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Infant feeding patterns and risk of acute respiratory infections in Baghdad/Iraq

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ABSTRACT

BACKGROUND: exclusive breastfeeding has been shown to protect infants from contracting various diseases. The aims of this study were: to examine the relationships between infant feeding patterns and the risk of Acute Respiratory Infections (ARI), and to assess the importance of some factors that can increase such risk.

METHODS: a case-control study was carried out during the period between February 1st 2005 - May 1st 2005. The study included 137 infants who were hospitalized in the Children Welfare Teaching Hospital for ARIs during the period of study (a case definition of acute lower respiratory infection as given by the WHO (1995) was used).

The Control group included 157 healthy infants who were randomly selected from two primary health care centers of the Al-Karkh sector of Baghdad for immunization. The risk of various factors thought to be associated to ARI were studied, these being: non-modifiable (age, gender, birth order, parent education, crowded residence, family history of asthma and history of ARIs in household members in previous 2 weeks) and modifiable (short duration of breastfeeding, cigarette smoking in proximity to the infant, delayed immunization and malnutrition). Logistic regression was used to adjust for confounders and for calculating adjusted odds ratios.

RESULTS: formula fed infants had a 2.7 times higher risk (CI:1.6-4.68) for ARIs compared to breast fed infants. Infants who had undergone a short duration of breastfeeding (<3 months) had a 1.4 times increased risk or ARI (CI: 0.89—2.23). Additional factors that were associated with higher ARIs were, male gender (OR= 2.0, CI:1.3-3.3), low educational level of mothers (OR= 6.4, CI:3.2-12.7) and fathers (OR=4.5, CI:2.27-8.78), crowded residence (OR= 4.5, CI: 2.6-7.8), positive history of ARIs in household members in the 2 weeks prior to the study (OR= 5.5, CI:3.3-9.3), family history of asthma (OR= 2.6, CI:1.4-4.9), and daily smoking of ≥7 cigarettes in proximity to the infant (OR= 2.0, CI:1.1-3.4). Age, birth order, delayed immunization and malnutrition, were not found to significantly increase the infants' risk of ARIs.

Multiple logistic regression showed that ARIs in household members during the 2 weeks prior to the study, low educational level of mothers, short duration of breastfeeding, living in a crowded residence, and family history of asthma or allergy were all significantly associated with an increase in the risk of ARIs.

CONCLUSIONS: short duration of breastfeeding is the only modifiable factor which showed a significant relationship with ARIs. The Promotion of breastfeeding is highly recommended as a strategy to reduce the risk of ARIs in infants.

Key words: Breastfeeding, Respiratory infections

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INTRODUCTION

Acute respiratory infections (ARIs) are among the leading cause of acute illnesses worldwide and remain the most important cause of infant and young children mortality (1). They are responsible for the deaths of 2 million children under 5 years of age every year worldwide, with most of these deaths (99%) occurring in developing countries (2). The estimated percentage of deaths from ARIs in children under five years in Iraq is 10-15% (1). The Multiple Indicator Cluster Survey (MICS) for the year 2000 in Iraq, showed that 6.9 percent of children under five had an acute respiratory infection in the two weeks prior to the survey (3).

Several risk factors are associated with ARIs (4, 5), some of them are un-modifiable (e.g.: age and sex of the child, age of the parents), whilst others are modifiable and these include many socio-demographic, nutritional and environmental modifiable risk factors (e.g.: lack of breastfeeding, severe malnutrition, indoor cooking fuel other than liquid petroleum gas, inappropriate immunization for age, history of ARIs in the family, and education of the parents). The identification of modifiable risk factors associated with ARIs may help to reduce the burden of disease. According to the WHO report, low birth weight, malnourished and non-breastfed children, and those living in overcrowded conditions are at higher risk of death from pneumonia (6).

Inadequate breastfeeding is identified as a significant risk factor in many studies. In a population-based case-control study in North America (7), current breastfeeding was associated with a decreased likelihood of invasive pneumococcal disease (odds ratio, 0.27; 95% confidence interval: 0.08-0.90). Evidence showed that breastfeeding had a positive influence, on the survival of the child (8) , especially exclusive breastfeeding. The protective effect of human milk against infections has been addressed by many investigators (9-12). Reported data has shown a reduced prevalence of infectious diseases in exclusively breastfed infants (13). Breastfeeding benefits have been demonstrated to be related to the amount of breast milk received (10). Fully breastfed infants have been shown to have lower overall illness rates, whereas minimal breastfeeding has not been found to be protective (14). Low duration of breast feeding was associated with a significantly increased risk for lower respiratory illnesses in US and Australian children (15, 16). Evidence about breastfeeding's role as a protection against respiratory infections was reported in studies done in Brazil (17, 18), Sri Lanka (19), Bangladesh (11, 20), Spain (12), Greece (21) and India (4).

