent to which a person's behaviour corresponds with agreed recommendations from a health care provider" (13). Completeness and timeliness are the measurement for adherence (14). Non-adherence vaccines may

consequence to a suboptimal immunity response (15). Adapting from previous study, associating factors of adherence towards childhood immunization were divided into socio-demographic characteristics, child factors, healthcare services and logistics (14). Socio-demographic characteristics include maternal age, religion, education level, employment status, marital status, number of children and household income. Child factors consist of birth order and caregiver. Healthcare services consist of usage of government or private healthcare services and logistics include distance to health facility and types of transportation. This study determined adherence (completeness and timeliness) and its associated factors towards different vaccines of childhood immunization of under five children among mothers attending a health clinic in Seremban.

METHODS

A cross-sectional study was conducted in a health clinic in Seremban district, Negeri Sembilan, Malaysia. The population being studied was under-five children's mothers who attended the child health clinic, with a sampling frame list of these mothers' attendances. The final sample size was 320 and respondents were selected via systematic random sampling with a fixed interval of five. Inclusion criteria were mothers with under-five children who attended the child health clinic for the purpose of childhood immunization and exclusion criteria were mothers that were non-citizen and also for mothers with multiple under-five children, the younger children are excluded. Based on Lemeshow, Hosmer, Klar, & Lwanga (16) hypothesis testing was used following the two proportions formula for calculation of sample size. The proportion of non-timeliness based on education level of respondents from previous study (17) was used with the adjustment for comparison of two groups and also 20% attrition rate of respondents.

Dependent variable was adherence level; completeness and timeliness. Independent variables were socio-demographic factors (maternal age, religion, education level, employment status, marital status, number of children and total household income), child factors (birth order and caregiver), healthcare services (use of government or private healthcare services) and logistics (distance to preferred health facility and types of transportation).

Data collection was using self-administered questionnaires and proforma. The questionnaires and proforma had been validated, underwent test-retested reliability and also internal consistency. Face validity conducted as means for content validity. The questionnaire was developed, adapting from a local study (18) and other previous researches (4,19,20,21,22,23). Proforma was used for obtaining immunization vaccines' dates and doses. Timeliness and completeness were determined by these dates, adapting and modifying from previous

study (17) in accordance to the Malaysian immunization schedule (24). Score of one was given to the date that was timely and another score of one for the date that was complete. The total scores were categorized into three groups; zero (not timely, not complete), one (timely or complete) or two (timely and complete). This dependent variable was further grouped into two: adherence and non-adherence. Groups of zero and one scores merged as non-adherence and adherence was the group with the score of two.

Data analysis was using IBM Statistical Analysis of Social Sciences System (SPSS) version 22.0. Descriptive analysis described as frequency, percentages, mean and median. Association between two categorical variables were via chi-square tests. Approval was obtained from Medical Research and Ethics Committee, Universiti Putra Malaysia Ethics Committee for Human Research, JKEUPM (UPM/FPSK/JKK-GS46530-2016/2017), Negeri Sembilan State Health Department and Seremban Health District Office. Respondents' written informed consents were attained before data collection.

Operational definitions include; completeness which is termed as receiving series of vaccines as recommended by the National Immunization Programme (14,25) and vaccine timeliness is referring to the acceptable minimum intervals between each doses and the minimum ages of valid doses (14,22). Valid doses are up to four days earlier (15) and seven days after (26,27) from the actual age.

RESULTS

Response Rate

Among 320 distributed questionnaires, 314 were eligible, consented and completed the questionnaire, giving a response rate of 98.1%. The others refused.

Descriptive Analysis

Socio-demographic Characteristics of Respondents, Child Factors, Healthcare Services and Logistics

Table 1 shows majority of respondents were 25 years old and older, Malay, Muslim, attained highest education of secondary school, employed, married and have total household income of RM5000 and more. Low education includes primary and secondary education whereby higher education includes STPM/Matriculation/Diploma, Degree, Masters and PHD.

All respondents were born in either a hospital or clinic. Majority were first or second born and mother was not fully the caregiver. Majority of respondents used services at government clinic or hospital and majority of the distance to preferred health facility was more than 5 km with usage of own transportation to attain immunization.

