ORIGINAL ARTICLE

Risk Factors Associated With Incomplete Immunisation in Hospitalised Infants

O Norlijah, MRCP*, B S Menon, MRCP*, M Y Y Azlyna, MD*

*Paediatric Unit, Department of Human Growth and Development, Faculty of Medicine and Health Sciences, University Putra Malaysia, Kuala Lumpur

Summary

To determine the immunisation status of hospitalised infants and to examine the potential risk factors associated with incomplete immunisation. Prospective study of infants admitted to a paediatric hospital in Kuala Lumpur, conducted by interviewing carers. Twenty-two percent of infants had incomplete immunisation. The most significant factor that was associated with incomplete immunisation was the carer's lack of knowledge on the timing of the next immunisation (p= 0.005). Other factors that had significant association were the presence of a previous admission to hospital (p= 0.03) and the infant's age of more than 6 months (p= 0.025). The rate of incomplete immunisation in the study population was 22%. An admission to hospital of an infant should be taken as an opportunity to update their immunisation in order to improve the rate of uptake.

Key Words: Infants, Carer, Incomplete Immunization

Introduction

Infant immunisation is widely accepted as a marker of the adequacy of health care and is one of the most cost-effective means of preventing childhood diseases[1]. According to the Centre of Disease Control report, the infant and childhood immunisation programme is one of the most effective health interventions of the 20th century. So far, there are nine diseases for which vaccines have been recommended for universal use in children. Due to substantial achievements made in the control of these diseases, there has been a decline in childhood mortality and morbidity.

Despite the achievements made through immunisation, there are still 'pockets' of population at risk of underimmunisation. Children who are poor, live in urban areas, or are members of minority groups are less likely to be up-to-date in their immunisation than the general population[2,3]. Underimmunisation, especially among preschoolers, has contributed to recent epidemics of measles in preschool children[4,5] and to the rising number of children who have acquired pertussis[6] in many parts of the world.

In 1999, according to an annual report from the Malaysian Ministry of Health (MOH), immunisation coverage for Malaysia was more than 90% except for measles. However compared to all other states in Malaysia, the Federal Territory of Kuala Lumpur has the lowest coverage of immunisation[7]. Except for Bacille Calmette Guerin (BCG) vaccine, the immunisation coverage for hepatitis B, DPT, oral polio and measles for the Federal Territory was 36%, 37.9% and 30.4% respectively which was much lower than that attained by the other states. Therefore to improve the immunisation coverage and to reach the nation's target of 90% coverage particularly in Kuala Lumpur, the factors associated with incomplete immunisation need to be identified and addressed. There is a dearth of local data examining the immunisation status in hospitalised children and its interelation with various

This article was accepted: 24 March 2005

Corresponding Author: Norlijah Othman, Paediatric Unit, Department of Human Growth and Development, Faculty of Medicine and Health Science, University Putra Malaysia, 50586 Jalan Masjid, Kuala Lumpur

sociodemographic factors. Since more than 80% of the vaccines recommended are given during infancy, this study will focus on the immunisation status of infants.

The objectives of this study were as follows:
1. To determine the proportion of incomplete immunisation in hospitalised infants.
2. To determine the risk factors associated with immunisation status.

Materials and Methods

Research setting and study population

This was a cross-sectional study carried out in one of the general paediatric wards of the Paediatric Institute of Hospital Kuala Lumpur, over a period of nine weeks from June till August 2001.

Included were all infants from 1 to 12 months of age, admitted to the assigned ward during the study period. Excluded were infants less than 1 month and patients beyond 12 months of age. Children with multiple hospital admissions during the period were reviewed at the time of their first admission. Infants were considered to have incomplete immunisation for age if they had not received a scheduled dose at the time of the study, and if it was more than 1 month overdue.

