Epidemiol. Infect. (1999), **122**, 441–446. Printed in the United Kingdom

Measles in Vietnamese refugee children in Hong Kong

W. R. J. TAYLOR*†

The British Red Cross Society, PO Box 117, Sai Kung, Hong Kong

(*Accepted 21 December 1998*)

SUMMARY

From September 1991–January 1992, there was a measles epidemic in an established refugee camp for 7000 Vietnamese 'Boat People' living in Hong Kong. This 16 week outbreak occurred against a backdrop of poor uptake of measles vaccination and overcrowded living conditions. Two hundred and sixty-two children were affected (155 boys, 107 girls); 235 children (89·7%) were < 2 years old, age range 5–39 months. Children age 6–11 months had the highest crude attack rate (AR) of 54·3%. The highest age specific crude AR was 83·8% in children aged 14 months. Measles complications affected 234 (89·3%) children. Sixty-six children (25·2%) were admitted to hospital. There were two deaths from pneumonia, giving a case fatality rate of 0·76%. Measles control in refugee camps continues to be a public health challenge.

INTRODUCTION

An effective measles vaccine has been available for some 30 years and is an established, cost-effective public health intervention [1]. Refugee camps pose their own unique problems in measles control with the result that outbreaks still occur [2–7]. An effective system of vaccine delivery has to be established as part of a comprehensive primary health care service in conjunction with the other needs of refugees; food, clean water and shelter. Achieving these goals is difficult especially in the acute phase of a refugee crisis when mortality rates from infectious diseases are at their highest [4–7]. Measles epidemics, in particular, can result in high case fatality rates (CFR), e.g. 34% in Somali refugees [6], 33% in Ethiopian refugees [4], and 15–21% in Mozambican refugee children [2]. Current guidelines for measles control in refugee camps include vaccinating children aged 6 months–5 years as a high priority [8] and adopting a two-dose schedule for children < 9 months of age [1, 8].

This paper reports the clinical, epidemiological, and public health aspects of a measles outbreak, lasting approximately 4 months, which occurred in an established and stable refugee camp for Vietnamese 'Boat People' in Hong Kong.

METHODS

Background, site and population

Hong Kong has been a place of asylum for the Vietnamese 'Boat People' since the fall of Saigon in 1975. During the 1980s, there were increasing arrivals of Vietnamese refugees necessitating the Hong Kong government to request the assistance of non-governmental organizations (NGOs) in providing medical and other services in the camps. The High Island camp was purpose built and opened in November 1989. It was situated in a country park in the eastern New Territories. Overall, conditions were reasonable compared to refugee camps in other countries. Clean

* Author for correspondence: 26, Pitchford Road, Heath Farm, Shrewsbury, Shropshire, SY1 3HS, UK.

† The findings and opinions expressed in this article are my own and do not in any way represent the policy or views of the British Red Cross Society.

water and food were available, there were washing and toilet facilities, the clinic was open 24 h a day, and referral to local hospitals was straightforward. Accommodation was cramped and consisted of large huts where approximately 250 refugees lived on top of each other on three tier bunk beds, each measuring approximately $6 \times 4 \times 4$ feet. At the onset of the measles outbreak in September 1991, most of the High Island refugees had been living in Hong Kong for 2–3 years.

The medical services in the camp were divided between the Hong Kong Public Health Service (HKPHS) and two NGOs: the British Red Cross (BRC), and the Save the Children Fund (SCF). SCF ran a maternal and child health service. The BRC medical team (one doctor and five nurses) operated a primary health care clinic and a disease surveillance system. Notifiable diseases were reported to the HKPHS which was also responsible for the administration of all routine childhood vaccinations. Vaccination series were commenced at a reception centre for new arrivals on Green Island and continued after transfer to camps in Hong Kong. At High Island, the HKPHS conducted weekly vaccination sessions. All administered vaccinations were documented on HKPHS immunization cards which were given to mothers. Measles vaccine was given to children $\geqslant 9$ months–12 years. There were no reported measles cases prior to this outbreak but the measles vaccine coverage during this time is unknown. Once the first few cases of measles were notified, the HKPHS conducted a hut to hut vaccination campaign targeting children aged 6 months–12 years.

