Breast-feeding protects against infection in Indian infants

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A retrospective study was undertaken at two isolated Manitoba Indian communities to determine whether the type of infant feeding was related to infection during the first year of life. Of 158 infants 28 were fully breast-fed, 58 initially breast-fed and then changed to bottle-feeding and 72 fully bottle-fed. Fully bottle-fed infants were hospitalized with infectious diseases 10 times more often and spent 10 times more days in hospital during the first year of life than fully breast-fed infants. Diagnoses were mainly lower respiratory tract infection and gastroenteritis. Gastroenteritis occurred in only one breast-fed infant. Breast-feeding was strongly protective against severe infection requiring hospital admission and also against minor infection. The protective effect, which lasted even after breast-feeding was discontinued, was independent of family size, overcrowding in the home, family income and education of the parents. Measures to achieve breast-feeding for virtually all infants, particularly in northern communities, should be given high priority.

Une étude rétrospective a été entreprise au sein de deux communautés indiennes du Manitoba afin de déterminer si le mode d'allaitement était relié à des infections durant la première année de la vie. Sur 158 nourrissons 28 ont été allaités au sein uniquement, 58 ont été allaités au sein initialement avant d'être nourris à la bouteille, et 72 ont été nourris à la bouteille uniquement. Les enfants nourris uniquement à la bouteille ont été hospitalisés pour des maladies infectieuses 10 fois plus souvent et ont passé 10 fois plus de temps à l'hôpital durant leur première année que les bébés qui ont été allaités au sein. Les infections des voies respiratoires inférieures et les gastro-entérites représentaient la plupart des diagnostics. Une gastroentérite est survenue chez un seul bébé nourri au sein. L'allaitement au sein a exercé un effet protecteur marqué contre les infections graves nécessitant une hospitalisation de même que contre les infections bénignes. Cet effet protecteur, qui s'est prolongé même après l'arrêt de l'allaitement, était indépendant de la grosseur de la famille, du surpeuplement du domicile, du revenu de la famille et de l'éducation des parents. Des mesures visant à assurer l'allaitement au sein de virtuellement tous les bébés, particulièrement dans les communautés nordiques, devraient recevoir pleine priorité.

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Although those who provide health care to Canadian Indian children are aware of the high incidence of infections, documentation is generally lacking. Respiratory tract infections, otitis media, gastroenteritis and dermatitis are particularly prevalent. For the 5-year period 1970 through 1974 the postneonatal mortality (number of deaths per 1000 live births at 28 days to 1 year of age) was four to five times higher for residents of Manitoba Indian reserves (28.4) than for residents of Manitoba as a whole (6.1) or of Canada in 1973 (4.8). Lower respiratory tract infection and gastroenteritis accounted for 60% of the deaths of Indian infants.[1] In 1976 the rates were 15.8 for Indian reserves and 4.9 for Manitoba.[2]

Undoubtedly many factors, such as inadequate and overcrowded housing, low income, poor sanitation and personal hygiene, and inadequate nutrition, contribute to the poor health of Indian children. The type of infant feeding may be another contributory factor because there is evidence that breast-fed infants are less prone to infection than bottle-fed infants.[3,4] Mortality statistics for Canadian Indian infants in 1962 showed a significantly higher mortality for bottle-fed compared with breast-fed infants.[5]

We undertook a retrospective study in two Indian communities to determine whether the type of infant feeding was related to the incidence and severity of infection during the first year of life.

Methods

Two isolated Indian communities in northern Manitoba, Cross Lake (population about 2200) and Garden Hill (population about 1300) were visited approximately every 2 months between 1972 and 1975. Preschool-aged children were examined and the presence of infection was recorded (by F.J.C., who was not aware of the type of feeding). Information about hospital admissions during the first year of life was obtained from records at the nursing stations; duration of hospital stay and diagnoses were confirmed by inspection, with permission, of hospital records. An overnight stay at a nursing station was counted as a hospital admission. An infant subsequently transferred to a secondary- or tertiary-care centre during the same illness was considered as having had a single hospitalization and the duration of stay at each location was aggregated for that episode. Hospitalizations for reasons other than infection were excluded. Family data and detailed information about infant feeding during the first year of life were obtained from the mothers (by J.E-S.).

