EFECT OF LOW BIRTH WEIGHT ON SEVERE CHILDHOOD DIARRHEA

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Abstract. A hospital-based case-control study was conducted at Phanat Nikhom District Hospital, Chon Buri Province, Thailand to determine the association between low birth weight and severe diarrhea and its magnitude of association among children under two years of age. Data were analyzed from 52 severe diarrheal cases and 121 mild diarrheal children attending the hospital during October 1988 to December 1989. Information regarding birth weight was obtained from hospital record or health card of each subject. Information on variables which may confound the association between low birth weight and severe diarrhea were also collected by interviewing all subjects' mothers with structured questionnaires. It was found that the crude Odds Ratio between low birth weight and severe diarrhea was 4.62. However after controlling for confounding variables : age, concurrent infection, duration of diarrheal attack prior attending hospital and ORT usage, the adjusted Odds Ratio was 3.92. The present study confirms that low birth weight is an important determinant of severe diarrhea and feasible intervention in the case of low birth weight needs to be explored.

INTRODUCTION

Diarrheal diseases are a leading cause of illness and death among young children in all developing communities through out the world. In Thailand acute diarrheal disease is the second leading cause of death in infants under one year and ranks fourth among leading causes of death for all ages (Varavithya and Ramaboot 1986).

Among risk factors, low birth weight is a major determinant of infant death, but there is little information on the effect of low birth weight on diarrheal diseases. An association between low birth weight and diarrheal illness and death has also been suggested (Ashworth and Feachem, 1985). However, there are few data which document such an association and its magnitude for the postneonatal period in developing countries. Therefore the present study sought to investigate the association between low birth weight and severe diarrhea and its magnitude of association among children age 2 years and under.

MATERIALS AND METHODS

Study subjects

The study was carried out in Phanat Nikhom District, Chon Buri Province, 110 km southeast of Bangkok. Phanat Nikhom Hospital is a rural community hospital with a capacity of 90 beds. It is the only hospital in an area with a catchment population of 120,000. The present research is a hospital based case-control study. The eligible study subjects were children age 2 years and under attending the hospital with acute diarrhea.

Selection of cases and controls

Cases were individuals with severe diarrhea and admitted in hospital. Controls were individuals with mild diarrhea and treated at the outpatient department. The criteria for admission were based on degree of dehydration : moderate to severe and severity of clinical signs and symptoms : high fever (38°C and higher) with either severe vomiting or severe abdominal pain, convulsion and shock, (although in the study no cases were admitted with either convulsion or shock).

At least two controls were selected for each case either on the same day or subsequent day. Matching on an individual basis was not performed. However, the age restriction for 2 years and less among cases and controls was done. The recruitment of cases and controls was done before the birth weight information was abstracted.

Either cases or controls whose their birth weight information could not obtained from hospital records or health cards were excluded from the analysis.

Sample size estimation

The present study was designed to have a power of 80% to detect statistically significant differences at the 5% level (one-tailed test) with ratio of cases and controls of 1 : 2, assuming that 10% of children with mild diarrhea would be of low birth weight (less than 2,500 g). It was also found that the Odds Ratio between low birth weight and severe diarrhea was 3.4 (Victora *et al*, 1988). Thus, on the basis of this information, the sample size of 52 cases and 104 controls was calculated (Schlesselman, 1982).

Data collection

In order to have reliable information regarding birth weight, only cases and controls whose birth weight were obtained from hospital records or health cards were included in the study. Information was also collected about variables that may confound the association between birth weight and severe diarrhea. These included children's age and sex; maternal age; maternal socioeconomic status : maternal education, family size and maternal occupation; breast feeding; concurrent infection; duration of diarrheal attack prior attending hospital; frequency of diarrhea and ORT usage. These informations were obtained by interviewing all subjects' mothers with structured questionnaires. Nevertheless it was found later on that all study mothers had the same occupation as rice farmer. Therefore variable occupation was not included in the analysis.