Data Collection

A standard questionnaire format was used for data collection by interviewing the infant's carer. All the data was collected by ANY, a third year medical student. The prepared questionnaire had undergone preliminary testing at a community health centre in the vicinity of the hospital. The questionnaire consisted of information regarding immunisation history, sociodemographic data of the patient's family and assessing the knowledge of the caregiver such as the reason(s) to immunise and the next schedule of immunisation for the patient. The patient's immunisation status was further counterchecked with the immunisation card, if available. The immunisation status of the infant was determined by referring to the standard Malaysian recommended schedule used at the time of study prior to the revised schedule in June 2002. It consisted of BCG at birth, three doses of hepatitis B at birth, 1 and 5 months, three doses of the primary course of diptheria, pertussis, tetanus and polio (DPT and polio) at 3,4 and 5 months; and measles vaccine at 9 months.

The maternal variables explored in the study were race, age, mother's occupation, educational level, transportation situation, travel time to the clinic, dependence on a third person for transportation to the clinic and availability of the immunisation card. Infant variables studied were age, sex, gestational age, hospital or home delivery, sibship size, reason for current admission, history of previous hospital admission and status of breastfeeding. Status of breastfeeding was defined as exclusively breastfed for at least two weeks at some stage during the first 6 months of live. Reason for current admission was categorised into acute or chronic; acute admission was defined as onset of illness within one week prior to admission while chronic was more than a week.

Data Analysis

The data collected was analysed using Statistical Package for Social Science (SPSS) version 10.0 software. The Chi-square test was performed for categorical or dichotomous variables. The Fisher Exact test was performed when the Chi-square test was not applicable. A p value of <0.05 was chosen as significant.

Results

A total of 115 infants were admitted to the assigned ward during the study period. Of these, only 100 infants were included as the remaining patients had been discharged prior to being interviewed.

Characteristics of Carers

Except for four infants, it was mainly mothers who had accompanied their infants. Sixty percent were housewives followed by non-executive workers. Seventy-five percent of them were Malays. The majority (85%) had attained at least a secondary education. Less than half of the carers interviewed were aged more than 30 years while five percent was less than 21 years old. Slightly less than half earned an average family income of less than RM$1000 (45%) and between $1001-3000 (44%) respectively while one family earned an average income of more than $3000.

Most of the carers had their own transport to take their children to the clinic for immunisation. The mode of transport was as follows: 49 carers had a car, 17 owned a motorcycle, 16 depended on public transport such as taxis, LRT (Light Railway Transport) or buses while 18 carers walked to the clinic as it was in the vicinity. The average travelling time to the nearest immunisation clinic was 13 minutes. Eighty percent of them had travel times of less than 20 minutes; only 20% had a travel time of more than 20 minutes. Fifty-four percent of the

carers had to wait for someone else to take them to the clinic.

Characteristics of Infants

Of the 100 infants, 62 were males and 38 were females. The mean age was 5.7 months at the time of admission. Fifty percent of infants had between 1-3 siblings, 24% had more than three and 26% were the only child in the family. All except one infant was delivered at hospital. Eighty-five of the infants were born full term, 14 were born preterm and information was not available for one infant because she was adopted. Regarding previous hospital admissions, 37 infants were admitted at some point previously. Forty eight percent of the infants were breast-fed for at least two weeks during the first 6 months of live.

Immunisation status of the infants

Twenty-two out of 100 hospitalised infants had incomplete immunisation. This gives rise to a complete immunisation rate of 78% in the study population. Ninety-one percent of the infants were up-to-date in their immunisation status at 3 months of age, and 81% were up to date at 6 months of age. Immunisation cards were available in 63 infants for inspection.

Factors associated with immunisation status

Table I and II show the results of bivariate analysis to determine the factors associated with immunisation status. Table I shows the association between the characteristics of infants and their immunisation status. The infant's age group of more than 6 months (p=0.025) and previous admission to hospital (p= 0.03) were found to have significant association with incomplete immunisation.

Table II shows the results of bivariate analysis between the carer's sociodemographic data and knowledge of immunisation with immunisation status. Among these factors, only the guardian's knowledge of the timing of the next immunisation was found to have a significant association (p= 0.005) with immunisation status.