While breastfeeding is important for all infants, it becomes vital in situations of emergency where access to health care, clean water and adequate nutrition is limited (22). In Iraq, there was a reported increase in mortality rate for children under five from 56 per 1 000 live births in the period from 1984–89 to 131 per 1 000 live births in the period from 1994–99, which was attributed to economic collapse, poor sanitation, lack of safe water, and inadequate provision of health care (23). The WHO 2006 report on health status indicators in Iraq revealed high Infant Mortality Rates (104.8 in males and 96.4 in females per 1 000 live births) and identified ARIs as one of the top causes of morbidity and mortality for under 5 children (24). According to a survey conducted by Ministry of Health, Iraq, in collaboration with WHO, there were 5-8 episodes of ARI per child per year (25). Analysis of the Multiple Indicator Cluster Survey (MICS) for the year 2000 in Iraq, showed a significant association between child's gender and risk of ARI (26). It should be noted that, in a previous study of children under 5 years age no significant associations were found between lack of breast feeding and risk of ARIs (26). However, in that study, breastfeeding was neither dose specific nor duration specific (ever breast fed), which may explain why this non-significant association was reported. Given the high mortality rates among Iraqi infants, we believe that identifying the protective role that breastfeeding plays against the risk of ARIs becomes very critical for the survival of Iraqi infants, especially with the current difficulties faced in this country related to controlling for the other modifiable risk factors. The present study aimed to examine the relationships between infant breastfeeding patterns and the risk of Acute Respiratory Infections (ARIs), and to assess the importance of some factors that can increase such risk.

METHODS

A case-control study was carried out during the period between February 1st 2005 - May 1st 2005. No sample size calculation was performed. The study included 137 infants who were hospitalized in the Children Welfare Teaching Hospital for Acute Respiratory Infections during the study period. A case definition for acute lower respiratory infection as outlined by the WHO (1995) was used as the criteria for case inclusion (27). The Control group included 157 healthy infants who were selected randomly from two primary health care centers of

the Al-Karkh sector of Baghdad for immunization. The following groups were excluded in this study: infants with a history of low birth weight or premature birth reported by mothers, infants with congenital cardiovascular or respiratory malformation, infants with chromosomal abnormalities, and infants with asthma. Direct interview of the mothers of the ARI cases and controls were carried out using a validated questionnaire. Validation of the questionnaire was done by two pediatricians and one community medicine specialist. The questionnaire included information about parents education, infant age, gender, feeding pattern (breastfeeding pattern which include exclusive breastfeeding plus predominant breastfeeding, case definition for both as given by the WHO (28, 29), Mixed feeding, Non-breast milk "Formula feeding"), duration of breastfeeding (in months), immunization history, crowding index (used as a socio-economic indicator, calculated by dividing number living in the household by number of rooms (30)), household smoking habits (no. of cigarette smoked by household members near the infant/day), history of ARIs among household members in the two weeks prior to the interview, and family history of asthma. Infants' height and weight were determined and their nutritional status was assessed (Z score values were calculated for these indices; weight for age, weight for height and height for age).

Ethical Considerations

The study was approved by the Scientific Council of Community & Family Medicine Ethical Review Committee, Iraq. The study was discussed with the participants' mothers and verbal consent was obtained from them before enrollment of the participants in the study.

Data analysis

Data were entered into a computerized database. The statistical analysis was done using SPSS version 13. Frequency distribution for selected variables was performed, and the statistical significance of the difference in means of normally distributed variables between the two groups was assessed by independent sample t-tests. The statistical significance and strength of the association between independent dichotomous variable and an outcome variable was measured by odds ratio (OR), which measure the risk in this study. A P value less than 0.05 was considered as statistically significant. A multiple logistic model was used to assess the risk of acute respiratory infection in the presence of certain factors or characteristics after adjusting for the effect of other factors in the model.

RESULTS

The study included 137 infants with ARI and 157 healthy controls. The Distribution of participants by feeding pattern and the duration of breastfeeding is shown in Table 1. It can be seen that formula fed infants had a 2.7 times higher risk for ARIs compared to breastfed infants and this increase in the risk for ARI is statistically significant. As regards duration of breastfeeding, Table 1 shows that a short duration of breastfeeding (< 3 months) is associated with a 1.4 times increase in the risk of ARIs, but this risk is statistically not significant.