Data on feeding history and hospital admissions were available for 158 infants, who represented about one third of the preschool-aged children in the communities. Data were analysed by *t*-tests, analysis of variance, chi-square tests and multiple regression analysis.

Results

The 158 infants had 106 hospitalizations for infection; the mean hospital stay was 8.9 days. For initial data analysis the infants were divided into three feeding groups: group A, fully breast-fed and received no other type of milk (28 infants); group B, initially breast-fed and then changed to bottle-feeding (58 infants); and group C, bottle-fed from birth (72 infants). The group A infants had a total of only three hospital admissions and spent an average of less than a

day in hospital for infection (Table I). There were 70 admissions among the group C infants, who spent an average of 9.4 days in hospital. Figures for group B infants were intermediate between those for groups A and C.

Since the change from breast to bottle in the group B infants was made at various ages, the hospital data for the three feeding groups were then analysed per year-equivalent of breast- or bottle-feeding (Table II). There were significantly fewer hospital admissions and fewer days spent in hospital per feeding year for breast-fed than for bottle-fed infants. To determine whether the protective effect lasted after breast-feeding was discontinued, we compared the hospitalization record of the group B infants while they were bottle-fed with that of group C infants who had been entirely bottle-fed for 12 months. The former had fewer hospital admissions than the latter (0.7 and 1.0 per year of bottle-feeding respectively) but the difference was not significant. However, the group B infants spent significantly fewer days in hospital than the group C infants (means 4.5 and 9.4 days per year of bottle-feeding; $X_1^2 = 72.17$, $P < 0.001$).

The hospital diagnoses were largely lower respiratory tract infection (pneumonia, bronchitis and bronchiolitis) and gastroenteritis (Table II). There were 23 admissions for gastroenteritis among bottle-fed infants and only 1 among breast-fed infants. Some infants had several types of infection.

The number of examinations done on each infant during the periodic visits to the communities varied. The number of infections per examination was significantly less in the infants who were being breast-fed at the time of examination than in the infants who were being bottle-fed (Table III). Upper respiratory tract infection, dermatitis and otitis media predominated.

Other factors that might have contributed to infant morbidity, such as family size, number of occupants per house, family income, occupation and education of the parents, were not found to be significantly related to hospitalization (Table IV). Apart from a significantly greater proportion of unmarried mothers among those whose infants were not hospitalized, for which no ready explanation was available, the type of infant feeding was the *only* variable that showed a significant relation to hospitalization.

Factors that might have influenced a mother's decision to breast-feed and the duration of breast-feeding were investigated. The type of feeding was independent of the marital status of the mother, the occupation of the father and the family income. Although 64% of the infants in each community were initially breast-fed, only 10% at Cross Lake compared with 26% at Garden Hill were still breast-fed at 12 months of age ($X_1^2 = 6.74$, $P < 0.01$). Women who breast-fed for 12 months or longer were older, had more children, had less formal education and lived in more crowded housing than those who bottle-fed or who breast-fed for less than 12 months ($P < 0.05$). Thus, the decreased morbidity in breast-fed infants prevailed in spite of more crowded living conditions. Women who smoked during pregnancy were less likely to breast-feed ($P < 0.05$), but the smokers were also younger than the nonsmokers, and multiple regression analysis suggested that age, rather than smoking habits, influenced the choice of feeding. With the exception of three infants, illness requiring hospitalization did not lead to the discontinuation of breast-feeding. All seven women who worked outside the home breast-fed their infants, two of them for at least 12 months.