Table 1. Socio-demographic Characteristics, Child Factors, Healthcare Services, Logistics Factors of respondents (N=314)

Socio-demographic Characteristics	Mean \pm SD	Median \pm IQR	n (%)
Maternal age (years)	30.27 \pm 4.91		
< 25 years old			47 (15.0%)
\geq 25 years old			267 (85.0%)
Ethnicity			
Malay			120 (38.2%)
Chinese			90 (28.6%)
Indian			95 (30.3%)
Others ^a			9 (2.9%)
Religion			
Islam			124 (39.5%)
Christian			29 (9.2%)
Hindu			80 (25.5%)
Buddha			76 (24.2%)
Others ^b			5 (1.6%)
Education level			
Primary school			13 (4.1%)
Secondary school			135 (43.0%)
STPM/Matriculation/Diploma			91 (29.0%)
Degree			65 (20.7%)
Masters			10 (3.2%)
Maternal employment status			
Employed			189 (60.2%)
Non-employed			125 (39.8%)
Marital status			
Married			313 (99.7%)
Single			1 (0.3%)
Number of children		2.00 \pm 2	
Total household income			
< RM1000			5 (1.6%)
RM1000 – RM1999			41 (13.1%)
RM2000 – RM2999			61 (19.4%)
RM3000 – RM3999			57 (18.1%)
RM4000 – RM4999			33 (10.5%)
\geq RM5000			117 (37.3%)

Child Factors	n (%)
Child's Place of Birth	
Hospital/clinic	314 (100%)
Home	0 (0%)
Birth Order	
Second and below	217 (69.1%)
Third and onwards	97 (30.9%)
Mother is Not the Full Caregiver	
Yes	232 (73.9%)
No	82 (26.1%)
Usage of Healthcare Services	
Government Clinic	
Yes	311 (99.0%)
No	3 (1.0%)
Government Hospital	
Yes	287 (91.4%)
No	27 (8.6%)
Private Clinic	
Yes	25 (8.0%)
No	289 (92.0%)
Private Hospital	
Yes	25 (8.0%)
No	289 (92.0%)
Logistics	
Distance to Health Facility (km)	
≤ 5 km	118 (37.6%)
> 5 km	196 (62.4%)
Types of Transportation	
Public transportation	9 (2.9%)
Own transportation	305 (97.1%)

^aOther ethnicities were Orang Asli, Dusun, Rungus, Kadazan, Iban and Punjabi

^bOther religions were no religion, Sikh and Bahai

Table 2. Adherence (completeness) towards Childhood Immunization Schedule among Respondents (N = 314)

Adherence (Completeness)	n (%)
Complete	308 (98.09 %)
Not complete	6 (1.91 %)

Adherence (Completeness) towards Childhood Immunization

Majority (98.09%) of respondents adhered (completeness) to childhood immunization as in Table 2.

Adherence (Timeliness) towards Different Vaccines of Childhood Immunization

However, in terms of timeliness, as in Table 3, it varies between 56.5% to 97.1%.

Bivariate Analysis

Factors associated with Adherence (completeness)

The only statistically significant associated variable for

completeness adherence towards immunization was types of transportation, as in Table 4 ($\chi^2=4.184$, $df=1$, $p=0.041$). Among 308 respondents that used own transportation, 98.4 % adhered.

Factors associated with Adherence (timeliness)

Tables 5 to 7 show the variables that were significantly associated with vaccine timeliness. Table 5 shows the significant associations between employment status and adherence (timeliness) for BCG ($\chi^2=6.963$, $df=1$, $p=0.008$), Hepatitis B dose one ($\chi^2=5.575$, $df=1$, $p=0.018$) and Hepatitis B dose two ($\chi^2=4.208$, $df=1$, $p=0.040$) vaccines.

Table 3. Adherence (timeliness) towards Childhood Immunization Schedule among Respondents (at Different Ages)

Age (months)	Vaccine types	Adherence (timeliness) n (%)	Non-adherence (timeliness) n (%)
0	BCG vaccine	304 (96.8 %)	10 (3.2%)
0	Hepatitis B Dose 1	305 (97.1%)	(2.9%)
1	Hepatitis B Dose 2	278 (88.5%)	(11.5%)
2	DTaP-IPV/Hib Dose 1	213 (76.3%)	(23.7%) ^a
3	DTaP-IPV/Hib Dose 2	159 (66.3%)	(34.1%) ^b
5	DTaP-IPV/Hib Dose 3	115 (58.1%)	(41.9%) ^c
6	Hepatitis B Dose 3	87 (56.5%)	(43.5%) ^d
9	MMR Dose 1	72 (64.9%)	(35.1%) ^e
12	MMR Dose 2	54 (76.1%)	(23.9%) ^f
18	DTaP-IPV/Hib Dose 4	25 (67.6%)	(32.4%) ^g