Measles case definition and data recording

All patients presenting to the clinic with suspected measles were seen by a clinic team member. Measles was diagnosed solely on the basis of the typical clinical picture either at presentation or as it evolved. The following clinical features constituted a case: fever and a generalized rash $\pm$ any one of the following: cough, coryza, Koplik spots or conjunctivitis. After diagnosis all cases were seen by the author. A standard reporting form was used for data recording: demographic data, history, vaccine history (from the HKPHS immunization card), physical signs, measles complications, reason/s for hospital referral, and hospital discharge diagnoses (verified by the author from hospital records). In the camp, pneumonia was diagnosed when all the following signs were present: dyspnoea, tachypnoea, sternal/intercostal/subcostal recession, and inspiratory crepitations. All patients were followed up closely until their measles resolved. New clinical data were recorded at each clinic visit. Complications were treated in the camp but no child received high dose vitamin A. Pneumonia was treated with oral ampicillin and cloxacillin or erythromycin (for children allergic to penicillin), oral rehydration salts were given for diarrhoea, and paracetamol syrup was prescribed for fever. Severely ill children were referred to hospital. Periodic visits were made into the camp to identify additional children with measles; parents were asked to bring these children for medical review.

Data analysis

Population data were obtained from the camp authorities. The attack rate (AR) was defined as the total number of measles cases/the population at risk. The 'under fives' population at risk was the total number of children < 5 years old at the start of the epidemic. The population at risk for each monthly age was the mean number of children of a given age (in months) over the course of the epidemic. The population at risk cannot be accurately determined because the number of children in the population with previous measles or measles vaccination pre-epidemic are unknown. Therefore, the protective efficacy of the measles vaccine administered during the epidemic cannot be calculated. Data were double entered, validated and analysed using Epi info 6.02 (WHO/CDC). Proportional data were compared using the uncorrected χ^2 values or the Fisher's exact test. Relative risks (RR) were calculated with the Taylor 95% confidence intervals (CIs). All statistical tests were 2 sided and a P value of $\leqslant 0{\cdot}05$ was considered a statistically significant result.

RESULTS

The population size was 7017. The 'under fives' numbered 1026 (534 boys, 492 girls) representing 14·6% of the population. There were 262 cases of measles in children (155 boys, 107 girls) who were all were followed up until resolution of illness. The mean and median ages were 15·3 and 14 months, respectively, range 5–39 months. Most children, 235 (89·7%), were < 2 years old. Boys < 5 years, 155/534 (29%), had a slightly higher risk of contracting

Table 1. *Clinical and epidemiological characteristics of measles cases during the High Island measles epidemic*

	Male ($n = 155$)	Female ($n = 107$)	Total ($n = 262$)
Age, median (range)	14 (6–37)	14 (5–39)	14 (5–39)
Crude attack rate*	29·0†	21·7	25·5
Unvaccinated	104	71	175 (66·8)‡
Vaccinated pre-epidemic	20	15	35 (13·4)
Vaccinated during epidemic	21	10	31 (11·8)
Vaccine history unknown	10	11	21 (8·0)
Complications	136	98	234 (89·3)
Hospital admissions	37	29	66 (25·2)
Deaths, *n* (CFR)§	1	1	2 (0·76)

* Based on under fives population at start of epidemic: males = 534, females = 492.
† Relative risk, 1·33, 95% confidence intervals 1·08–1·65, $P = 0·007$ (χ^2).
‡ *n* (%)
§ CFR, case fatality rate (%).

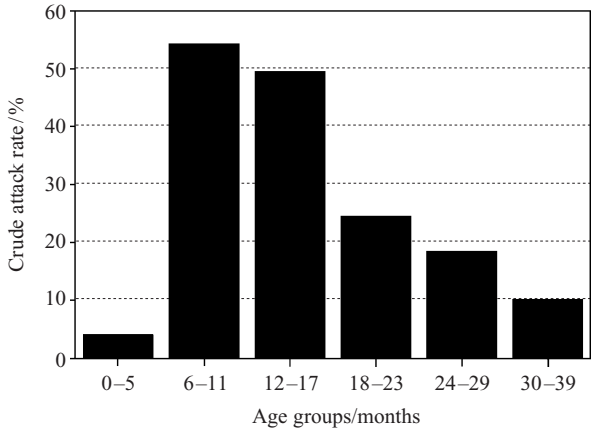

Fig. 1. Attack rates of children with measles in the different age groupings.