Discussion

This study was part of a larger investigation of nutrition and growth of preschool-aged children at Cross

Table I—Hospitalization of 158 infants for infection during first year of life

Variable	Type of feeding		
	Group A (breast only) (n = 28)	Group B (breast, then bottle) (n = 58)	Group C (bottle only) (n = 72)
Total no. of hospital admissions	3	33	70
Mean no. of hospital admissions per child*	0.1	0.6	1.0
Total no. of days in hospital	25	252	676
Mean no. of days in hospital per child†	0.9	4.4	9.4

*Means of all groups significantly different; P at least < 0.05.
†Mean of group C significantly different from means of other two groups; P < 0.01.

Table II—Hospitalization for infection per breast- or bottle-feeding year

Variable	Type of feeding	
	Breast	Bottle
Total no. of feeding years	48	107
Total no. of hospital admissions	13	93
Mean no. of hospital admissions per feeding year*	0.27	0.87
Total no. of days in hospital	120	833
Mean no. of days in hospital per feeding year†	2.5	7.8
Diagnosis		
Lower respiratory tract infection	9	63
Gastroenteritis	1	23
Upper respiratory tract infection	0	7
Otitis media	0	5
Other	3	8

*Means significantly different; $X_1^2 = 52.12$; $P < 0.001$.
†Means significantly different; $X_1^2 = 148.19$; $P < 0.001$.

Table III—Diagnoses in nonhospitalized infants, related to type of feeding at time of examination

Variable	Type of feeding	
	Breast	Bottle
No. of examinations	73	131
Diagnosis		
Upper respiratory tract infection	10	35
Dermatitis	5	11
Otitis media	2	4
Gastroenteritis	0	2
Other	2	3
Mean no. of diagnoses per examination*	0.26	0.42

*Means significantly different; $X_1^2 = 4.50$, $P < 0.05$.

Lake and Garden Hill. No protein-energy malnutrition was found, and the growth variables of the children were generally comparable to those of other North American children (data to be published).

The results of this study are striking. Fully bottle-fed babies were admitted to hospital with severe infection 10 times more often during the first year of life than babies who were completely breast-fed. Breast-feeding seemed to offer some protection against severe infection requiring hospital admission even after it was discontinued. Minor infections, those not severe enough to necessitate hospitalization, were also less prevalent among the breast-fed infants.

The higher morbidity and mortality for bottle-fed infants was documented long ago.[3,4] The protective effect of breast milk was originally ascribed to its cleanliness and the lack of opportunity for infection. It is now known that breast milk contains a number of anti-infective agents, such as leukocytes, lactoferrin and antibodies predominantly in the IgA fraction of the milk protein.[6,7] It is well recognized that bottle-feeding contributes to higher infant morbidity and mortality in developing countries.[4,8] However, it is not generally recognized that there are health advantages to breast-feeding in industrialized countries, where infant formulas are readily available, sanitary conditions are good and water is safe. Nevertheless, several workers in the United Kingdom[9] and the United States[10,11] have demonstrated less infection, particularly gastroenteritis, among breast-fed infants; others have not.[12,13] The generally high living standards in Canada, however, do not extend to its Indian communities. At the time we collected our data the sanitary and personal hygiene standards were generally suboptimal at Cross Lake and Garden Hill. None of the houses had plumbing; water was carried from the lakes or, in some households at Garden Hill, from a standpipe. Only one third of the homes had refrigerators. Infant formulas prepared and stored under these conditions would clearly be liable to contamination. However, the protective effect of breast-feeding found in this study was not confined to infections of the gastrointestinal tract, but extended to a number of infections, especially pneumonia, bronchitis and bronchiolitis.

Over the past few decades breast-feeding has declined in popularity in Indian communities,[14] in common with other parts of Canada, and indeed most of the industrialized world.[15] Our data indicate that it is the younger, better-educated women living in less crowded homes who are less likely to breast-feed. We have shown that breast-feeding, at least in isolated Indian communities where infant morbidity and mortality are higher than in Canada as a whole, has a very strong protective effect against infection. This effect is independent of family size, overcrowding in the home, family income and education of the parents. The economic advantages of breast-feeding are also considerable, both to the family — breast milk costs less to produce than artificial formulas cost to buy — and to society as a whole, for breast-feeding reduces the cost of hospitalization. Furthermore, human milk is nutritionally superior to any type of infant formula,[15] and breast-feeding fosters the bonding between mother and infant, which is of benefit to both of them.[16] For these reasons it is incumbent upon health professionals to give high priority to the promotion of breast-feeding for virtually all infants in these communities.