Gender, age and nutritional status distributions of participants (Table2) show that only gender (being male compared to female) is associated with a significant increase in the risk of ARIs. Deterioration of nutritional status is associated with the increased risk of ARI in the three indicators considered, although the risks are not significant in all of them. When the studied infants were distributed by parent education and Crowding Index (Table 3), we noticed that parents' lower education was associated with a significant increase in the risk of ARIs and that this increase in risk was more prominent when we considered mothers' education. The Crowding Index in the current study was used as a socio-economic indicator, with higher Crowding Index indicating lower socio-economic status. In this study (Table 3), a higher Crowding Index of the participants is associated with a significant increase in the risk of ARIs.

Distribution of cases and controls according to history of ARIs among household members in the two weeks prior to examination, and family history of asthma is shown in Table 4. It can be seen that having a history of ARI in any household member is associated with a significant increase in the risk of ARIs among infants living in that household. The highest risk was noticed when the infants' mother had such history. Regarding family history of asthma, Table 4 shows that the risk of ARIs is increased among infants who have such history, and particularly in those children whose father may have had an asthmatic history. This factor is associated with a more than fourfold increase in the risk of ARIs, a datum which is statistically significant. The study of the relationship between ARIs and exposure to passive smoking (Table 5) shows that

smoking ≥7 cigarette per day in proximity to the infants is associated with two fold increase in the risk of ARIs which is statistically significant. To overcome the possible interrelationship between the different variables examined beforehand, a multiple logistic regression model, using the backward elimination method with the risk of ARI as the dependent variable, was used. Table 6 shows that, on adjusting for the effect of all studied variables, factors that significantly increase the risk of ARIs (in descending order for OR) are: positive history of ARIs in household members during the 2 weeks prior to the study, low educational level of mothers, short duration of breastfeeding, living in a crowded residence, and positive family history of asthma or allergy.

TABLE 1

DISTRIBUTION OF CASES AND CONTROLS ACCORDING TO FEEDING PATTERN AND DURATION OF BREASTFEEDING

VARIABLE	SUBCATEGORIES	CASES		CONTROL		OR	95%CI	P
		N	%	N	%			
Feeding pattern	Breast feeding	41	29.9	71	45.2	Reference		
	Mixed feeding	23	16.8	40	25.5	1.0	0.52-1.89	0.99
	Formula feeding	73	53.3	46	29.3	2.7	1.6-4.68	<0.001
Duration of breast feeding	**≥3months**	**59**	**43.1**	**81**	**51.6**	**Reference**		
	<3months	**78**	**56.9**	**76**	**48.4**	**1.4**	**0.89-2.23**	**0.14**

TABLE 2

DISTRIBUTION OF CASES AND CONTROLS ACCORDING TO GENDER, AGE AND NUTRITIONAL STATUS

VARIABLES	SUBCATEGORIES	CASES (N=137)		CONTROLS (N=157)		OR	95%CI	P
		N	%	N	%			
Gender	Female	45	32.8	78	49.7	Reference		
	Male	92	67.2	79	50.3	2.0	1.26-3.24	S
AGE (Months)	< 3	47	34.3	66	42.0	Reference		
	4-6	47	34.3	41	26.1	1.6	0.92-2.82	NS
	7-9	28	20.4	40	25.5	1.0	0.553-1.81	NS
	10-12	15	10.9	10	6.4	2.1	0.87-5.1	NS
Weight-for- height Z score	Acceptable	123	89.8	147	93.6	Reference		
	Moderate wasting	10	7.3	9	5.7	1.3	0.52-3.37	NS
	Severe wasting	4	2.9	1	0.6	4.8	0.53-43.3	NS
Weight-for-age Z score	Acceptable	124	90.5	153	97.5	Reference		
	Moderate underweight	7	5.1	2	1.3	4.3	0.88-21.1	NS
	Severe	6	4.4	2	1.3	3.7	0.73-18.6	NS
Height-for-age Z score	Acceptable	122	89.1	147	93.6	Reference		
	Moderate stunting	9	6.6	7	4.5	1.5	0.56-4.28	NS
	Severe	6	4.4	3	1.9	2.4	0.59-9.84	NS