Table I: Association between characteristics of infants with immunisation status

Variables	Complete immunisation n=78 (%)	Incomplete immunisation n=22 (%)	p
Age (months)			
0-6	46 (59)	7 (32)	0.025*
6.1-12	32 (41)	15 (68)	
Sex			
Male	46 (59)	16 (73)	0.241
Female	32 (41)	6 (27)	
Reason for admission			
Acute	62 (79)	16 (73)	0.5
Chronic	16 (21)	6 (27)	
Number of siblings			
No siblings	24 (31)	7 (32)	0.381
1-3 siblings	37 (47)	13 (59)	
>3 siblings	17 (22)	2 (9)	
Born in hospital			
Yes	77 (99)	22 (100)	0.594
No	1 (1)	0 (0)	
Gestational age			
Term	66 (85)	19 (86)	0.865
Preterm	11 (14)	3 (14)	
Unsure	1 (1)	0 (0)	
Previous hospital stay			
Yes	23 (29)	14 (64)	0.03*
No	55 (71)	8 (36)	
Breast fed			
Yes	37 (47)	11 (50)	0.832
No	41 (53)	11 (50)	

* denotes significant p value

Table II: Association between carer's characteristics and knowledge on immunisation with immunisation status

Variables	Complete immunisation n=78 (%)	Incomplete immunisation N=22 (%)	p
Age (years)			
<21	4	1	0.784
21-30	38	9	
>30	36	12	
Mother's occupation			
Executive	4 (5)	1 (5)	0.914
Non-executive	32 (41)	8 (36)	
Self-employed	1 (1)	0 (0)	
Housewives	41 (53)	13 (59)	
Educational level			
No formal education	2 (2)	0 (0)	0.567
Primary education	10 (13)	3 (14)	
Secondary education	59 (76)	15 (68)	
Tertiary education	7 (9)	4 (18)	
Mode of transport to clinic			
Car	40 (51)	9 (41)	0.326
Motorbike	11 (14)	6 (27)	
Bus	1 (1)	1 (5)	
Others	10 (13)	4 (18)	
Walking	16 (21)	2 (9)	
Travel time to clinic			
<20 minutes	62 (79)	18 (82)	0.809
>20 minutes	16 (21)	4 (18)	
Need to wait for anybody			
Yes	41 (53)	13 (59)	0.587
No	37 (47)	9 (41)	
Knowledge of reasons to immunise			
Appropriate response	73 (94)	18 (82)	0.088
Inappropriate response	5 (6)	4 (18)	
Response on type of next immunisation schedule due			
Correct response	33 (42)	7 (32)	0.375
Incorrect response	45 (58)	15 (68)	
Response on timing of next immunisation schedule due			
Correct response	57 (73)	9 (41)	0.005*
Incorrect response	21 (27)	13 (59)	

* denotes significant p value

Discussion

This data shows that the immunisation level of the study population of infants attending a children's hospital was 78%, a level lower than the required 90-95% needed for herd immunity to prevail in the general population[8]. The incomplete immunisation rate of 22% found in this survey was also comparable to other studies, which also found that a fifth of children admitted to hospital were incomplete in their immunisations[9,10]. On the other hand, our results are comparably lower than that found in a children's hospital in Australia, in which of 204 mothers interviewed, 34% (135) had not complied fully with the recommended schedule[11].

Consistent with previous reports on risk factors associated with underimmunisation in children, we found an association between an infant's age and underimmunisation status. Infants of more than 6 months were found to have an increased likelihood of not updating their immunisation. Vaccination status at 3 months of age has been previously reported to be the strongest predictor of immunisation status[10,12,13]. At an age of more than six months, infants should have been immunised with measles, 3rd dose of DPT, polio and Hepatitis B. On-time initiation of immunisation is especially important in the prevention of *Bordetella pertussis* and measles, which have a high morbidity in the first year of life. The low compliance in completing the immunisation series could be due to a combination of parental delay in seeking preventive care and the fact that compliance falls with repeated dosing.