Table IV—Relation of family and infant feeding variables to hospitalization of infants

Type of variable	Infants hospitalized	Infants not hospitalized	Test (and degrees of freedom)	P value*
Continuous, mean ± standard error of mean				
Birth weight (kg), n = 158	3.37 ± 0.09	3.48 ± 0.06	$t = 1.13$ (156)	NS
Birth rank, n = 158	4.7 ± 0.4	5.3 ± 0.3	$t = 1.19$ (156)	NS
Mother's age (yr), n = 158	26.6 ± 0.8	28.3 ± 0.7	$t = 1.53$ (156)	NS
Parity, n = 158	5.2 ± 0.4	6.1 ± 0.4	$t = 1.65$ (156)	NS
No. in household, n = 54	7.3 ± 0.5	8.0 ± 0.6	$t = 0.87$ (52)	NS
No. of rooms in home, n = 49	4.5 ± 0.3	3.7 ± 0.4	$t = 1.47$ (47)	NS
No. of occupants per room, n = 49	1.9 ± 0.2	2.7 ± 0.4	$t = 1.87$ (47)	NS
Discrete, no. (and %)				
Infant feeding				
Group A, n = 28	3 (5)	25 (26)		
Group B, n = 58	22 (35)	36 (38)	$X^2 = 15.2$ (2)	< 0.001
Group C, n = 72	38 (60)	34 (36)		
Mother unmarried, n = 58	0 (0)	6 (21)	$X^2 = 5.80$ (1)	< 0.025
Mother's education less than grade 6, n = 153	16 (27)	38 (40)	$X^2 = 2.26$ (1)	NS
Father unemployed, n = 51	7 (31)	10 (37)	$X^2 = 0.60$ (1)	NS
Family income less than $500 per month, n = 50	20 (74)	16 (70)	$X^2 = 0.00$ (1)	NS
Mother smoked during pregnancy, n = 155	31 (50)	37 (40)	$X^2 = 2.09$ (1)	NS
Water not boiled or otherwise treated, n = 62	2 (7)	0 (0)	$X^2 = 0.35$ (1)	NS
No refrigerator in home, n = 52	14 (52)	19 (76)	$X^2 = 2.31$ (1)	NS

*NS = not significant.

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References

1. *Maternal and Child Care Vital Statistics,* 1975, Manitoba Ministry of Health and Social Development, Winnipeg, 1975, p 82
2. *Maternal and Child Care Vital Statistics: Update, 1976. Manitoba Statistics,* Manitoba Ministry of Health and Social Development, Winnipeg, 1978, table IV-6B
3. GERRARD JW: Breast-feeding: second thoughts. *Pediatrics* 54: 757, 1974
4. KNODEL J: Breast-feeding and population growth. *Science* 198: 1111, 1977
5. GRAHAM-CUMMINGS, cited by SCHAEFER O: Food resources and changing dietary patterns of the Eskimo child, in *Nutrition of Indian and Eskimo Children, Report of the Second Canadian Ross Conference on Pediatric Research,* HAWORTH JC (ed), Ross Laboratories, Montreal, 1975, p 5b
6. MATA LJ, WYATT RG: Host resistance to infection. *Am J Clin Nutr* 24: 976, 1971
7. MCCLELLAND DBL, MCGRATH J, SAM-

