RISK FACTORS FOR SEVERE MEASLES

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Abstract. A retrospective study on measles was carried out in 522 children admitted to the Department of Pediatrics, Sumber Waras Hospital, Jakarta during the period of January 1982 - December 1986. Most of the subjects (91.1%) came from lower socio-economic levels, living in unfavorable environmental conditions in crowded housing. The predominant age group was 2-5 years; complications were observed in 82.6% and mortality in 10.3%. The most common complications and cause of deaths were bronchopneumonia (94.4%), encephalopathy (88.9%) and diarrhea (25.9%) or combinations thereof.

The outcome of measles infections is determined by the presence of malnutrition and complications which is influenced by the nutritional intake, exposure, susceptibility and constitution of the patients. The household characteristics (socio-economic, socio-cultural and health facilities available) influence the above mentioned interactions through intermediate variables of nutrition (feeding pattern, food supplements), constitution, age) and treatment.

Research and intervention on measles can be designed and planned based on this model of interactions.

INTRODUCTION

Measles is a highly contagious viral disease in childhood that can be prevented by immunization. The diagnosis is usually not difficult to establish clinically.

Before 1970, measles was not considered as a health problem in Indonesia. This might be due to the fact that children who are more likely to suffer serious complications of the disease are those of underprevileged communities who do not have easy access to health services. Unfavorable beliefs about measles in the communities are also reasons for a delay in seeking medical treatment.

Measles is considered as a health problem following outbreaks of the disease in various regions in Indonesia. The most serious one occurred in Lombok island in 1977 involving more than 12,500 children, predominantly the under-five age group (Soeprapti, 1979). Measles immunization was started in 1982 but the national coverage in 1986 and 1988 was only 26% and 64.2%, respectively (Direktur Jenderal PMP dan PLP, 1986; Kandu, 1989).

Household surveys conducted in 1980 (Budiarso *et al,* 1980) and 1986 (Budiarso *et al,* 1987) revealed that measles is one of the ten leading causes of morbidity and mortality in infancy and in the under five age group and it is presumed to have a role in the morbidity of diarrhea and bronchopneumonia, the first two leading causes of morbidity in infancy and under fives.

The case fatality rate of measles in Indonesia is estimated to be 3% - 4%, increasing to 10% in outbreaks.

The risks factors for severe measles are undernutrition, poor socio-economic conditions, poor sanitation, unfavorable habits and beliefs in the communities.

The purpose of this retrospective study is to present risk factors for measles and to propose a model of interactions as a basis for designing and planning further studies and interventions.

MATERIALS AND METHODS

The subjects of this study consisted of children admitted to the Department of Pediatrics, Sumber Waras Hospital during the period January 1982 - December 1986 with the clinical diagnosis of measles.

The clinical diagnosis was made on the basis of history and clinical features, namely those of coryza, cough, sore eyes and a generalized maculopapular

rash appearing in the retroauricular regions spreading to face, trunk and extremities. The skin rash appear after 3 days or more of high fever; hyperpigmentation and desquamation were characteristic during convalescence.

Nutritional status was determined using 50 percentile of the Harvard weight-for-age standard. Patients were considered well-nourished, under nourished and severely malnourished if the body weight was respectively $\geqslant$ 80%, 60%-79% and $<$ 60%. of standard weight.

RESULTS

During a 5 year period (1982-1986) 522 patients (270 boys and 252 girls) with a clinical diagnosis of measles were admitted to the Department of Pediatrics, Sumber Waras Hospital; all were unvaccinated for measles (Table 1).

Age distribution of the subjects is presented in Table 2. Most of the subjects (81.9%) were under-five, predominantly 1-4 years age group and 91.2% of subjects were malnourished.

The most frequent complications were bronchopneumonia, diarrhea and encephalopathy and the difference in incidence by nutritional status was statistically significant (Tables 3, 4).