We found that infants who had a previous hospital stay were significantly more likely (p=003) to have incomplete immunisation status. This was similar to findings reported by Kum-Nji et al where children under 24 months with more than two hospital admissions were delayed in immunisation compared to those who had one admission in a study on hospitalised children in Tennessee, USA[14]. A history of previous hospital stay could be due to an existing chronic illness in a child, which is perceived as a contraindication to immunisation by both health providers and parents. However, this aspect was not explored in this study. According to Tifft and Lederman, infants with chronic illness are more likely to be underimmunised because their routine sequences of well child visits are interrupted by visits for specific illness[10]. They found in their study that more than half of the hospitalised infants with incomplete immunisation were admitted for exacerbation of chronic illnesses. This constitutes a missed opportunity, which is a major reason for the continuing incomplete immunisation of vulnerable children[15]. Ideally, the admission to hospital of a young child should be taken as an opportunity to update a child's immunisation status in order to improve the rate of uptake of immunisation[10,11].

Correct knowledge of the immunisation schedule is significantly associated with higher immunisation rate[16]. Incorrect knowledge of the recommended age for the first measles-mumps-rubella (MMR) vaccine at 15-18 months was found to be a significant risk factor for delayed immunisation in 2-year-old children in Colorado[17]. Similarly in this study, we found that the carer's incorrect knowledge of the timing of the immunisation schedule was a significant predictor of incomplete immunisation. Awareness of the timing of the next scheduled immunisation is thus more important than the type of immunisation due. As long as the carers know the appropriate time to bring their children for the next immunisation, children will be less likely to be behind schedule and hence, there will be no problem in completing the whole immunisation series.

We found that the other variables studied were not risk factors for delayed immunisation. These findings were contrary to findings conducted 10-15 years ago. For instance, male gender and preterm babies were shown to be associated with delayed immunisation among 215 preschoolers evaluated for immunisation[14]. Several other studies in the past have studied the relationship of sociodemographic factors with immunisation status. Factors such as poverty, mother's education and maternal age were recognised as established risk factors associated with poor uptake of immunisation[12,13,14,17-19]. A maternal age of less than 21 years old at the time of the child's birth and maternal education of less than high school have been found to be a significant predictor for delayed immunisation in contrast to our findings. In our study population, most of the carers were more than 30 years old and only five of them were aged less than 21 years old. In terms of educational level, 85% of the carers had attained at least a secondary education.

We also studied the relationship of sibship size and reasons for admission with immunisation status and found that none of these factors were associated with the risk of delayed immunisation. This was again contrary to findings in three other studies where larger

family size comprising of more than 2 older siblings was found to be significant predictors for delayed immunisation[14,16,17-19].

To date, there is very scarce data available on the effect of breast-feeding and site of delivery at birth on immunisation rate. Our study showed that these factors did not bear any relationship to the uptake of immunisation.

In this study, we found that the average travel time to the nearest immunisation clinic was only 13 minutes and the majority of carers had some means of transport to go to the clinic. This shows that the majority of guardians did not have any problem getting to the immunisation clinic. However, slightly more than half (54%) of the carers had to wait for another family member to take them to the clinic. Lack of transportation was a significant factor associated with delayed immunisation, a finding by Kum-Nji et al in America14. However we did not find any significant association between mode of transport, travel time and the need to wait for a family member with immunisation status.

There are several limitations to this study. First, the sample size was small due to a limited time frame. Therefore some tests of significance were difficult to perform. The second limitation of our study is that we have data only for the first 12 months rather than the first 24 months of life. The other obvious limitation of this study is that our sample may not reflect the general population characteristics, and thus our findings may lack external validity.

Children with incomplete immunisations are at risk for preventable diseases and may also be important reservoir of disease in the community[4,20]. This study of risk factors for incomplete immunisation demonstrated that infant aged more than 6 months, a history of previous hospitalisations and incorrect parental knowledge of recommended age for immunisation were significant risk factors for incomplete immunisation. It also showed that almost a quarter of hospitalised infants studied had incomplete immunisation.