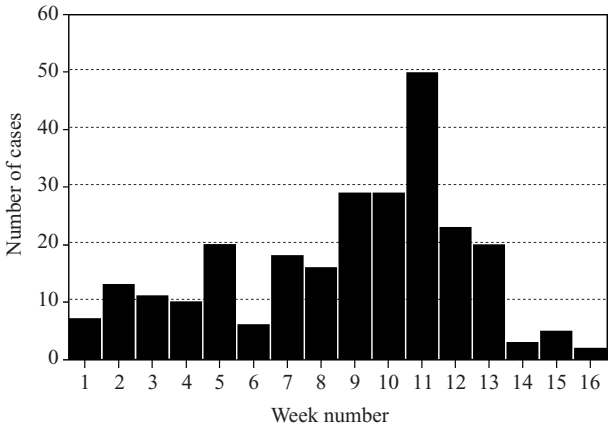

Fig. 2. Epicurve of the High Island measles epidemic: from late September 1991–mid-January 1992.

measles than girls < 5, 107/492 (21·7%), RR = 1·33 (95% CIs 1·08–1·65). The majority of children with measles, 175/262 (66·8%), had not been vaccinated pre-epidemic (Table 1). The highest age specific crude ARs were 83·8 (31/37), 68·7 (22/32), 62 (18/29), 58·3 (14/24) and 54·3 (19/35)% in children aged 14, 11, 10, 9 and 12 months, respectively. Overall, children aged 6–11 months (Fig. 1) had the highest AR, 54·3% (76/140). The epidemic lasted 16 weeks, starting in late September 1991 and ending in mid-January 1992 (Fig. 2).

Most children, 234/262 (89·3%), had at least one measles related complication. Pneumonia was the most common complication, followed by stomatitis, and significant diarrhoea (> 5 motions/day [9]); a small proportion, 10/262 (3·8%), had febrile convulsions (Table 2). The most frequent number of

Table 2. *Measles related complications affecting 262 Vietnamese children with measles*

Complication	*n*	%
Pneumonia	160	61·1
Stomatitis*	105	40·1
Diarrhoea > 5/day	64	24·4
Acute otitis media	62	23·7
Oral candida	25	9·5
Secondary pyoderma	21	8·0
Febrile convulsion	10	3·8
Bloody diarrhoea	9	3·4
Oral herpes simplex†	5	1·9
Stridor	1	0·4

* Five cases had oral ulceration.
† Three cases had oral ulceration.

Table 3. *The distribution of measles complications and hospital admissions within different age groups of children with measles during the High Island outbreak*

	Age groups (months)				
	5–11 ($n = 80$)	12–17 ($n = 109$)	18–23 ($n = 46$)	24–29 ($n = 17$)	30–39 ($n = 10$)
No. (%) with complications	73 (91·3)	100 (91·7)	40 (87)	13 (76·5)	8 (80)
No. (%) hospital admissions	19 (23·8)	34 (31·2)	9 (19·6)	3 (17·6)	1 (10)

Table 4. *Vaccine status of children with measles and the risks of measles complications or hospital admission*

	Complications			Admission		
	$\geqslant 1$	0	RR*	Yes	No	RR
Vaccinated	56	10	0·92 (0·82–1·02)	14	52	0·69 (0·41–1·16)
Unvaccinated	162	13		54	122	

* RR, relative risk (95% confidence intervals).

complications per child was two, affecting 97/262 (37%) children; 152/262 (58%) children had $\geqslant 2$ complications. The number of complications per child and the distribution of specific complications were similar between the age groups and between the sexes (details not shown). There were 66/262 (25·2%) hospital admissions and two deaths, giving a case fatality rate 0·76% (Table 1). Measles complication and hospital admission rates were lower in older children but these differences were not statistically significant compared to younger children (Table 3).

Vaccinated ($n = 66$) and unvaccinated ($n = 175$) children had similar morbidity with respect to the number of complications per child ($P = 0{\cdot}42$), and the occurrence of the three main complications: (i) pneumonia 38/66 (57·6%) *vs.* 110/175 (62·8%), $P = 0{\cdot}45$, (ii) stomatitis 26/66 (39·4%) *vs.* 74/175 (42·3%), $P = 0{\cdot}68$, and (iii) significant diarrhoea 20/66 (30·3%) *vs.* 43/175 (24·6%), $P = 0{\cdot}36$. The risk of having at least one measles complication and the risk of hospital admission were both independent of vaccine status (Table 4).

DISCUSSION

This measles epidemic occurred in an established and stable camp for Vietnamese refugees. Very young children of age range 5–39 months were affected. Overall, measles attack rates and measles related complication rates were high but the case fatality rate was low.