Combination of bronchopneumonia-diarrhea; bronchopneumonia-encephalopathy and bronchopneumonia-diarrhea-encephalopathy were found respectively in 13.9%, 13.8% and 2.1% of subjects. Mortality by age group and nutritional status are presented in Tables 5 and 6.

Apparently the mortality rate was significantly higher in the younger age group and in more severe malnourished group. The mortality rates according to age group and to nutritional status are presented in Tables 7 and 8 respectively. There was a significant difference in the mortality rate among children of 2 years-old or more and in mildly-undernourished and well-nourished groups, whereas in children below 2 years-old and severely malnourished the difference was not statistically significant.

The most frequent cause of mortality was the combination of bronchopneumonia-encephalopathy (59.3%) and bronchopneumonia-encephalopathy-diarrhea (24.1%). Table 9 shows that death occurred mostly during the first 24 hours after admission.

DISCUSSION

This study shows that case fatality rate was higher among those with malnutrition, those less than 2 years of age and those with complications including bronchopneumonia, encephalopathy, diarrhea and combinations thereof, ie mortality and complications were higher among malnourished children.

High severe measles morbidity and mortality are common in populations in which malnutrition is frequent; it has long been accepted as major risk factor for fatal attacks of measles among children in developing countries (Aaby *et al,* 1984; Kasongo Project team, 1983; Morley and Aaby, 1988).

The role of micronutrient deficiencies in measles mortality seems to be more important than currently

Table 1

Yearly distribution and case fatality rate of 522 measles patients admitted to the Department of Pediatrics, Sumber Waras Hospital (1982-1986).

Year	All patients	Measles cases	Prevalence (‰)	Mortality	Case fatality (%)
1982	3.059	126	41.2	13	10.31
1983	3.245	71	21.9	9	12.67
1984	3.616	133	36.8	11	8.27
1985	2.979	72	24.2	9	12.50
1986	3.284	120	36.5	12	10.00
Total	16.183	522	32.3	54	10.30

Table 2

Age distribution of 522 measles patients admitted to the Department of Pediatrics, Sumber Waras Hospital (1982-1986).

Age	Nutritional status			Total
	Well nourished	Under nourished	Severely malnourished	
6-9 months	26	5	3	34
9-12 months	28	16	2	46
12-23 months	51	68	16	135
2-4 years	85	101	21	207
5-10 years	59	28	4	91
> 10 years	6	3	0	9
Total	255	221	46	522

50 percentile Harvard-Weight-for age = 100%

Table 3

Complications of measles by age group.

Complications	Age group				Total
	6-11 months (n = 80)	12-23 months (n = 135)	2-4 years (n = 207)	⩾ 5 years (n = 100)	(n = 552)
Bronchopneumonia	63 (77.5%)	111 (82.2%)	160 (77.3%)	57 (57.0%)	391 (74.9%)
Gastroenteritis	30 (37.5%)	36 (26.7%)	28 (13.5%)	3 (3.0%)	97 (18.6%)
Encephalopathy	12 (15.0%)	29 (21.5%)	43 (20.8%)	5 (5.0%)	89 (17.0%)
Convulsions	11	12	13	3	39
Acute otitis media	7	10	12	2	31
UTI	3	3	4	0	10

appreciated. Zinc has an important role in maintenance of normal immunity status (McClain *et al,* 1983) and vitamin A deficiency has been linked to child survival (Sommer *et al,* 1983).

With reference to the malnutrition-infection syndrome (van Noren and van Vianen, 1984) the interaction of risk factors for measles is as in Fig 1. Household characteristics have their effects on these interactions through intermediate variables which are behavioral and biological in nature. These include nutritional, constitutional, exposure, curative and susceptibility variables.

Nutritional status of the patients is determined by the intake of food which is in turn influenced by the constitution of the children and the nutrition given by their mothers/guardians. The latter include the feeding pattern (breastfed or bottlefed), age of weaning, post-weaning nutrition and food supplied to the under fives (nutritional variables).

Table 4

Complications of measles by nutritional status.

