SPECIAL ARTICLE

Risk Factors for Acute Respiratory Infections in Underfive Children*

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ABSTRACT A longitudinal study on acute respiratory infections was conducted from April 1988 until June 1990, in Cikutra, an urban community in the municipality of Bandung, Indonesia. The study consisted of 3 parts: a presurvey, a cross sectional study, and a one-year prospective study. All children aged less than five years in Cikutra were included in the presurvey. A simple questionnaire was used for collecting data. In the cross sectional study 500 children were selected by stratified random sampling. Field investigators visited the children's homes and interviewed mothers using a standardized questionnaire. For the prospective study 269 children of less than 48 months of age were enrolled, and followed for one year. The prevalence of all ARI was 57-58%, mild-moderate ARI 55-56% , and severe ARI 5%. On average the children suffered from 6.7 episodes of ARI per child per year, with a mean duration of episode of 5.3 days. Several factors showed significant relationship with the prevalence, incidence, severity of duration of ARI. **[Paediatr Indones 1995; 35:65-77]**

Introduction

Acute respiratory infections (ARI) still constitutes a major health problem in developing countries such as Indonesia. The high mortality and morbidity has been shown in many studies. According to WHO a child suffers on average from 5 to 8 episodes of ARI per year when he or she lives in an urban area.[1]

The mortality of ARI in developing countries is also high. According to Miller (1985)[2] six million underfive children died every year due to ARI, and most of them lived in developing countries.

Several risk factors have been consid-

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mortality. Many studies were done on those factors; however, some of them showed conflicting results.[3]

Several records on ARI mortality and morbidity have been published in Indonesia. However, most of them came from university hospitals, and thus might contain very selective cases, and might not representative for the whole population.[4] It is reported that the prevalence of ARI ranged from 12 to 45%; yet we do not know the incidence of ARI, and neither the possible risk factors for it. Therefore, we decided to study the prevalence, incidence, duration and risk, or beneficial factors for ARI.

Methods

Our study consisted of 3 parts: a presurvey, a cross sectional study, and a one-year prospective study.

The presurvey. All underfive children in Cikutra were enrolled. There were 3225 households in Cikutra with 1967 underfive children; however, in 6 children the exact age was not known, thus only 1961 children were included for the analysis. The aim of the presurvey was to obtain baseline data on underfive children, to know the prevalence of ARI, and to investigate several possible risk factors. Data were collected by trained primary health care workers, who interviewed the mothers or adult guardians using a simple questionnaire. For this study ARI was classified into two classes: mild-moderate and severe.

The cross sectional study. Six hundred underfive children were selected by stratified sampling from the 1961 children of the presurvey. However, only in 500 children could the questionnaires be analyzed. The aim of this study was to obtain detailed data on possible risk or beneficial factors. Data were collected by nurses from the local health center, who had been trained before as field investigators. They interviewed the mothers or adult guardians using questionnaires which were modified from the epidemiologic children's questionnaire of the American Thoracic Society.[5] For this study ARI was also classified into mild-moderate and severe, similar as in the presurvey.

The prospective study. All the children from the cross sectional study with age of less than 48 months were planned to be included. However, the prospective study was postponed due to some technical difficulties in the field. Thus, at the beginning of the prospective study, only 269 children could be enrolled. The aims of the prospective study were to know the incidence, severity and duration of ARI; to investigate several technical data such as plasma retinol level, IgE, eosinophil, hemoglobin, parasite in stool, chest X-ray and tuberculin test, and to know the influence of vitamin A supplementation. In this study the children were subdivided at random into 2 groups according to those who received vitamin A or placebo.

Before the study started, physical and laboratory examinations were performed by a medical team. Every two weeks the *kader* who had been trained before as field interviewers visited the children's homes, interviewed mothers or adult guardians on respiratory symptoms during the previous two weeks, using a questionnaire. Every month the doctor re-examined the children and rechecked the filled-in bi-weekly questionnaires. Two hundred thousand IU vitamin A or placebo were given on the first and sixth month of the study. Plasma retinol levels were assayed three times: before the study started, at the third, and sixth month of the study. For this study ARI was classified into three classes: mild, moderate, and severe.