Data analysis :

Chi-square test with Yates' correction (Mantel and Haenzel, 1959) was used to assess which variables were appeared to be associated with severe diarrhea. Furthermore point and 95% interval estimates of Odds Ratio (OR) was calculated to determine the magnitude of association between severe diarrhea and others variables (Greenberg and Kleinbaum, 1985). Either variables which were significant associated with severe diarrhea or variables whose OR was 2 and greater were further assessed whether they were confounding variables

through logistic regression analysis (Kleinbaum *et al*, 1982) by stepwise selection on the basis of maximum likelihood ratio (MLR). The effect of birth weight was adjusted after including the confounding variables in the logistic model by using BMDP software (Dixon *et al*, 1985).

RESULTS

During October 1988 to December 1989, a total of 61 cases (severe diarrhea) and 138 controls (mild diarrhea) attended Phanat Nikhom District Hospital. However information on birth weight from either hospital records or health cards was found among 52 cases and 121 controls. Thus the analysis was performed on these groups. In the present study, birth weight was classified into 3 categories : (1) less than 2,500 g as low birth weight, (2) 2,500-2,999 g and (3) $\geq$ 3,000 g. The birth weight distributions of cases and controls are shown in Table 1. There was an association between low birth weight and severe diarrhea (p = 0.012) with a significant trend of the Odds Ratio for severe diarrhea increasing as birth weight decreased.

From cross tabulations between various factors and severe diarrhea (Table 2), it was found that age, concurrent infection with diarrheal attack and duration of diarrheal illness prior to attending hospital were significantly associated with severe diarrhea (p < 0.05). It was also interesting to note that even though maternal age, maternal education and ORT usage were not statistically significantly associated with severe diarrhea, their Odds Ratios were greater than 2.

As a result of logistic regression analysis, it was revealed that age, concurrent infection, duration of diarrhea prior attending hospital and ORT usage were confounding factors. Table 3 presents the adjusted Odds Ratio after controlling for age and for age with other confounding variables. It was noted that controlling for age and for age with other confounders resulted in some changes to the risk estimates but did not alter the main finding. After such adjustment, children age 2 years and less with birth weight less than 2,500 g were found to be 3.9 times more likely to develop severe diarrhea than those weighing more than 2,500 g at birth when they got diarrhea. Tests for

Table 1

Association between birth weight and severe childhood diarrhea at Phanat Nikhom Hospital.

	Cases	Controls	OR* (95% CI)	P
Birth weight (g) :				
< 2,500	10	6	4.62 (1.53-13.96)	0.012
2,500-2,999	16	43	1.03 (0.50-2.13)	
≥ 3,000	26	72	1.00	

*OR = Odds Ratio
95% CI = 95% Confidence interval

interaction of the effects on severe diarrhea of birth weight and age, birth weight and concurrent infection, birth weight and duration of diarrhea prior to attending hospital and birth weight and ORT usage were performed (Table 4). There was no evidence that effects of birth weight on severe diarrhea varied according to age, concurrent infection, duration of diarrhea prior attending hospital and ORT usage.

DISCUSSION

It was apparent that low birth weight was associated with an increased risk of severe diarrhea and the association still persisted after controlling for confounding variables. However the estimated risk from the present study (OR = 3.9) was higher than the previous report by Victora et al (1988) in Brazil (OR = 2.2). The difference was possibly due to (1) study population : rural Thais vs urban Brazilians; (2) outcome assessment : non-fatal severe diarrhea vs fatal severe diarrhea; (3) study age group : 0-2 years vs 0-1 year; (4) birth weight information : information was not based on recall vs 40% of information was based on recall.

Whether low birth weight itself is a cause of increased severe diarrhea may be difficult to assess because there are several socioeconomic, demographic and environmental variables that may confound the association. Therefore it was essential to identify confounding variables in the study

because failure to control such variables might lead to biased results. For example crude OR was 4.62 while adjusted OR was 3.92 after controlling for confounding variables. Thus the degree of confounding (Schlesselman, 1982) was 1.18, reflecting overestimation of crude OR by 18%.