Complications	Nutritional status			Total
	Well nourished (n=255)	Under nourished (n=221)	Severely malnourished (n=46)	
Bronchopneumonia	158 (61.9%)	187 (84.6%)	46 (100.0%)	391 (74.9%)
Gastroenteritis	35 (13.7%)	44 (19.9%)	8 (39.15%)	97 (18.6%)
Encephalopathy	89 (9.8%)	45 (20.4%)	19 (41.3%)	87 (17.0%)
Convulsions	21	17	1	39
Acute otitis media	17	13	1	31
UTI	2	8	0	10

Table 5

Mortality of measles by age.

Age	Number of patients	Death (%)
6-11 months	80	15 (18.7)
12-23 months	135	16 (11.8)
2-5 years	207	20 (9.7)
>5 years	100	3 (3.0)
Total	522	54 (10.3)

Table 6

Mortality of measles by nutritional status.

Nutritional status	Number of patients	Death (%)
Well nourished	255	15 (5.9)
Under nourished	221	28 (12.7)
Severely malnourished	46	11 (23.9)
Total	522	54 (10.3)

The constitution of the patients at birth depends on the nutritional condition of the mother, including reproductive pattern, food supplement to the pregnant and lactating mother and unfavorable habits such as smoking, alcohol etc (constitutional variables).

Factors determining the possibility of contracting measles include the susceptibility of the patients and exposure to the virus. Susceptibility to measles infection depends on the constitution and immunity of the children. Acquisition after active immunization against measles or passive acquisition transplacentally will decline with age. Mortality is consistently reported to be highest among children below 12 months of age and remains high through 3 years of age but thereafter declines (Aaby *et al*, 1983). This study reveals that out of 522 subjects, 422 (80%) were in the 12 months age group and over and all were unvaccinated. Mortality is significantly higher in children less than 1 year of age (susceptibility variables).

Exposure to measles is higher under bad housing conditions, overcrowded and extended families (exposure variables). Malnourished children excrete virus for a longer period and perhaps in a larger quantity than well nourished children (Scheifele and Forbes, 1973; Morley, 1983). It is reported that secondary contacts in the household

Table 7

Mortality by age group among each nutritional status of measles admitted to the Department of Pediatrics, Sumber Waras Hospital (1982-1986).

Nutritional status / Age group	Well-nourished		Under-nourished		Severely malnourished	
	Number	fatality (%)	Number	fatality (%)	Number	fatality (%)
6-11 months	54	8 (14.8)	21	7 (33.3)	21	4 (19.0)
12-23 months	51	3 (5.9)	68	9 (13.2)		
2-4 years	85	4 (4.7)	101	10 (9.9)	25	7 (28.0)
$\geqslant$ 5 years	65	0	31	2 (6.3)		
Total	255	15 (5.9)	221	28 (12.7)	46	11 (23.9)
	$p < 0.01$		$p < 0.05$		$p < 0.05$	

Table 8

Mortality by nutritional status among each age group of measles admitted to the Department of Pediatrics, Sumber Waras Hospital (1982-1986).

Age group / Nutritional status	6-23 months		2-4 years	
	Number	Fatality (%)	Number	Fatality (%)
Well-nourished	105	11 (10.5)	85	4 (4.7)
Under-nourished	89	16 (17.9)	101	10 (9.9)
Severely-malnourished	21	4 (19.0)	21	6 (28.6)
Total	215	31 (14.4)	207	20 (9.7)
	$p > 0.05$		$p < 0.01$	

Table 9

Cause of mortality among 54 fatal cases.

Complication	Number of cases	Case fatality (%)
Bronchopneumonia-Encephalopathy-Diarrhea	11	11 (100%)
Bronchopneumonia-Encephalopathy	72	32 (44.4%)
Encephalopathy	6	2 (33.3%)
Bronchopneumonia-Diarrhea	73	2 (2.7%)
Diarrhea	13	1 (7.7%)
Bronchopneumonia	235	6 (2.5%)

Table 10

Period of hospitalization before death among 54 fatal cases.