Definitions and classification

ARI was defined as any infections of acute onset (<14 days) apparently due to microorganisms, in any area of the respiratory tract including the nose, ear, pharynx, larynx, trachea, bronchi, bronchioles, or lung. For this study we use the classification of ARI according to the degree of severity as proposed by WHO in 1982: mild, moderate and severe.[6]

Results and Discussion

Characteristics of the subjects is shown in Table 1.

Morbidity and duration of ARI

The overall prevalence of ARI during one month before the study ranged between 57-58%, for mild-moderate ARI 55% and for severe ARI 5%. The prevalence of ARI in our study is higher than in other studies conducted in Indonesia.[7-9] This may be caused by the fact that our study was conducted in the rainy season, where the prevalence of ARI was higher. From our prospective study we found indeed, an incidence of ARI of 43% during the dry season and 56% during the rainy season.

However, as also mentioned by Hadiwinoto and Prihatini[9] a different environment may cause a difference in the morbidity of ARI. Our study showed that the overall incidence ARI was 6.7 episodes per child per year. Two children never experienced ARI during the whole year, thus the cumulative incidence during the observation period was 99%. One child had experiences with 20 episodes of ARI during the one year observation; however, most of the children (i.e., almost 50% of subjects) suffered from 5-8 episodes of ARI.

Several community-based studies conducted in several urban and rural areas in developing countries showed that the incidence of ARI in an urban area ranged from 5 to 7 episodes per child/ year.[10,11] This is similar with our study, except for the study from Thailand[12] which showed higher episodes. The duration of ARI is also important because the longer the child suffers from ARI the higher the chance to compromise her / his growth and development. From the prospective study we found that on the average each child suffered from ARI for 36 days per year, and the mean duration of ARI episodes was 5.3 days. Our finding was shorter than that mentioned by the WHO[1] which stated a duration of ARI of 7-9 days, or Lang et al[13] who reported a mean duration of 8.5 days. however, Lang's study was undertaken in Burkina Faso, a rural area in West Africa, and our study was done in an urban area where the sick child can easily seek medical help. Furthermore, in our prospective study in fact, there

Table 1. Characteristic of subjects

Characteristics	Children (%)	Characteristics	Children (%)
Breast feeding in infants:		**Parent's education:**	
Yes	93.6	Father	
No	5.4	< 12 years	64.4
Nutritional status:		>= 12 years	35.6
< -3 SD	3.2	Mother	
< -2 SD	23.1	< 12 years	78.1
< -1 SD	36.2	>= 12 years	21.9
≥ -1 SD	37.4	**Parent's occupation:**	
Crowding:		Father	
Family size		Working	98.7
< 5	30.6	Not working	2.3
≥ 5	69.4	Mother	
Room occupancy:		Working	18.0
< 3	54.4	Not working	82.0
≥ 3	45.6	**Indoor air polution:**	
Square meters per person		Smoking pollution	
=> 10 m2	19.8	Smoking parents	84.9
< 10 m2	80.2	Non	15.1
Family income:		Bedroom pollution	
< 25 USD	24.0	Coils : Yes	75.0
≥ 25 USD	76.0	No	25.0
Family possession:		Smoking : Yes	38.2
House		No	61.8
Cwn house	38.5	Kitchen pollution	
No house	61.5	Yes	96.2
Car		No	3.8
Yes	4.6	**Asthma and atopy in children:**	
No	95.6	Asthma	6.0
Motorcycle		Wheezing	12.4
Yes	14.8	Atopy	28.0
No	85.2	**Asthma in the family:**	
Television		Father	3.5
Yes	54.0	Mother	5.0
No	46.0	Sibling	2.7
Maid		**Atopy in the family:**	
Yes	7.2	Father	19.3
No	92.8	Mother	28.3
Tuberculin test >10 mm	16.8	Sibling	19.0
Immunization status:		**Technical data:**	
BCG	91.0	PRL (μg/dl) < 10	7.8
DPT	90.0	10 - 20	53.2
Polio	87.0	> 20	47.0
Measles	64.0	**Hemoglobin (g/dl):**	
Xerophthalmia:	0	< 11	4.9
Parasite (s) :	35.8	≥ 11	95.1
Abnormal chest X-ray:	20.4	**Median IgE (IU/ml):**	436.0
		< 100	6.3
		Median eosinophil (μl)	580.0
		< 400	31.1

was also intervention on ARI management.

