

# Acute respiratory infection and malnutrition among children below 5 years of age in Erbil governorate, Iraq

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## العدوى التنفسية الحادة وسوء التغذية بين الأطفال دون سن الخامسة في محافظة إربيل، العراق

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الخلاصة: يُعتبر سوء التغذية من عوامل الاختطار الهامة للعدوى التنفسية الحادة التي تعتبر سبباً أساسياً للوفيات والمراضة بين الأطفال دون سن الخامسة. وتهدف هذه الدراسة للحالات وللشواهد إلى التعرف على العلاقة بين الحالة التغذوية وبين العدوى التنفسية الحادة بين الأطفال دون سن الخامسة ممن يراجعون المستشفى التعليمي في إربيل، العراق. وقد قارن الباحث بين الأطفال الذين أدخلوا إلى المستشفى بتشخيص عدوى تنفسية علوية بعد الشهر الرابع في الفترة 2006 – 2007، وعددهم 190 طفلاً، مع مجموعة من الشواهد غير المصابين بعدوى تنفسية علوية، وعددهم 192 طفلاً. ووجد الباحث أن الحالات بين الذكور أعلى بمقدار يعتد به إحصائياً (64.7% للذكور مقابل 53.1% للإناث)، في حين أن العمر الوسطي كان أخفض (15.6 ± 15.4 شهراً مقابل 19.7 ± 26.4 شهراً). كما أن الوزن والطول كان أخفض لدى مجموعة المصابين مما هو عليه لدى الشواهد، دون أن يكون هناك فرق يعتد به إحصائياً للوزن بالنسبة للعمر أو للطول بالنسبة للعمر. وكان هناك ترابط يعتد به إحصائياً بين العدوى التنفسية العلوية ومؤشرات سوء التغذية، وفقاً للمعايير الأنثروبولوجية لغوميز وويلكم، ولم يلاحظ مثل هذا الترابط وفقاً للمعايير واترلو.

**ABSTRACT** Malnutrition is an important risk factor for acute respiratory infection (ARI), which is a leading cause of mortality and morbidity among children aged < 5 years. This case-control study aimed to determine the relationship between nutritional status and ARI among young children aged < 5 years attending a teaching hospital in Erbil, Iraq. Children admitted to hospital with a diagnosis of ARI over a 4-month period in 2006–2007 ( $n = 190$ ) were compared with a control group without ARI ( $n = 192$ ). Significantly more ARI cases were male (64.7% versus 53.1%) and the mean age was lower [15.6 (SD 15.4) versus 26.4 (SD 19.7) months]. Weight and height were lower in the ARI group but there was no significant difference in weight-for-age or in height-for-age. There was a significant association between ARI and indicators of malnutrition according to the Gomez and Welcome anthropometric criteria but not the Waterlow criteria.

## Infection respiratoire aiguë et malnutrition chez des enfants de moins de cinq ans dans le gouvernorat d'Erbil (Iraq)

**RÉSUMÉ** La malnutrition est un facteur de risque important d'infection respiratoire aiguë ainsi qu'une cause majeure de mortalité et de morbidité chez les enfants de moins de cinq ans. La présente étude cas-témoins visait à déterminer la relation entre l'état nutritionnel et l'infection respiratoire aiguë chez des enfants âgés de moins de cinq ans admis à l'hôpital universitaire d'Erbil (Iraq). Les enfants hospitalisés ayant reçu le diagnostic d'infection respiratoire aiguë au cours d'une période de quatre mois en 2006 et 2007 ( $n = 190$ ) ont été comparés à un groupe témoin sans infection respiratoire aiguë ( $n = 192$ ). Les enfants de sexe masculin étaient nettement plus nombreux à être atteints d'une infection respiratoire aiguë (64,7 % contre 53,1 %) et l'âge moyen était inférieur (15,6 mois [ET 15,4] contre 26,4 mois [ET 19,7]). Le poids et la taille étaient inférieurs dans le groupe des patients infectés mais aucune différence significative n'a été observée pour le poids selon l'âge ou la taille selon l'âge. Il existait une forte association entre une infection respiratoire aiguë et les indicateurs de malnutrition selon les classifications anthropométriques de Gomez et Welcome, mais pas selon les critères de Waterlow.