Period of hospitalization	Nutritional status			Total
	Well-nourished	Under-nourished	Severely-malnourished	
<24 hours	13	17	8	38 (70.4%)
24-48 hours	0	4	1	5 (9.3%)
>48 hours	2	7	2	11 (20.3%)
Total	15	28	11	54

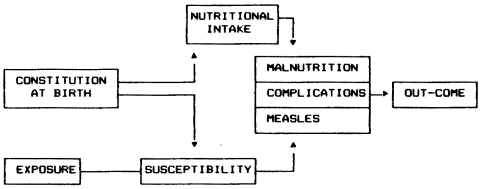

Fig 1—Interaction of risk factors for measles.

suffer from more severe measles as compared with the index cases/first case in the household (Aaby *et al,* 1984).

Epidemiologic data show that epidemic patterns in highly endemic areas (crowded urban) are different from those of low endemicity (rural areas). An epidemic pattern occurs every other year (see-saw pattern) in highly endemic cities and every 3 years or more in rural areas. The outcome of measles is also influenced by the interventions taken, including drugs for complications, restoration of fluid and electrolyte imbalance and other supportive measures (curative variables).

Fatality in this study occurred mostly in the first 24 hours of hospitalization. This indicates that fatal cases were admitted in worse condition. This situation might be due to unfavorable beliefs and habits existing in the community, namely (1) the belief that measles is one of the milestones in child development; (2) medications may modify rash manifestations leading to uncertainly in diagnosis; (3) measles is a disease of superstition and must be treated by the traditional medicine man.

The interactions of risk factors for measles (malnutrition, complications, nutritional, constitutions at birth, susceptibility and exposure) and intermediate variables (constitution, nutrition, exposure, susceptibility and curative) are shown in Fig 2.

The household characteristics compromise an analytically diverse group of factors having in common the fact that all are aspects of the household where the child is reared. They include:

1. Demographic composition
   - size (overcrowded)
   - sex and age composition

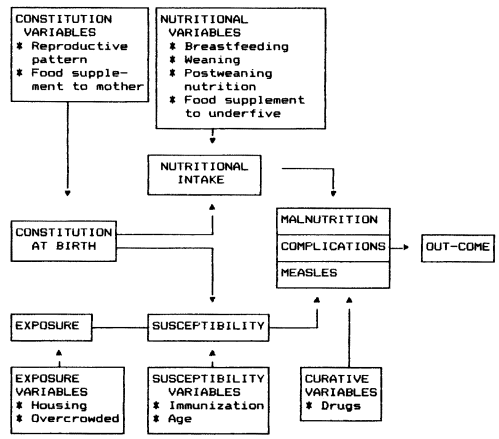

Fig 2—Interactions of variable risk factors for severe measles.

It is of great importance for the distribution of food and care within the household and for the risk factor exposure.

2. Socio-economic conditions
   - occupation and income
   - housing
   - safe water supply etc
3. Socio-cultural conditions
   - level of parental educations
   - notions concerning health and hygiene, good nutrition, health and disease
   - unfavorable beliefs and habits
   - extended family and overcrowded
4. Health facilities
   - availability to the patients (locations, fee etc)
   - utilization of the health facilities by the community

The complete model of interactions is shown in Fig 3. Using this model of interactions, intervention and research can be planned and designed.

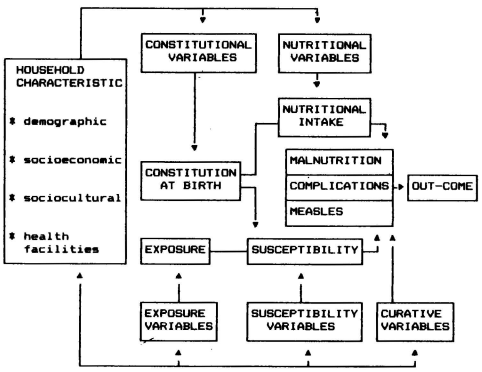

Fig 3—Model of risk factors interaction for measles.

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