Risk factors

Several risk factors have been considered to influence ARI morbidity, mortality and degree of severity. We investigated several possible risk factors, however, not all factors showed interesting results. Several factors that seemed important from our study were the followings:

Age. Our study showed that the prevalence of ARI was lower in infants of less than 1 year old compared to the other age groups. Our study revealed that the incidence and duration of ARI decreased with increasing age. We found that significantly the incidence of ARI was higher, and the duration longer in younger children. However, no children of less than one year were included. Several studies showed that the incidence of ARI was higher in infants of less than one year old which decreased with increasing age.[14,15]

Nutritional factor. We assessed the nutritional status of the children according to weight for age, and compared it to the median weight for age of the reference population of the National Center for Health Statistics.[16] Sixty-three percent of the children showed weight for age below -1 SD of the median weight for age of the reference population of the NCHS, and 25% showed less than -2 SD below the median. This study clearly showed a tendency toward a higher prevalence of mild-moderate and severe ARI and a higher incidence of severe ARI. however, this was not significant. Several studies showed malnutrition to be one of the important risk factors for ARI.[12,17] In chronic and severe malnutrition, more lower respiratory tract infections were found.[11] It is also reported that duration and mortality rate of lower respiratory tract infections (LRTI) were higher in severely malnourished children.[13] However, Cruz et al[10] similar with us, failed to find the relationship between malnutrition and ARI.

Breast-feeding. In our study almost all infants (95%) were still breast-fed. Our study failed to show any protective effects of breast-feeding; the prevalence of mild-moderate and severe ARI was similar in breastfed or non breastfed infants. However, the number of non breastfed infants in our study was too small (5%) for a meaningful analysis. From our prospective study we could not analyze the role of breast feeding because there were no more infants included. It is mentioned that breast feeding can protect infants against infections such as ARI.[18] Several studies showed the prevalence of ARI to be higher in non breast-fed infants. However, Launer et al [19] found in their study in Indonesia that in adequately breast-fed infants only the duration of the respiratory tract illnesses was shorter.

Vitamin A. Great attention was paid to vitamin A because of studies conducted in Indonesia, especially on the role of vitamin A supplementation on ARI.[20,21] Several recent studies were conducted to know the effect of vitamin A supplementation on ARI morbidity, mortality and duration of illness.[12,23-32] Among the studies in communities not all show that vitamin A supplementation

shows a favorable effect.[22,27,30] At the moment the only widely accepted practice, as also proposed by the WHO, is to give vitamin A supplementation in children with measles in population where the case fatality rate of measles is more than 1%.

From the laboratory examination before the study we found that the mean plasma retinol level (PRL) among the children was 20 μg/dl which is the lower limit of normal value, and 53% of the children showed a PRL of less than 20 μg/dl, 8% of them showed a deficient level. However, no xerophthalmia was found on the eye examination before the study started. From the prospective study (Table 2) no difference was found in the incidence and of ARI between vitamin A supplemented and unsupplemented children; also no difference was found before and after supplementation. However, the duration of ARI was longer in unsupplemented vitamin A children.

Family income. Twenty one percent of the children came from low income families (<25 USD/month), 73% from middle income (25-125 USD/month) and only 5% from high income families (>125 USD/month). The prevalence of mild-moderate ARI was significantly higher in children of lower income families. Nevertheless, no influence of income on the incidence, severity and duration of ARI was found. Social economic status was considered as an important risk factor in developed countries.[3,6] According to Miller[2] more ARI was found in less privileged children. However, Lang et al[13] also failed to show a positive effect of socio-economic status.