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Received: 21/11/11; accepted: 26/01/12

## Introduction

Acute respiratory infections (ARI) are major causes of morbidity and mortality in the children of developing countries. While the incidences of ARI are similar in developed and developing countries the course of the disease and the outcomes of ARI may be more severe in developing nations [1]. The effect of poor nutrition, lack of immunization, overcrowding, air pollution and other factors have been reported by several investigators [1,2]. ARI is the cause of almost one-third of all deaths in children < 5 years of age. Most of these deaths are from pneumonia [2].

Risk factors for deaths in children with ARI have been identified as age < 1 year, malnutrition and pneumonia as a complication of infection with measles, pertussis, malaria or HIV [3]. Significant associations have also been observed regarding type of feeding and ARI; breastfeeding appears to be highly protective against the occurrence of ARI in infants [4]. The epidemiological evidence is now overwhelming that, even in developed countries, breastfeeding protects against gastrointestinal and to a lesser extent respiratory infection [5]. Malnourished children with severe acute upper respiratory tract infection (URTI) were shown to have a 2–3 times higher mortality rate than healthy children [6]. Malnutrition generally implies undernutrition. In children, undernutrition manifests as underweight and stunting (short stature) while severely undernourished children present with symptoms and signs characteristic of conditions known as kwashiorkor, marasmus or marasmic kwashiorkor [6].

In northern Iraq (including Erbil city) a significant improvement was found between 1994 and 2002 in children's nutritional status; the percentage of underweight children aged < 5 years fell from 25.8% in 1994 to 10.7% in 2002. Nevertheless, among children aged < 5 years, 13.2% were underweight in 2000 with 4.3% acute (wasted) and

13.0% chronic (stunted) [7]. The objective of the current study was to study the relationship between nutritional status and ARI among young children attending a teaching hospital in Erbil, Iraq.

## Methods

A case-control study was undertaken in Raparin teaching hospital, which is the only specialized paediatric hospital in Erbil city.

### Study sample

A total of 190 children < 5 years old who were admitted to Raparin hospital with a diagnosis of ARI over a period of 4 months from 1 November 2006 to 1 March 2007 were recruited. The inclusion criteria were all children with respiratory infection who had been admitted to the emergency department during the study period. Neonates and children with known chronic respiratory problems (e.g. asthma, cystic fibrosis, congenital respiratory malformations, tuberculosis), prolonged cough more than 3 weeks, congenital heart disease or foreign body inhalation were excluded from the study. A control sample of 192 children was collected from children attending the paediatric surgical or dental department over the same period for simple surgical procedures, excluding any child with acute or chronic medical illness.

ARI was defined as the presence of cough with or without fever for less than 2 weeks. Acute URTI was diagnosed in those with rhinorrhoea, cough with or without fever, sore throat and tonsillar enlargement, pharyngeal congestion or audible stridor [2]. Acute LRTI was diagnosed in those who presented with prodromal symptoms of rhinorrhoea, cough, fever, with wheeze, dyspnoea, chest retractions, scattered rales and features of hyperinflation, consolidation, patchy or interstitial infiltrates on chest radiography [8].

## Data collection

Information was collected from parents via a face-to-face interview. This included the child's age, sex, duration of illness, symptoms, type of feeding and whether exclusively breastfed in the first 4–6 months. Oral consent was taken from the parents of each child enrolled in the study.

A respiratory system examination was done and anthropometric measures were taken. Weight was measured by precision dial scale (Seca Optima). Participants were weighed in light clothing as far as possible and without shoes. The scales were calibrated before use. Height was measured by using the Centers for Diseases Control measuring board. Individuals were measured barefoot and standing erect, with feet together and head against the measuring rod, looking straight ahead, with arms hanging loosely at the sides and palms facing thighs. Length was measured for children below age of 2 years, with the child lying supine with legs fully extended at the hips and knees and feet at right angles to legs [9].

Three classification systems that are commonly used for assessing growth retardation and nutritional status in the community were applied (Gomez, Welcome and Waterlow) [10] (Table 1). Wasting (decreased weight for length or height) is associated with acute malnutrition and is distinguished from stunting (decreased length-for-age or height-for-age) seen with chronic malnutrition. This system depends on a standardized normal distribution using Z-scores in which the 5th percentile is 2 standard units below the mean [10].