^a 35 children was not due for DTaP-IPV/Hib Dose 1 during the data collection

^b 74 children was not due for DTaP-IPV/Hib Dose 2 during the data collection

^c 116 children was not due for DTaP-IPV/Hib Dose 3 during the data collection

^d 160 children was not due for Hepatitis B Dose 3 during the data collection

^e 203 children was not due for MMR Dose 1 during the data collection

^f 243 children was not due for MMR Dose 2 during the data collection

^g 277 children was not due for DTaP-IPV/Hib Dose 4 during the data collection

Table 4. Association between Logistics and Adherence (completeness) towards childhood immunization (N = 314)

Variables	Not Complete n = 6 (%)	Complete n = 308 (%)	χ^2	df	p value
Types of Transportation					
Public transportation	1 (11.1 %)	8 (88.9 %)	4.184	1	0.041*
Own transportation	5 (1.6 %)	300 (98.4 %)			

*Significant at $p<0.05$

Table 5. Association between Employment Status and Adherence (Timeliness) towards BCG, Hepatitis B Vaccine – Dose 1 and Dose 2 (N = 314 respectively)

Variables	Not Timely n = 10 (%)	Timely n = 304 (%)	χ^2	df	p value
Employment status					
Employed	2 (1.1%)	187 (98.9%)	6.963	1	0.008*
Non-employed	8 (6.4%)	117 (93.6%)			

*Significant at $p < 0.05$

Variables	Not Timely n = 9 (%)	Timely n = 305 (%)	χ^2	df	p value
Employment status					
Employed	2 (1.1%)	187 (98.9%)	5.575	1	0.018*
Non-employed	7 (5.6%)	118 (94.4%)			

*Significant at $p < 0.05$

Variables	Not Timely n = 36 (%)	Timely n = 278 (%)	χ^2	df	p value
Employment status					
Employed	16 (8.5%)	173 (91.5%)	4.208	1	0.040*
Non-employed	20 (16.0%)	105 (84.0%)			

*Significant at $p < 0.05$

Table 6. Association between Education Level and Adherence (timeliness) towards DTaP/Hib/IPV Vaccine – Dose 4 (N = 37)

Variables	Not Timely n = 12 (%)	Timely n = 25 (%)	χ^2	df	p value
Education level					
Low education	9 (56.2%)	7 (43.8%)	5.508	1	0.019*
High education	3 (14.3%)	18 (85.7%)			

*Significant at $p < 0.05$

Table 6 shows significant associations between education level towards adherence (timeliness) of DTaP/ IPV/ HiB Dose four vaccine ($\chi^2=5.508$, $df=1$, $p=0.019$). Table 7 shows significant associations between age groups and also usage of government clinic towards adherence (timeliness) of MMR dose one vaccine.

DISCUSSION

High response rate (98.1 %) for this study was similar to a study on immunization in the Philippines (28) and higher in contrast to a local study (29). This is due to obtaining immunization information from immunization records that was provided by the mothers and also the usage of questionnaires during the study.

Table 7. Association between Age Groups and Usage of Healthcare Services with Adherence (Timeliness) towards MMR Vaccine – Dose 1 (N = 111)

Variables	Not Timely n = 39 (%)	Timely n = 72 (%)	χ^2	df	p value
Age groups					
< 25 years old	9 (60.0%)	6 (40.0%)	4.705	1	0.030*
≥ 25 years old	30 (31.2%)	66 (68.8%)			
Usage of Healthcare Services					
Government Clinic					
Yes	36 (33.3%)	72 (66.7%)	5.692	1	0.017*
No	3 (100.0%)	0 (0.0%)			
Government Hospital					
Yes	35 (34.0%)	68 (66.0%)	0.836	1	0.361
No	4 (50.0%)	4 (50.0%)			
Private Clinic					
Yes	4 (33.3%)	8 (66.7%)	0.019	1	0.890
No	35 (35.4%)	64 (64.6%)			
Private Hospital					
Yes	3 (37.5%)	5 (62.5%)	0.021	1	0.884
No	36 (35.0%)	67 (65.0%)			

*Significant at $p < 0.05$

98.09% of respondents in this study adhered (completeness) towards immunization schedule in comparison with previous researches (4,12,30) and with the country's more than 95% immunization coverage (7,8,9). Immunization coverage is an important maternal child health's indicator. Hence, the successfulness of this indicator is emphasized upon.