Crowding. We defined crowding as the number of persons in the household, family size of more than 5 persons, the square meter space per person of less than 10 m^2 and the number of persons sleeping in the same room of more than 3 persons per bedroom. In our study the prevalence of ARI was higher in more crowded conditions; however, no influence of crowding on the incidence, severity or duration of ARI was found, except, a higher incidence of severe ARI in children with a family size of more than 5 persons in the households. Our study confirmed the study of Turner et al[33] but it was different, again, from those of Lang et al.[13]

Atopy. Recently airway hyperactivity was identified as one of the important risk factors for ARI. However, not many studies were done on the role of atopy and airway hyperactivity on ARI. The prevalence of atopy and asthma in the subjects and family was ranging between 19-28%, and 3-6%, respectively; and the prevalence of wheezing in children was 12%. No influence of these factors on the prevalence or duration of ARI was found. However, the incidence of moderate ARI was higher in the presence of a history of atopy in the family, and in children with a history of atopy, wheezing and asthma. Cogswell et al also found a similar result, more respiratory infections in atopic children. A recent publication from IUATLD also mentioned that airway hy- perreactivity is one of the endogenous risk factors for ARI.[35] Nevertheless, the relationship between atopy and ARI in developing countries has remained unrecognized. We therefore consider our findings important.

The serum IgE and blood eosinophil count were also measured before the prospective study started. The median values of IgE and eosinophil before the study were high, 436 IU/mL and 580/μl with a large range (18-9707 IU/μl and 70-5090/μl), respectively. The normal limit of IgE is 100 IU/ml, only 6.3% of the children showed IgE of less than 100 IU/μl and the normal limit for eosinophil is 400/μl, 31.1% of the children showed eosinophil count of less than 400/μl. Figure 1 and 2 show the association between incidence and duration of ARI and serum IgE and blood eosinophil count. We found no relationship between these two data and ARI.

Season. We found the incidence of all mild, moderate and severe ARI to be significantly higher during the rainy season. It was mentioned that in the tropics more ARI occurred during the rainy season.[14] However, Lang et al[13] found more ARI during the dry season, they attributed this low humidity as the cause for the decreasing defense mechanism.

Table 2. Relationship between incidence and duration of ARI and plasma retinol levels and vitamin A supplements in 269 children

Categories retinol level (μg/dl)	Vitamin A suppl.	Number of children N	%	Plasma retinol (μg/dl) mean (SD)	Incidence of ARI/year mean (SD)	Duration (days/year) mean (SD)
< 10	Yes	7	3.5	7.8 (1.5)	6.4 (1.6)	29.3 (12.2)
< 10	No	9	4.4	7.8 (1.9)	6.8 (2.9)	33.1 (14.6)
10 - 20	Yes	42	20.5	15.2 (2.8)	7.3 (3.9)	39.5 (24.2)
10 - 20	No	50	24.5	15.9 (2.7)	7.2 (3.2)	42.5 (25.7)
> 20	Yes	54	26.5	26.7 (5.9)	6.5 (3.4)	22.9 (19.3)
> 20	No	42	20.6	25.5 (5.4)	7.1 (4.0)	36.6 (22.8)

p > 0.05 for each of the categories of retinol levels

In this study we also investigated other factors such as sex, indoor air pollution, parents education and occupation, family goods, and immunization status of the children. Also se-veral other technical data such as hemoglobin concentration, parasite in the stool, chest X-ray and tuberculin test. However, we failed to show a significant effect of those factors.

Conclusions

Our study showed that the prevalence of ARI in the area of study was high, 57 to 58%, for mild-moderate ARI 55 to 56% and 5% for severe ARI. These findings were higher than those of other studies done in Indonesia. However, these were similar with the studies from other developing countries. The incidence of ARI was 6.7 episodes per child per year. It is similar with that reported from developed or developing countries. The dur-