SON RR: Antimicrobial factors in human milk. Studies of concentration and transfer to the infant during the early stages of lactation. *Acta Paediatr Scand* (suppl 271): 1978
8. BÉHAR M: The role of feeding and nutrition in the pathogeny and prevention of diarrheic processes. *Bull Pan Am Health Organ* 9: 1, 1975
9. ROBINSON M: Infant morbidity and mortality; a study of 3266 infants. *Lancet* 1: 788, 1951
10. CUNNINGHAM AS: Morbidity in breast-fed and artificially fed infants. *J Pediatr* 90: 726, 1977
11. LARSEN SA, HOMER DR: Relation of breast versus bottle feeding to hospitalization for gastroenteritis in a middle-class US population. *J Pediatr* 92: 417, 1978
12. WHEATLEY D: Incidence and treatment of infantile gastro-enteritis in general practice. *Arch Dis Child* 43: 53, 1968
13. ADEBONOJO FO: Artificial vs breast feeding. Relation to infant health in a middle-class American community. *Clin Pediatr* 11: 25, 1972
14. SMITH MC: Food resources in changing dietary patterns of the Canadian Indian child, in *Nutrition of Indian and Eskimo Children, Report of the Second Canadian Ross Conference on Pediatric Research,* op cit, p 12
15. Nutrition committee, Canadian Paediatric Society: Breast-feeding: what is left besides the poetry? *Can J Public Health* 69: 13, 1978
16. LOZOFF B, BRITTENHAM GM, TRAUSE MA, et al: Mother-newborn relationship — limits of adaptability. *J Pediatr* 91: 1, 1977

A university department's involvement with medical care in the Canadian North

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Both visiting consulting services and resident general practice services to the Churchill Health Centre in northern Manitoba are provided by the University of Manitoba through its northern medical unit. The roles of the university's department of obstetrics and gynecology with regard to visiting consulting services include patient care, education and medical audit. This paper reviews the several aspects of this involvement over the period 1971 through 1977.

Les services itinérants de consultation et les services locaux de pratique générale au Churchill Health Centre, dans le nord du Manitoba, sont assurés par l'université du Manitoba grâce à son unité médicale pour les régions nordiques. Le rôle des services universitaires d'obstétrique et de gynécologie en ce qui concerne les services itinérants de consultation incluent les soins aux patients, l'éducation et la surveillance médicales. Cette publication se penche sur les différents aspects de cette tâche pour la période allant de 1971 à 1977.

Since 1970, as noted elsewhere,[1] the University of Manitoba has provided the medical services to the northern Manitoba town of Churchill and its catchment area, which includes the Keewatin district of the Northwest Territories as well as a few very small northern Manitoba settlements. The present population of the three main ethnic groups is approximately as follows: Inuit 4000, Caucasians 2000 and Indians 700. The population of Churchill has been steadily reduced through the exodus of various government activities to its present level of approximately 1500.

The 30-bed Churchill Health Centre has diagnostic and treatment facilities and an ambulatory clinic, and it houses the social services for the town of Churchill. The medical staff consists of general practitioners employed by the northern medical unit of the University of Manitoba. The seven settlements of the Keewatin district each has a nursing station staffed by one to four nurse practitioners, who provide primary care to the settlement but are backed up by phone contact with and regular monthly visits from the Churchill Health Centre doctors.

A cadre of University of Manitoba specialists have a regular program of consulting visits to the Churchill Health Centre and in limited areas, and less frequently, to the Keewatin nursing stations.

This paper describes the role of the department of obstetrics and gynecology within this framework since 1971. The functions encompassed can be considered in the following categories: (a) regular consulting visits to Churchill, (b) occasional consulting visits to the Keewatin nursing stations, (c) provision of a phone consultation and referral service, and (d) participation in a clinical training course for nurse practitioners working in the North.

Consulting visits

Table I shows the numbers of consulting visits to Churchill, patients seen and operating sessions each year from 1971 through 1977. Consulting trips are usually made every 4 to 6 weeks to Churchill. The number of patients seen has decreased slightly owing to the reduced population. All seven Keewatin settlements were visited in 1972 for patient care and for nursing in-service education. As a matter of policy of the Health and Welfare Canada regional office, obstetric and gynecologic consulting visits to the settlements are not regularly made. However, in 1976 five of the settlements were again visited for an obstetric review.[2]

Obstetric and gynecologic operations

The number of such operations

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