Adherence (timeliness) towards immunization schedule is challenging (18). BCG adherence in this study was 96.8%, in comparison with a study in 31 low and middle-income countries that portrayed BCG to be highly adhered to (31). Hepatitis B vaccines' doses, showed decreasing trend of adherence from 97.1%, 88.5% to 56.5% respectively, in comparison with a local study in Kota Kinabalu (18). BCG (96.8%) and Hepatitis B dose one (97.1%) vaccines were highly adhered most probably because routinely in hospital, it is administered upon delivery. High Hepatitis B dose two adherence (88.5%) is likely due to one-month postnatal check-up and mothers bring along their newborns. Four doses of DTaP-IPV/Hib decreased in adherence trend (76.3%, 66.3%, 58.1%) respectively but increased in the last dose (67.6%), in contrast with a local study (18), with first to last dose non-adherence increment, probably due to non-similar sociocultural

norms between eastern and peninsular Malaysia. MMR dose one adherence in this study is in comparison with a study this year among children in China (30); 64.9% and 60.5% respectively. Higher adherence of MMR dose two as compared to dose one; 76.1% and 64.9% respectively, is in comparison with the same study. The reason is likely due to inaccurate accusations heard or read from the media regarding MMR vaccine association with autism (32). No bad experience from this first dose subsequently made adherence to the second dose to be higher.

Types of transportation were significantly associated with adherence (completeness) towards immunization ($\chi^2=4.184$, $df=1$, $p=0.041$). Among adhered mothers, own transportation was preferred perhaps due to difficulty in utilizing public transportation with infants.

Employment status was statistically significantly associated with adherence (timeliness) towards BCG vaccine ($\chi^2=6.963$, $df=1$, $p=0.008$), Hepatitis B dose one ($\chi^2=5.575$, $df=1$, $p=0.018$) and Hepatitis B dose two vaccines ($\chi^2=4.208$, $df=1$, $p=0.040$). This finding is in contrast with previous study in India (33) because of inability of working mothers to take leave. However, in

this country, post-delivery working mothers are entitled for maternity leaves for a minimum of 60 consecutive days (34) hence the high adherence of BCG, Hepatitis B dose one and dose two vaccines. Education level was significantly associated with adherence towards DTaP/IPV/ HiB dose four vaccine ($\chi^2=5.508$, $df=1$, $p=0.019$, in comparison with previous research (35). Mothers with higher education level may be more aware to seek and utilize immunization efforts. Maternal age was statistically significantly associated with adherence towards MMR dose one vaccine ($\chi^2=4.705$, $df=1$, $p=0.030$), in comparison with previous study (36). This is perhaps due to maturity of awareness regarding the importance of adherence towards childhood immunization and a wider interaction socially among these mothers. Utilization of government clinic and adherence towards immunization MMR dose one vaccine was significantly associated ($\chi^2=5.692$, $df=1$, $p=0.017$), in comparison with previous study (4). This positively gives the impression of an organized, systematic and preferred choice of health facility among respondents.

CONCLUSION

Adherence (completeness) towards childhood immunization schedule among mothers was higher in comparison with timeliness for the different vaccines and its doses. Statistically significant associations were types of transportation and adherence (completeness); employment status and adherence (timeliness) towards BCG, Hepatitis B dose one and two vaccines; education level and adherence (timeliness) towards DTaP/IPV/ HiB dose four, and also uses of government clinic and adherence (timeliness) towards MMR dose one. This study is included in the minimally available local similar topic of study hence markedly useful as a baseline for the purposes of research expansion both for comparison or intervention. High response rate made the targeted population represented. Questionnaires were validated and test-retested to ensure validity and reliability. However, at the point of time, causal relationship could not be measured through cross-sectional study. Future study is advised to use same age of children such as more than 18 months of age to ease analysis and likelihood of immunization to be all completed. Future researches with similar interest may benefit from the questionnaires and proforma that had been validated and pre-tested.

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