What strategies will best improve immunisation delivery? Further provision of free vaccine is unlikely to make a significant impact in this population since this has always been the government policy as part of provision towards comprehensive child health care. Encounters with a health care provider, including an emergency departmental visit or hospitalisation, should be taken as an opportunity to administer vaccines. Other strategies that may be helpful to improve immunisation uptake include improving educational programs for the public and health providers with regard to the importance of and contraindications to immunisation[21]. A continual reminder of the recommended immunisation schedules, further emphasizing the need to receive immunisations at recommended ages and stressing on the importance of bringing their child's immunisation card to each visit could further cut down incomplete immunisation rates. A concerted effort is therefore needed to address the issue of incomplete immunisation especially in the Federal Territory of Kuala Lumpur.

1. Centers for Disease Control and Prevention. Achievements in Public Health, 1900-1999 impact of vaccine universally recommended for children- United States, 1990-1998. MMWR Morb Mortal Wkly Rep 1999; 48: 243-48.
2. Williams IT, Milton JD, Farrell JB, et al. Interaction of socioeconomic status and provider practices as predictors of immunisation coverage in Virginia children. Pediatrics 1995; 96: 439-46.
3. Amal NM. How parents in a rural area of Pekan district, Pahang perceive immunization. Med J Malaysia 1995; 50(2): 198-200.
4. World Health Organization. Progress in reducing global measles deaths: 1999-2002. Wkly Epidemiol Rec 2004; 3: 20-1.
5. Centers for Disease Control and Prevention. Measles vaccination levels among selected groups of preschool-

aged children-United States. MMWR Morb Mortal Wkly Rep 1991; 40: 36-39.

6. Vitek CR, Pascual B, Baugman AL et al. Increase in deaths from pertussis among young infants in the United States in the 1990's. Paed Inf Dis 2003; 22(7): 628-34.
7. Annual Report of Communicable Disease. Ministry of Health. 1999.
8. Anderson RM, May RM. Vaccination and herd immunity to infectious diseases. Nature 1985; 318: 323-9.
9. Riley DJ, Mughal MZ, Roland J. Immunisation state of young children admitted to hospital and effectiveness of a ward based opportunistic immunisation policy. BMJ 1991; 302: 31-3.
10. Tifft CJ, Ledermann HM. Immunization status of hospitalized preschool-age children. Am J Child. 1988; 142: 719-20.
11. Ferson MJ. Immunisation state and its documentation in hospitalised patients. Arch Dis Child, 1990; 65: 763-7.
12. Bates AS, Fitzgerald JH, Dittus RS, et al. Risk factors for underimmunisation in poor urban infants. JAMA 1994; 272(14): 1105-110.
13. Bobo Jk, Gale JL, Purushottom BT, Wassilak SGF. Risk factors for delayed immunization in a random sample of 1163 children from Oregon and Washington. Pediatrics 1993; 91: 308-14.
14. Kum-Nji P, James D, Herrod HG. Immunisation status of hospitalised pre-school children: Risk Factors Associated with inadequate immunisation. Pediatrics 1995; 96: 434-38.
15. McConnochie KM and Roghmann KJ. Immunisation opportunities missed among urban poor children. Pediatrics 1992; 89: 1019-26.
16. Wood D, Halfon N, Donald Sherbourne C, et al. Increasing immunisation rates among inner-city, African American Children. JAMA 1998; 279(1): 29-34.
17. Wood D, Schuster M, Donald-Sherbourne C, et al. Reducing missed opportunities to vaccinate during child health visits. Archives of Pediatric Adolescent Medicine; 152: 238-43.
18. Miller LA, Hoffman RE, Baron AE, Marine WM and Melinkovich P. Risk factors for delayed immunization against measles, mumps and rubella in Colorado two-years-olds. Pediatrics 1994; 94(2): 213-19.
19. Jarman B, Bosanquet N, Rice P, et al. Uptake of immunisation in district health authorities in England. British Medical Journal 1988; 296: 1775-9.
20. Frank JA Jr, Orenstein WA, Bart KJ, et al. Major impediments to measles elimination. AJDC 1985; 139: 881-88.
21. Ad Hoc Working Group for the Development of Standards for Pediatric Immunisation Practices. Standards for Pediatric immunisation practices. JAMA 1993; 269(14): 1817-9.