Acceptable, Z Score>-2; Moderate, Z Score -2 to -2.9; Severe, Z Score ≤ -3

S= significant, NS= not significant

TABLE 3

DISTRIBUTION OF CASES AND CONTROLS ACCORDING TO PARENTS' LEVEL OF EDUCATION AND CROWDING INDEX

VARIABLES		CASES		CONTROLS		OR	95%CI	P
		N	%	N	%			
Mother's years of education	≥13	18	13.1	52	33.1	Reference		
	7-12	50	36.5	74	47.1	2.0	1.02-3.72	0.042
	≤6	69	50.4	31	19.7	6.4	3.2-12.73	<0.001
Father's years of education	≥13	29	21.2	73	46.5	Reference		
	7-12	69	50.4	62	39.5	2.8	1.62-4.86	<0.001
	≤6	39	28.5	22	14	4.5	2.27-8.78	<0.001
Crowding Index	<2	23	16.8	75	47.8	Reference		
	≥2	114	83.2	82	52.2	4.5	2.62-7.83	<0.001

TABLE 4

DISTRIBUTION OF CASES AND CONTROLS ACCORDING TO HISTORY OF ARIs IN HOUSEHOLD MEMBERS IN THE 2 WEEKS PRIOR TO THE INVESTIGATION AND FAMILY HISTORY OF ASTHMA

		CASES		CONTROLS		OR	95%CI	P
		N	%	N	%			
HISTORY OF ARIs AMONG HOUSEHOLD IN PREVIOUS 2 WEEKS	MOTHER	60	43.8	18	11.5	6.0	3.32-10.92	<0.001
	FATHER	38	27.7	16	10.2	3.4	1.79-6.4	<0.001
	SIBLING	60	43.8	40	25.5	2.3	1.39-3.73	0.001
	OTHER RESIDENTS	59	43.1	26	16.6	3.8	2.22—6.54	<0.001
	ANY RESIDENTS	109	79.6	65	41.4	5.5	3.27-9.29	<0.001
HISTORY OF ASTHMA OR ALLERGY IN THE FAMILY	MOTHER	8	5.8	3	1.9	3.2	3.32-10.92	0.09
	FATHER	11	8.0	3	1.9	4.5	1.79-6.4	0.024
	SIBLING	12	8.8	5	3.2	2.9	1.39-3.73	0.05
	ANY RESIDENTS	33	24.1	17	10.8	2.6	3.27-9.29	0.003

TABLE 5

DISTRIBUTION OF CASES AND CONTROLS ACCORDING TO AVERAGE NUMBER OF CIGARETTES SMOKED IN PROXIMITY TO THE INFANTS/DAY BY ALL SMOKERS IN THE HOUSEHOLD

AVERAGE NUMBER OF CIGARETTE SMOKED NEAR THE INFANTS/DAY	CASES		CONTROLS		OR	95%CI	P
	N	%	N	%			
NON-SMOKERS	48	35	65	41.4	Reference		
1-6	32	23.4	53	33.8	0.8	0.46-1.45	0.99
≥7	57	41.6	39	24.8	2.0	1.14-3.44	<0.001
TOTAL	137	100	157	100			

TABLE 6

MULTIPLE LOGISTIC REGRESSION MODEL USING THE BACKWARD ELIMINATION METHOD WITH THE RISK OF ARIs AS DEPENDENT VARIABLE

INDEPENDENT VARIABLE	OR	P
Very short duration of breastfeeding (<3 months) compared to longer periods	2.5	0.012
Lowest educational level of mother (≤primary school level) compared to higher levels	3	0.001
Crowded residence(crowding index≥2) compared to less crowded	2.3	0.016
Positive past history of ARIs in any household member during the previous 2 weeks	3.8	<0.001
Positive family history of asthma or allergy	2.2	0.041

Predictive value of the model=74.5%

P model<0.001

DISCUSSION

Acute respiratory infections (ARIs) are the main cause of morbidity and one of the most frequent reason for the use of health services around the world, and it has been estimated that up to 25% of severe acute respiratory infections might be prevented if addressing the risk factors responsible for these infections (31). Breastfeeding has long been believed to provide numerous health benefits against infectious diseases of bacterial, viral and parasitic origin in nursing infants (32). A recently published large-scale prospective study demonstrated that infants exclusively breastfed for 6 months, as per WHO recommendations, presented fewer infectious episodes than their partially breastfed or non-breastfed peers, and this protective effect persisted after adjustment for potential confounders for ARIs (OR 0.58, 95% CI 0.36 to 0.92) (33).

