ORIGINAL ARTICLE

Risk Factors of Infantile Diarrhea (A Case-Control Study)

by

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Abstract

From March thru April 1990 an unmatched case-control study had been conducted at the pediatric out-patient Clinic of Dr. Pirngadi Hospital Medan to assess risk factors of infantile diarrhea. The study population were infants, aged younger than 24 months. The mothers of the infants were interviewed, using structured questionaires.

Sample size, calculated by means of formula, with 95 % level of confidence, 90 % power of study, 50 % estimated proportion of exposure in the control-group and 2.0 estimated odds ratio, was 124.

All infants with diarrhea were included in the case-group until a total number of 124 infants were reached. One control, an infant without diarrhea, was taken for each case from the nearest sequence of attendance after the case. A total of 20 risk factors were tested. Exposure was indicated from the last day before illness.

Computerized statistical analysis was performed to calculate odds ratio, 95 % confidence interval and two tailed significance testing for qualitative dichotomic data by means of Chi square test.

A total of nine factors were confirmed as risk factors of infantile diarrhea i.e mother's age than 20 years, working mother, not cleaning nipple before suckling the baby bottle feeding, having only one nursing bottle/teat, not ready for use nursing bottle/teat, giving left over supplementary food without reheating, no hand-washing before giving supplementary food and malnutrition.

The result of this study can be emphasized in health education, especially in diarrheal disease control of infacy; Further well-designed studies are needed.

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Introduction

According to National Health System the objective of the national health development is to achieve the ability to live healthy for the whole population to realize an optimal degree of public health as one of the elements of public wellbeing of the national objectives (1).

One of the sensitive indicators of degree of public health is infant Mortality Rate (IMR). In Indonesia, the IMR at the end of the Five Year Plan III (Pelita III) was 70 % and it was 56,0 % at the end of Five Year Plan IV (Pelita IV), still the highest among Asean countries. It is expected that at the end of Five Year Plan V (Pelita V) it will be lower than 40 % . The major cause of the high IMR and Under Five Mortality Rate (U5MR) is the high morbidity and mortality of some infectious diseases such as diarrhea, acute respiratory tract infection (ARI) and vaccine preventalble diseases.

Diarrhea, mostly caused by infection, is stil one of the health problems in developing countries. In Indonesia the incidence of diarrhea is 200-400 per 1.000 population per year, 60-80 % of them occurred in the under-five, mostly infants (2). Acording to the report of WHO the episode of diarrhea in infants and the under-five is about 2-8 per year, and it is not uncommon that in some countries about 15-20% of their lifes were spent for diarrhea. Throughout the world acute diarrhea is the cause of 5 million deaths per year. In Indonesia it is about 200.000-250.000 per year (3). The 1986 Household Survey revealed that the proportion of infant death caused by diarrhea was 15,5% (4).

There is evidence that infants who receive no breast milk at all are at greater risk of experiencing diarrhea than those who are partially breast-fed, and infants who are partially beast-fed are at greater risk than those who are exlusively breast-fed (5).

Compared with infants who are partially breast-fed, those who are not breast-fed at all have a median risk of contracting diarrhea of 3.0 at 0-2 months of age, 2.4 at 3-5 months of age and 1.4 at 6-11 months of age. If infants who receive no breast milk are compared with those who are exlusively breast-fed, the risk of diarrhea varies about 3.5-14.9 at the first 6 months of life (6).

Due to the bi-directional association between nutritional status and diarrhea, malnourished children are at increased risk of contracting diarrhea, especially persistent or severe diarrhea and improvement of the nutritional status should result in decreased prevalence and possibly incidence of diarrhea (5).

The increased risk of diarrhea observed with the introduction of supplementary foods suggests that these weaning foods are an important vehicle for the transmission of enteric pathogens. Environmetal health and personal hygiene like cleanliness of the nipples in breast-fed infants, feeding bottle and teats in bottle-fed infants may also play an important role. Water used for the preparation of food and fluids given to young children can be finishing other hazzards. In infants who have been given supplementary food, preparing, processing, storing and serving food are also important factors. Introducing weaning food after 4-6 months of sitting or reheating leftover food, hand-washing bvefore preparing or giving food may reduce the incidence of infantile diarrhea (5).