Measles occurs in refugee camps [2–7], urban areas of developing countries [10–13], isolated areas [14, 15], and poorly vaccinated Western communities [16, 17]. Predominantly young [18, 19] or young and older children may be affected [14, 20, 21], including children < 6 months [2, 15, 20–22]. Older Vietnamese children did not develop measles probably because of immunity due to previous infection or vaccination.

Most of these Vietnamese children suffered significant morbidity. Pneumonia, stomatitis and diarrhoea were important complications consistent with other studies [18–21, 23–28]. Stomatitis affected 40% of children but the proportion of children with ulcerative stomatitis was low, 8/262 (3·1%), consistent with studies from Afghanistan [24] and sub-Saharan Africa [29–31]. Interestingly, no child suffered with keratitis; a complication found in association with malnutrition, vitamin A deficiency, and herpes simplex keratitis [29, 32, 33]. Despite the severity of measles in this epidemic, the CFR was low (0·76%). This was due to several factors: stable camp conditions, tight medical supervision of patients, simple treatment protocols, and early hospital referral. High dose vitamin A may have been beneficial in these Vietnamese children but was not administered because of a lack of awareness of the WHO recommendations [8].

This measles epidemic occurred in camp which had a competent, lead agency responsible for vaccine delivery, as recommended [8], and where NGOs were part of the camp medical infrastructure. The majority

of children with measles were unvaccinated ($\simeq 67\%$) which is probably the main cause of this outbreak. Primary vaccine failure accounted for 13% of affected children who had been vaccinated before the epidemic – a significant contribution. The children who developed measles despite receiving vaccine during the epidemic (12%) may have been vaccinated too late i.e. after the third day of measles exposure [34].

After the epidemic mothers were interviewed to ascertain the cause of the low vaccine uptake. Many mothers reported they were unaware of the existence or benefits of measles vaccination and, in accordance with Vietnamese folklore, they believed children are born with measles which manifests as a natural and expected event later in childhood. These cultural beliefs were unknown to any of the BRC ex-patriate staff. Attendance at the weekly HKPHS vaccination sessions varied and was very low on rainy days. In between these visits, there were missed opportunities to vaccinate children attending the BRC clinic because it was not set up to undertake routine childhood vaccinations. Missed vaccinations also resulted from the periodic transfer of refugees to other camps within Hong Kong. Infrequent vaccination sessions and missed opportunities are well recognized causes of low vaccination uptake by communities [35, 36].

The principal public health message of this outbreak is that improved vaccine uptake at High Island may have been achieved by (i) better co-ordination between the NGOs and the HKPHS, (ii) the two NGOs assisting the HKPHS with vaccine administration, (iii) a greater awareness of the need to conduct vaccine surveys and to maintain high levels of vaccination in the 'under fives', and (iv) involving the community in health education and vaccination campaigns.