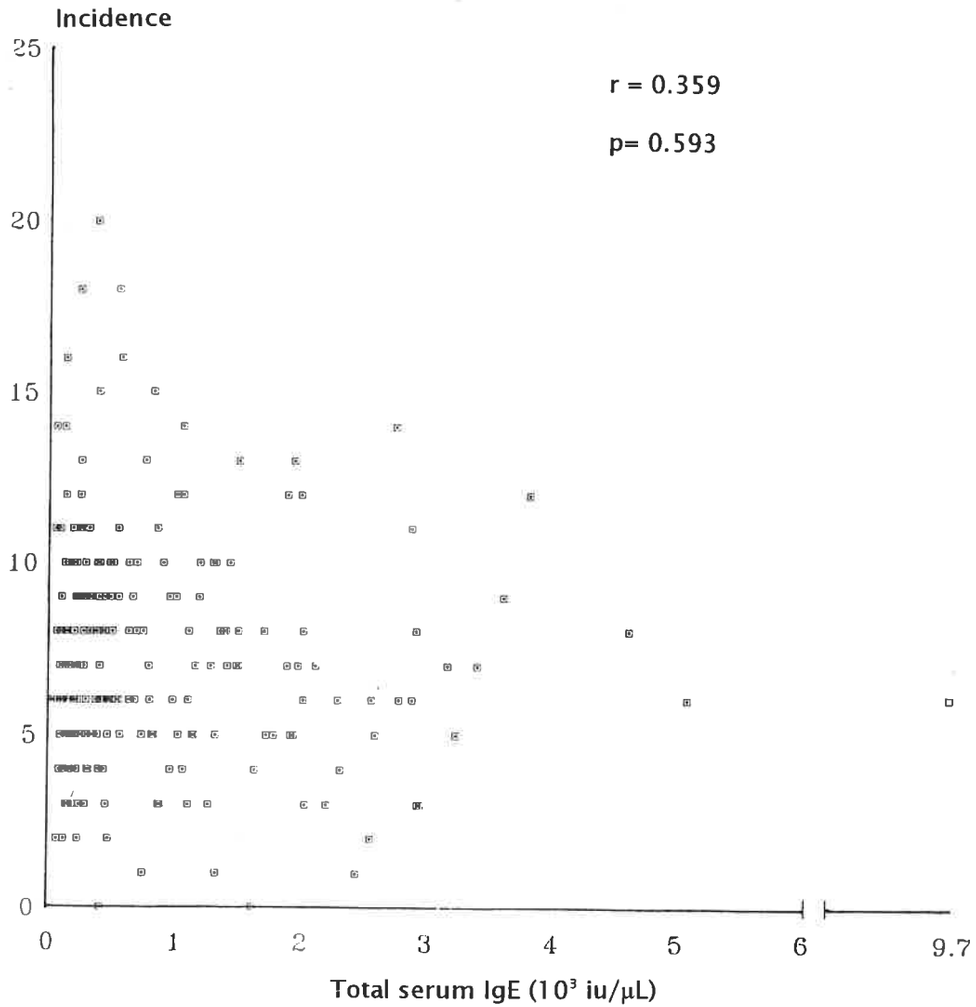

Figure 1

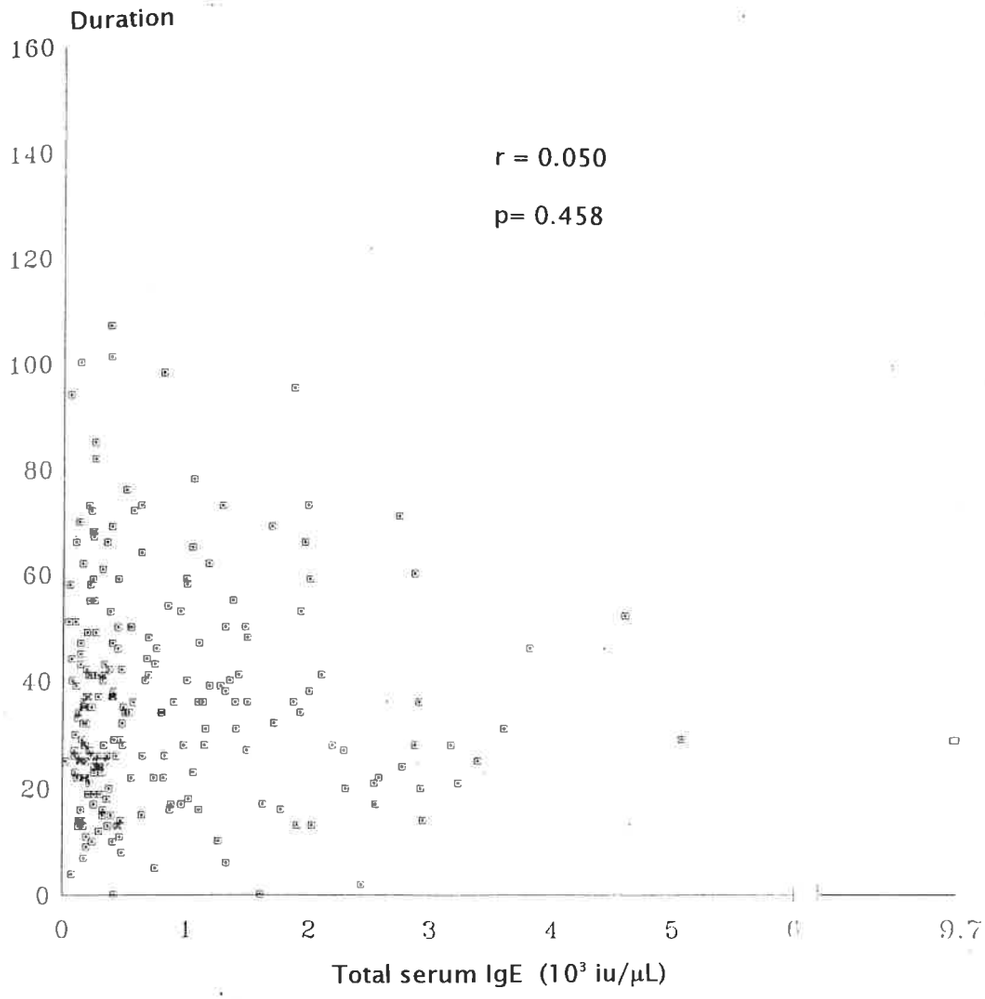

Figure 2

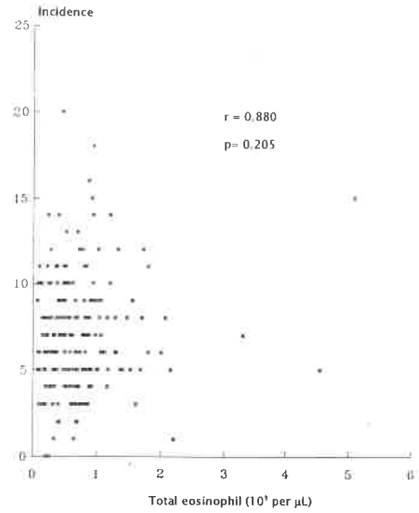

Figure 3

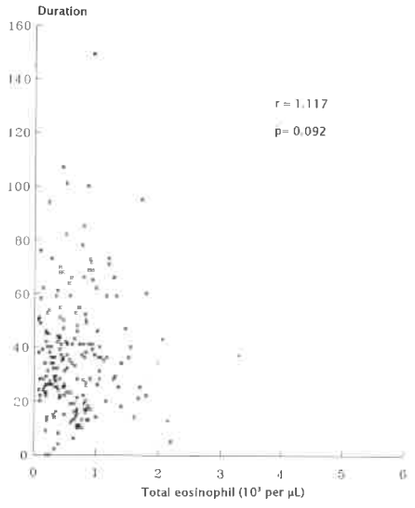

Figure 4

ation of ARI of 5.3 days was shorter than in other studies in developing countries. Furthermore, our study revealed that several risk factors showed a significant association with ARI such as: age, crowding, history of atopy in the family, and history atopy, asthma and wheezing in the children. Our study failed to show a beneficial effect of vitamin A supplementation on ARI incidence; however, we found that the duration of ARI in unsupplemented children seemed longer. We also found that airway hyper-reactivity and atopy were important risk factors for ARI. However, even though a significant relationship was found, it does not mean that the factor has a very important influence. In the presurvey, a discriminant analysis on several risk fac- was analyzed together. All those factors, family income, vitamin A supple- mentation and age, however, only influenced 18% of ARI in infants, the rest might be caused by another factors, and in children of 1 to 5 years even much more less (0.4-1.8%).

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