In 113 infants of 1-2 years of age who had ever contracted diarrhea before the age of 1 year, Sugitha et al (7) in Bali found that child's age (child'factor) and mother's education (mother's factor) influenced the occurrence of diarrhea. They also found that in 87,69 % of the infants weaning food had been introduced before the age of 4 mont and diarrhea were found more in infants whose mother's age was younger than 20 years or older than 35 years.

In a descriptive cross-sectional study at the Pediatric Out-Patient Clinic of Dr. Pirngadi Hospital Medan, among 72 infants aged 0-24 months suffering from diarrhea Lubis (8) found that 66.7% of infants younger than 1 year ; 52,8% suffered from malnutrition ; 75% were bottle-fed ; 59.3% had only one nursing bottle/teat; in 74,3 % of them supplementary food had been given before the age of 4 months; in 90,9 % breast feeding had been stopped before the age of 1 year; 63,9 % of the mothers were younger than 20 years; 33,3 % were working mothers, 66,7 % never cleansed the nipples first before suckling the baby and 62,9 % were given food without hand-washing before.

The occurrence of diarrhea depends upon some risk factors. Clinical and field studies on diarrheal disease in Indonesia have much been reported. But studies concerning behavioral factors, especially analytical studies, is still scarcely found. The assesment of possible risk factors requires direct observation, but such a study is labour intensive and time consuming, Another alternative is observing previous behaviour from medical record or by means of questionaire, such as in this study. It is realized that information provided may be inaccurate or misleading for it is hard to recall previous practices and individuals may not be consistent with their practices. Of great concern it will be difficult to demonstrate a statistically significant effect of any behavior that is practised almost universally. However, by making it carefully and tidy it is hoped that this study will give a contribution to the development of science and research activity in the future.

The aim of this study is to asses risk factors of infantile diarrhea in order to be able to prevent it more effectively and efficiently.

Materials and methods

Study population

In this analytic observasional case-control study the study population were infants aged younger than 24 months attending the Pediatric Out-Patient Clinic of Dr. Pirngadi Hospital Medan.

Sample size

Sample size was calculated by means of formula (9) :

$$n \text{ (each group)} = \left[\frac{(Z_a / \sqrt{2\,pq} + Z_\beta / \sqrt{p_c q_c + p_t q_t})}{p_t - p_c} \right]^2$$

n = Sample size for case or control-group
a = Type I error —> level of confidence = 1 - a
Z_a = Standardized normal deviate for a
ß = Type II error —> power of study = 1 - ß
Z_β = Standardized normal deviate for ß
p_c = estimation of the proporsion exposed of the control-group
————> $q_c = 1 - p_c$
p_t = expected proporsion exposed of the case-group

$$= \frac{p_c \times OR}{(1 + p_c (OR - 1)} \longrightarrow q_t = 1 - p_t$$

OR = estimation of odds ratio

$p = (p_t + p_c)/2 \longrightarrow q = 1 - p$

With a 95 % level of confidence, 90 % power of study, 50 % estimation of the proporsion exposed of control-group, 2.0 estimation of odds ratio (so as the expected proporsion exposed of case-group is 70 %, a total of 124 infants in both case and control group was required. A structured questionaire was used in the interview with the infant's mother to assess the exposed rate in the case and control-groups. Exposure was indicated in the last day before illness.

Variables and factors observed were :

1. Infant's age < 12 months
2. Male infant
3. Father's age < 25 years
4. Father's education < 6 years
5. Father's job, not a government employee
6. Mother's age < 20 years
7. Mother;s education < 6 years
8. Working mother
9. Not cleansing the nipple before suckling the baby
10. Bottlefed infant
11. Having only one nursing bottle
12. Not ready for use nursing bottle
13. No municipal water supply
14. Unboiled drinking water
15. Introducing supplementary food at the age of < 4 months
16. Supplementary food not finished at one sitting
17. Giving left over supplementary food
18. Giving left over supplementary food without reheating
19. No hand-washing before giving supplementary food
20. Malnourished infant

Null hypotesis

Each of the factors mentioned above was not a risk factor of infantile diarrhea.

Inclusion criteria

The case-group consisted of infants 0-24 months old age attending the Pediatrics Out-Patient Clinic of Dr. Pirngadi Hospital Medan, suffering from diarrhea, with or without other disease. Diarrhea was defined as excretion of watery stool with a frequency of more than 3 times per 24 hours. The control-group consisted of infants 0-24 months of age without diarrhea attending the same clinic.