REFERENCES

1. World Health Organisation. Measles. WHO Wkly Epidemiol Rec 1993; **68**: 14–5.
2. Porter JH, Gastellu-Etchegorry M, Navarre I, Lungu G, Moren A. Measles outbreaks in the Mozambican refugee camps in Malawi: the continued need for an effective vaccine. Int J Epidemiol 1990; **19**: 1072–7.
3. Ryan B. Severe measles in Vietnam. Med J Aus 1976; **1**: 353–5.
4. Shears, P, Berry AM, Murphy R, Nabil MA. Epidemiological assessment of the health and nutrition of Ethiopian refugees in emergency camps in Sudan, 1985. BMJ 1987; **295**: 314–8.
5. Marfin AA, Moore J, Collins C, et al. Infectious disease surveillance during emergency relief to Bhutanese refugees in Nepal. JAMA 1994; **272**: 377–81.
6. Moore PS, Marfin AA, Quenemoen LE, et al. Mortality rates in displaced and resident populations of central Somalia during 1992 famine. Lancet 1993; **341**: 935–8.
7. Toole MJ, Waldman RJ. An analysis of mortality trends among refugee populations in Somalia, Sudan and Thailand. Bull WHO 1988; **66**: 237–47.
8. Toole MJ, Steketee RW, Waldman RJ, Nieburg P. Measles prevention and control in emergency settings. Bull WHO 1989; **67**: 381–8.
9. Morley D. 'Severe' measles. In: Paediatric priorities in the developing world, London: Butterworths, 1973: 207–30.
10. Taylor WR, Ruti-Kalisa, ma-Disu M, Weinman JM. Measles control efforts in urban Africa complicated by high incidence of measles in the first year of life. Am J Epidemiol 1988; **127**: 788–94.
11. Dabis F, Saw A, Waldman RJ, et al. The epidemiology of measles in a partially vaccinated population in an African city: implications for immunization programs. Am J Epidemiol 1988; **127**: 171–8.
12. Leoning WEK, Coovadia HM. Age-specific occurrence rates of measles in urban, periurban and rural environments: implications for time of vaccination. Lancet 1983; **ii**: 324–6.
13. Heyman DL, Mayben GK, Murphy KR, Guyer B, Foster SO. Measles control in Yauonde: justification of one dose, nine month minimum age vaccination policy in tropical Africa. Lancet 1983; **ii**: 1470–2.
14. Narain JP, Khare, S, Rana SRS, Banerjee KB. Epidemic measles in an isolated unvaccinated population, India. Int J Epidemiol 1989; **18**: 952–8.
15. Lindtjorn B. Severe measles in the Gardulla area of southwest Ethiopia. J Trop Ped 1986; **32**: 234–9.
16. Rodgers DV, Gindler JS, Atkinson WL, Markowitz LE. High attack rates and case fatality during a measles outbreak in groups with religious exemption to vaccination. Pediatr Infect Dis J 1993; **12**: 288–92.
17. Sutter RW, Markowitz LE, Bennetch JM, Morris W, Zell ER, Preblud SR. Measles among the Amish: a comparative study of measles severity in primary and secondary cases in households. J Infect Dis 1991; **163**: 12–6.
18. Gupta BM, Singh M. Mortality and morbidity pattern in measles in Tanga district, Tanzania. Trop Geog Med 1975; **27**: 383–6.
19. Oruamabo RS, Mbuagbaw LT. Measles in Port Harcourt, Nigeria. Trop Doct 1987; **17**: 88–9.
20. Kambarami RA, Nathoo KJ, Nkrumah FK, Pirie DJ. Measles epidemic in Harare, Zimbabwe, despite high immunization coverage rates. Bull WHO 1991; **69**: 213–9.
21. Satpathy SK, Chakraborty AK. Epidemiological study of measles in Singur, West Bengal. J Comm Dis 1989; **22**: 23–6.
22. Sinha NP. Measles in children under six months of age: an epidemiological study. J Trop Pediatr 1981; **27**: 120–2.
23. Avila-Figuero C, Navarrete-Navarro S, Martinez-Aguilar M, Ruiz-Gutierrez E, Santos JI. Compli-

acaiones en ninos con sarampion. Bol Med Hos Infant Mex 1990; **47**: 520–3.
24. Arya LS, Taana I, Tahiri C, Saidali A, Singh M. Spectrum of complications in Afghanistan: a study of 784 cases. J Trop Med Hyg 1987; **90**: 117–22.
25. Khoo A, Ho CK, Ong TK, Khairul A. Measles – an experience in Sandakan hospital, Sabah, 1990. Singapore Med J 1994; **35**: 595–8.
26. Choudhry VP, Atmar M, Amin I, Aram GN, Ghani R. Effect of protein energy malnutrition on the immediate outcome of measles. Indian J Pediatr 1987; **54**: 717–22.
27. Ramakrishan K. Measles a clinical study of 600 cases. Indian J Pediatr 1978; **15**: 1036–7.
28. Fischer PR. Measles in Zaire: 1987. Clin Pediatr 1987; **27**: 234–5.
29. Whittle HC, Smith JS, Kogbe OI, Dossetor J, Duggan M. Severe ulcerative herpes of mouth and eye following measles. Trans R Soc Trop Med Hyg 1979; **73**: 66–9.
30. Commey JOO, Richardson JE. Measles in Ghana – 1973–1982. Ann Trop Paed 1984; **4**: 189–94.
31. Morley D, Martin WJ, Allen I. Measles in east and central Africa. E Afr Med J 1967; **44**: 498–508.
32. Foster A, Johnson GJ. Measles, corneal ulceration and childhood blindness. Trop Doct 1988; **18**: 74–8.
33. Ukety TO, Maertens K. Ocular ulcerative herpes following measles in Kinshasa, Zaire. Curr Eye Res 1991; 10 (supp): 131–7.
34. Immunisation against infectious disease. London: HMSO, 1992: 63.
35. Yach D, Metcalf C, Lachman P, et al. Measles opportunities for measles immunisation in selected western Cape hospitals. S Afr Med J 1991; **79**: 437–9.
36. Cutts F, Soares A, Jecque AV, Cliff J, Kortbeek S, Colombo S. The use of evaluation to improve the expanded programme on immunisation in Mozambique. Bull WHO 1990; **68**: 199–208.