In this study, breastfeeding provides protection against ARIs, as formula fed infants were found to have a 2.7 times higher risk of ARIs, though for those partially breastfed (mixed feeding) the odds ratio did not indicate a strong evidence of protection. Many epidemiological studies (32) have demonstrated the protection against infection provided by breastfeeding. However, the apparent protection of breastfed infants could reflect better overall nutrition for breastfed infants or reduced exposure to infectious agents rather than specific anti-infective substances in breast milk. A prospective cohort study (34) including 1 202 healthy infants who were born in New Mexico and actively tracked for breastfeeding and respiratory illnesses during the first 6 months of life, demonstrated that, after adjustment for potential confounding factors, full breastfeeding was associated with a reduction in lower respiratory illness risk (odds ratio = 0.81, 95% CI: 0.68-0.96). In the present study, after adjusting for the confounding effect of other factors studied, a short duration of breastfeeding (less than 3 months) significantly increases the risk of ARIs among infants by 2.5 times. This is consistent with a study done in the US (15), which showed that, after adjusting for demographic variables, breastfed infants for 4-5 months had significantly increased odds for pneumonia (OR: 4.27; 95% CI: 1.27–14.35) compared with those who were breastfed for ≥ 6 months. Our study provides evidence that, among Iraqi infants, breast feeding protects against respiratory morbidity. This finding is exceptionally important for the survival of Iraqi infants, especially in view of the reported high infant mortality rate in Iraq, and the significant contribution of ARIs to infants' death (24, 25). The WHO data about the national prevalence of breastfeeding shows that the rates of exclusive breast feeding among < 4 months and < 6 months are 33.9% and 25.1% respectively (35). In Iraq, where access to health care, clean water and adequate nutrition is limited (22, 23, 36), and where current difficulties are encountered in controlling the other modifiable risk factors for ARIs, strategies which include promotion of breastfeeding become extremely important for the prevention of ARIs among Iraqi infants.

Apart from breastfeeding, we studied other factors that could affect the risk of ARIs among infants. In the present study, age is associated with a slight increase in the risk for ARIs and reached a significant level only in infants aged less than four

months and in those aged 4-6 months. Lower risk of ARI among those under-6 months aged compared to older infants was reported in another study done in Greenland (37). Another study done in five slums of Dhaka city (20) showed that the risk of ARIs was 1.85 times higher among infants aged above 6 months. Gender (being males) in this study was also associated with an increased risk for ARI, and this finding is supported by other studies, in which the Relative Risk of being a boy and having lower respiratory tract infection was 1.5 (37). In our study nutritional status was not a significant risk factor for ARIs, and this disagrees with other findings (38).

Current data shows that infants whose mothers are less educated have a three times higher risk of ARIs compared to infants whose mothers are more educated. This is in agreement with other findings (34) which showed that the adjusted Odd Ratio for the risk of ARIs among partial versus non-breastfed infants was higher when maternal education was ≤12 years (OR=1.41) compared to instances of higher maternal education categories (OR for 13-15 Ys=0.81, OR for > 16 Ys = 0.73).

This study demonstrates that exposure to passive smoking by household members who smoke close to the infant is another risk factor for ARIs among infants. However, on adjusting for the effect of other variables, this factor failed to show a significant relationship to the risk for ARIs. This is in agreement with a cohort study done in Soweto (39) which showed lack of association between passive smoking and risk of moderate to severe ARIs in the multivariate analyses.

Another factor that demonstrates a significant risk for ARIs in the studied infants is living in crowded residences. Our finding emphasized results obtained in a case control study done among Alaskan native children (30), in which a crowding index ≥2 was associated with a higher risk for hospitalization due to ARIs. It has been suggested that crowding may plausibly increase the risk of respiratory infection by increasing the opportunity for cross infection among the family. The agents of such infection are readily transmitted usually through air droplets in crowded and ill-ventilated rooms where people are sneezing, coughing or simply talking (40).

Our data demonstrate that infants who had a positive past history of ARIs in any household member in the two weeks prior to investigation had a five times higher risk of having ARIs. This finding is in agreement with that reported in a case-control study carried out in Brazil (17). Current data also demonstrates that infants who have a positive family history of asthma or allergy have a two times higher risk of ARIs after adjusting for the other factors. This result coincides with the result obtained from a hospital based case-control study carried out in India (4). Similarly, in 2004, a case-control study on hospitalized children living in Oxfordshire, UK, investigated the importance of family history in the risk of lower respiratory tract infection in early childhood, and reported that maternal history of asthma can increase the risk of severe lower respiratory tract infection in first year of life (41).

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