All of the infants fulfilling the inclusion criteria was included as case, whereas the control was taken from the nearest sequence of attendance from the case, one control for each case, until up to a total of 124 infants for each case and control-group were obtained. Matching was not done bacause factors that were usually matched such as age, sex, etc were decided as risk factors to be tested in this study.

Exclusion criteria

Infants who were not brought by his or her own mother were excluded from the study.

Others

Body weight was measured using a baby scale (Tanita), sensitive to 10 g. Degree of dehydration was determined by means of the Maurice King score. Nutritional status was assessed by means of the Road to Health Chart, using the weight to age parameter. In the case-group, the body weight was adjusted to the appropriate degree of dehydration. Weaning is meant as introducing other food beside breast feeding. This study was conducted from March thru April 1990.

Statistical analysis

Odds ratio (relative risk or estimation of risk ratio) of each factor, 95 % confidence interval, and two-tailed significance test for qualitative dichotomic data with 0.05 level of significance was analyzed by computer, using True Epistat statistical soft ware.

Multivariate analysis with logistic regression was not done because the number of data was not the same for each risk factor, e.g. having only one nursing bottle/ teat and not ready for use nursing bottle/ teat, were only fit for those who were bottle-fed; unfinished food at one sitting, giving left over food, without reheating, were only appropriate when supplementary food had been introduced.

Results

A total of 248 infants were found, consisting of 124 infants in the case-group and 124 infants in the control-group. There were 180 (73 %) infants aged younger than 12 months and 68 (27%) 12 months and over of age.

One hundred and thirty of them (52%) were males and 118 (48%) females (Table 1).

A total of 32 infants (26 %) of the case-group were exclusively breastfed; 42 (34 %) had mixed feeding , 45 (36 %) were exclusively bottlefed, and remaining 5 (4 %) infants were neither given breast milk nor infant formula. In the control-group it was found 44 %; 22 %; 24% and 10 % respectively. (Table 2). In other words 74 infants (60 %) of the Case-group and 82 infants (66 %) of the Control-group were still breast-fed. In 87 (70%) infants of the Case-group and 57 (46 %) of the Control-group bottle mil were given, with or without breast milk.

In 118 (95 %) infants of the Case-group weaning food had been introduced in the Control-group it was in 112 (90 %) infants. The age distribution of introduction of weaning food can 43 % of 112 infants of the Control-group supplementary food had been introduced before the age of 4 months.

Table 1. *Age and sex distribution*

Age (mos)	Case (n=124)			Control (n=124)			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
0 - 11	52	40	92	42	46	88	94	86	180
12 - 24	20	12	32	16	20	36	36	32	68
Total	72	52	124	58	66	124	130	118	248

Table 2. *Type of feeding*

Type of feeding	Case		Control	
	Total	%	Total	%
Exclusively breastfed	32	26	55	44
Mixed-feeding	42	34	27	22
Exclusively bottlefed	45	36	30	24
Neither breast/bottlefed	5	4	12	10
Total	124	100	124	100

Table 3. *Age of introduction of weaning food*

Age of introduction of weaning food (month)	Case		Control	
	Total	%	Total	%
0 - 3	48	41	48	43
4 - 5	28	24	46	41
6 - 8	24	20	16	14
9 - 11	16	13	2	2
> 12	2	2	0	0
Total	118	100	112	100

The types of weaning food were banana, premasticated rice, rice porridge, milk porridge and rice porridge with vegetables/meat. Table 4 showed that malnutrition was found in 54 (43 %) infants of the Case-group and only in 28 (23 %) of the Control-group.

Table 4. *Nutritional status*

Nutritional status	Case		Control	
	Total	%	Total	%
Wellnourished	70	57	96	77
Mild/moderate malnutrition	50	40	27	22
Severe malnutrition	4	3	1	1
Total	124	100	124	100

Risk (odds ratio) of all factors that was tested is shown on Table 5.