Even though the criteria for admission of severe diarrhea were defined, selection bias of cases and controls due to misclassification of disease status was possible. This was because diarrheal children whose degree of dehydration or clinical signs and symptoms were between mild and severe were likely to be admitted to hospital. Therefore the present risk estimates (OR) were likely to have been biased towards unity by non-differential misclassification of disease status (severe diarrhea). Nevertheless, this bias was minimized as physical examination of all cases and controls were done by the same pediatrician.

The present study confirms that low birth weight is an important determinant of severe diarrhea. Low birth weight is related to many factors such as socioeconomic status, multiple pregnancy, birth interval, nutritional status, maternal health, maternal age, etc (Ashworth and Feachem, 1985). Thus it is quite important to determine whether interventions to reduce prevalence of low birth weight are feasible at a community or national level and whether such interventions are cost-effective in comparison with other strategies for reducing severe diarrhea.

Table 2

Association between various potential risk factors and severe childhood diarrhea at Phanat Nikhom Hospital.

Variables	Cases	Controls	OR (95% CI)	P
Age (months) :				0.025
≮ 3	14	13	3.29 (1.18-9.32)	
4-12	21	56	1.15 (0.51-2.57)	
13-24	17	52	1.00	
Sex :				0.576
male	34	72	1.29 (0.62-2.69)	
female	18	49	1.00	
Family size :				0.628
> 1 child	32	68	1.25 (0.61-2.56)	
1 child	20	53	1.00	
Maternal age (years) :				0.414
≤ 20	10	15	2.07 (0.61-7.18)	
21 – 30	33	78	1.32 (0.52-3.38)	
≥ 31	9	28	1.00	
Maternal education :				0.169
no	5	5	2.47 (0.54-11.20)	
primary school and higher	47	116	1.00	
Breast feeding :				0.475
no	30	61	1.34 (0.66-2.72)	
yes	22	60	1.00	
Concurrent infection :				0.010
yes	47	86	3.83 (1.35-13.27)	
no	5	35	1.00	
Duration of diarrhea prior to hospitalization :				0.023
> 24 hours	45	83	2.94 (1.14-7.89)	
within 24 hours	7	38	1.00	

Table 2 (con)

Variables	Cases	Controls	OR (95% CI)	P
Frequency of diarrhea (per day)				0.426
10 times and more	14	22	1.70 (0.68-4.25)	
5-9 times	17	43	1.05 (0.46-2.39)	
3-4 times	21	56	1.00	
ORT usage :				0.060
no	20	28	2.08 (0.97-4.43)	
yes	32	93	1.00	

Table 3

Adjusted Odds Ratios of birth weight for severe childhood diarrhea according to age and age with other confounders*.

Birth weight (g)	Odds Ratio (95% Confidence interval) adjusted for age	adjusted for age and other confounders*
less than 2,500	4.94 (1.59-15.37)	3.92 (1.18-13.01)
2,500-2,999	1.11 (0.52-2.33)	0.88 (0.39-1.98)
more than 3,000	1.00	1.00

*Confounders (selection by stepwise logistic regression) :
    − age
    − concurrent infection
    − duration of diarrheal attack prior attending hospital
    − ORT usage

The logistic model :
In (odd) =   − 3.8244 - 0.129 birth weight1 + 1.367 birth weight2
            − 0.05 age1 + 0.8111 age2 + 1.516 concurrent
            + 1.388 duration + 1.420 ORT
Goodness of fit : Chi-square (D Hosmer), p = 0.846

Table 4

Test for interactions of effects of birth weight on severe diarrhea according to age, concurrent infection, duration of diarrhea and ORT usage.

	Model				
	1	2	3	4	5
Variables :					
BW (birth weight)	#	#	#	#	#
Age	#	#	#	#	#
Concurrent	#	#	#	#	#
Duration	#	#	#	#	#
ORT	#	#	#	#	#
BW*age		#			
BW*concurrent			#		
BW*duration				#	
BW*ORT					#
Log likelihood	-87.938	-84.921	-86.417	-87.600	-87.937
p-value of improvement of Chi-square	-	> 0.05	> 0.05	> 0.05	> 0.05

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