Table 5. *Odds ratio, 95 % confidence interval and significance testing*

No. Risk factor	Proporsion of		Odds ratio	95% confidence	Significancy
	Case	Control			
1. Infant's age < 12 months	92/124	88/124	1.2	0.7-2.1	NS
2. Male infant	72/124	58/124	1.6	0.9-2.6	NS
3. Father's age < 25 years*	31/122	24/122	1.4	0.8-2.5	NS
4. Father's education <6 years*	16/122	14/122	1.2	0.5-2.5	NS
5. " not a government employee	98/122	94/122	1.2	0.7-2.2	NS
6. Mother's age < 20 years	23/124	6/124	4.5	1.9-10.7	NS
7. Mother's eduction < 6 years	20/124	22/124	0.9	0.5-1.7	p < 0.01
8. Working mother	45/124	23/124	2.5	1.4-4.4	NS
9. Bottle-fed infant	87/124	57/124	2.8	1.6-4.6	p < 0.01
10 Not cleaning nipple	68/74	56/82	5.3	2.2-12.9	p < 0.01
11. Having only one nursing bottle	59/87	21/57	3.6	1.8-7.2	p < 0.01
12. Not ready for use nursing bottle	54/87	12/57	6.1	2.9-12.8	p < 0.01
13. No municipal water supply	50/124	54/124	0.9	0.5-1.5	NS
14. Unboiled drinking water	2/124	4/124	0.5	0.1-2.6	NS
15. Introducing supplementary food < 4 months	48/118	48/112	0.9	0.5-1.5	NS
16. Supplementary food not finished at one sitting	40/118	46/112	0.7	0.4-1.3	NS
17. Giving leftover suppl. food	36/40	36/46	2.5	0.7-8.5	NS
18. Giving leftover supplementary food without reheating	29/36	18/36	4.1	1.5-11.5	p < 0.01
19. No hand-washing before giving supplementary food	44/118	20/112	2.7	1.5-5.0	p < 0.01
20. Malnutrition	54/124	28/124	2.6	1.5-4.6	p < 0.01

* = Two fathers from each group have passed away
NS = Not significant

Discussion

Infant's age < 12 months
There were 92 infants (74 %) aged younger than 12 months in the case-group, quiet similar to what was found in the Control-group revealing 88 infants (71 %). In this study it could not be proven that age younger than 12 months was a risk factor of infantile diarrhea (95 % confidence intrval : 0.7 - 2.1).

Male infant
A total of 72 infants (58 %) in the Case-group were males whereas in the Control-group there were 58 males (47 %). However, it could not be proven that male sex was a risk factor of diarrheal disease of infancy.

Father's age < 25 years
Our Family Planning Program recommends male to postpone his marriage until the age of 25 years. In this study father's age younger than 25 years was found in 31 infants (25 %) of the Case-group and in 24 infants (20 %) of the Control-group. It could not be proven that father's age younger than 25 years was a risk factor of infantile diarrhea (95 % confidence interval : 0.8 - 2.5).

Father's education < 6 years
In the Case-group father's education of 6 years or less was found in 16 infants (13 %), compared with 14 infants (11 %) in the Control-group. They were not statistically different.

Father's not a government employee
Although fathers who were government employees had been trained regularly and their wives had participated more in women activities such as PKK, Posyandu, etc, it was hypothesized that their infants had the same risk for diarrhea compared with infants of non-government employee. This study did not reject the hypothesis (95 % confidence interval : 0.7 - 2.2).

Mother's age < 20 years
In the Case-group mother's age of younger than 20 years was found in 23 infants (18 %), while in the Control-group it was found in only 6 infants (5 %). Compared with infants with mother's age of 20 years or more those with mother's age of younger than 20 years were at 4.5 times higher risk (confidence interval 1.9 - 10.7; $p < 0.01$) of contracting diarrhea. This finding was inconcordance with not only our Family Planning Program recommending females to postpone their marriage until the age of 20 years but also our program on early detection of abnormalities of growth and development of the under-five stating mother's age of younger than 20 years as one of the family risk factors.

Mother's education < 6 years
There were 20 infants (16 %) of the Case-group and 22 infants (18 %) of the Control-group having their mother's education up to the primary school (6 years or less). It could not be proven that mother's education of 6 years or less was a risk factor of infantile diarrhea.

Working mother
The proportion of working mothers in the Case-group was 36 %, whereas in the Control-group it was only 19 %. Odds ratio was 2.5 (confidence interval 1.4 - 4.4). The difference was statistically significant. It meant that infants of working mother were at 2.5 times higher risk of contracting diarrhea compared with those of not working mothers.

Bottle feeding
Bottle milk, with or without breast milk, was given to 87 infants (70%) in the Case-group and only to 57 infants (46 %) in the Control-group. It can be proven that bottle feeding wasa risk factor of infantile diarrhea with Odds ratio of 2.8 (confidence interval 1.6 - 4.6; $p < 0.001$).

Not Cleansing the nipple
In 92 % of infants of the Case-group and 68 % of the Control-group, the nipple was not cleansed befor giving breast feeding. The Odds ratio was 5.3 (confidence interval 2.2 - 12.9; $p < 0.001$. It can be proven that infants breast-fed without first cleansing the nipples were at 5.3 times higher risk of suffering from diarrhea compared witrh those breast-fed with first clausing the nipples.

Having only one nursing boyttle/teat
Among bottlefed infants those who had only 1 nursing bottle/teat had 3.6 times greater risk of suffering from diarrhea compared with infants who have more than 1 (confidence interval 1.8 -7.2; $p < 0.001$).

Not ready for use nursing bottle/teat
Bottle-fed infants who had not ready for use nursing bottle/teat were at 6.1 times grater risk of contracting diarrhea compared with those who had. The difference was statistically significant.

No municipal water supply
In 74 infants (60 %) of the Case-group and 70 infants (56 %) of the Control-group drinking water were not from the municipal water resource. However, it could not be proven that no municipal water resource was a risk factor of infantile diarrhea (confidence interval 0.5 -1.5; $p > 0.05$).

Unboiled drinking water
Almost all of the infants either in the Case-group (98 %) or the Control-group (97 %) was given boiled drinking water. No statistically difference was found. As stated earlier it was hard to demontrate a statistically significant effect of any behaviour that is practised almost universally.

Giving supplementary food < 4 months
It is well known that exclusively breast-fed with breast milk of good quality and quantity is safe for infants up to the age of 4-6 months, so supplementary food is not recommended before the age of 4 months. Early introducing supplementary food will give rise to some disadvantages o.a. diarrhea. Nevertheless, giving supplementary food too late will also give rise to other disandvantages such as malnutrition. However, it could not be proven in this study that early introduction of suplementary food was a risk factor of infantile diarrhea.

Supplementary food not finished at one sitting
Supplementary food that was not finished at one sitting was found in 34 % of the Case-group and 41 % of the Control-group. The difference was not statistically significant.

Reintroducing left over supplementary food
Among infants with unfinished supplementary food at one sitting, reintroducing of the left over food was found in 90 % and only in 78 % of the Control-group. However, the difference was also not statistically significant.

Giving stored supplementary without reheating
Among infants given left over supplementary food, reintroducing without reheating was found in 81 % in the Case-group whereas in the Control-group it was found in only 50 % (Odds ratio 4.1, confidence interval 1.5 - 11.5 dan $p < 0.05$).

This study confirmed that although

supplementary food was not finished in one it could be introduced after reheating without producing greater risk of suffering form infantile diarrhea.

No hand-washing before giving supplementary food

In 44 infants (37 %) of the Case-group supplementary food were given by the mothers without hand-washing before in the Control-group it was found in only 20 infants (18 %). It could be confirmed that infants given supplementary food without hand-washing before were at 2.7 times grater risk of contracting diarrhea compared with those given supplementary food after hand-washing (confidence interval 1.5 -5.0; ; < 0.01).

Malnourished infant

Malnutrition was found in 54 infants (44 %) of the Case-group whereas in the Control-group it was only found in 28 infants (23 %). Malnourished infants was a risk factor of infantile diarrhea (Odds ratio 2.6; confidence interval 1.5 - 4.6; $p < 0.001$).

Conclusion

It was confirmed that in infants aged younger than 24 months attending the Pediatric Out-Patient Clinic of Dr. Pirngadi Hospital Medan risk factors of infantile diarrhea were :

1. Mother's age < 20 years
2. Working mother,
3. Not cleaning niplle before suckling th baby
4. Bottlefed infant,
5. Only one nursing bottle,
6. Not ready for use nursing bottle,
7. Giving left over supplementary food without reheating,
8. Not washing hands before giving supplementary food, and
9. Malnutrition.

Recomendation

1. Nine risk factors mentioned above should be emphasized in public health education especially in the control of diarrheal diseases of infancy.

2. Further field studies are needed such as interventional study to evaluate the impact of controlling those factors on the incidence of infantile diarrhea.

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