## Data analysis

SPSS, version 18.0 was used for analysis. We used the *t*-test to compare means and the chi-squared test for categorical variables to check the relationship between ARI and demographic, anthropometric and nutritional status variables. *P*-values  $\leq 0.05$  were considered

**Table 1 Classifications of malnutrition used in the current study [6]**

Classification	Criteria	Class
Gomez	Weight below % median weight-for-age	
	75%–90%	Mild malnutrition
	60%–74%	Moderate malnutrition
	< 60%	Severe malnutrition
Waterlow	Z-scores (SD) below median weight-for-height	
	80%–90%	Mild malnutrition
	70%–80%	Moderate malnutrition
	< 70%	Severe malnutrition
WHO, wasting	Z-scores (SD) below median weight-for-height < 3rd percentile or Z-scores 2 SD below mean	Moderate and severe wasting
WHO, stunting	Z-scores (SD) below median height-for-age < 3rd percentile or Z-scores 2 SD below mean	Moderate and severe stunting
Welcome	Weight-for-age	
	60%–80%	With oedema: kwashiorkor Without oedema: undernutrition
	< 60%	With oedema: marasmus-kwashiorkor Without oedema: marasmus

WHO = World Health Organization; SD = standard deviation.

statistically significant. Odds ratios (OR) were used to estimate the relative risk of ARI for certain variables with 95% confidence interval (CI).

## Results

Of the 190 patients with ARI 78 had lower respiratory tract infection (LRTI), 51 had URTI and 61 had mixed URTI and LRTI.

There was a higher proportion of male children in the ARI group than in the control group (64.7% versus 53.1%) ( $P = 0.02$ ) (Table 2). The mean age of the ARI group was significantly lower than the control group [15.6 (15.4) versus 26.4 (19.7) months]  $P < 0.001$ .

Although fewer children in the ARI group were exclusively breastfed compared with the control group (34.7% versus 43.8%), type of feeding was not significantly different between the groups ( $P = 0.20$ ) (Table 2). Breastfeeding was not a significant risk factor, even when exclusive breastfeeding was plotted against both mixed and bottle feeding (OR = 1.46; 95% CI: 0.96–2.21,  $P = 0.07$ ).

Mean weight was significantly lower in the ARI group than the controls [8.9 (3.6) kg versus 11.7 (4.8) kg] ( $P < 0.001$ ) and so were mean height [73.4 (14.5) cm versus 83.4 (17.7) cm] ( $P < 0.001$ ). However, weight-for-age on growth chart ( $P = 0.104$ ) and height-for-age on growth chart ( $P = 0.104$ ) were not statistically significantly related to ARI.

There was no significant difference between the groups using the Waterlow nutritional state assessment ( $P = 0.06$ ), but ARI was more common among children with indicators of malnutrition according to the Welcome ( $P = 0.007$ ) and Gomez criteria ( $P < 0.001$ ) (Table 2). Two ARI cases had oedema but their weight-for-age was normal so they were not considered as marasmic kwashiorkor or kwashiorkor.

When the Gomez malnourished classes (mild, moderate and severe) were combined the risk of ARI was more than 2-fold higher (OR = 2.30; 95% CI: 1.48–3.58). Similarly, when the Welcome malnourished classes (60%–80% and < 60%) were combined the risk of ARI was also nearly twice as

high as in the control group (OR = 1.95; 95% CI: 1.15–3.30).

## Discussion

We found that sex was a risk factor for ARI in this study, in agreement with other studies have shown that males were more vulnerable to ARI than were females [3,4,11,12]. Our finding of lower mean age in the ARI group also agrees with findings showing that younger children were more likely to have ARI [3,4], with infants being main group affected. Tupasi et al. in Manila found that age < 2 years significantly increased the risk of having ARI [13] and Kanchi and Kakeri reported that among children aged < 5 years with ARI in a Bombay hospital, 40.9% were < 1 year of age [12]. One study showed that among 800 children studied, 59% were boys and 56.3% were infants with mean age 6.5 (SD 5.6) [11].

Feeding pattern (exclusive breastfeeding, bottle feeding or mixed feeding) was not statistically significant in relation to ARI even when plotted in

**Table 2 Comparison of demographic, anthropometric, feeding and malnutrition variables in children aged < 5 years with and without acute respiratory infection (ARI)**

Variable	ARI group (n = 190)		Control group (n = 192)		P-value
	<b>Mean (SD)</b>		<b>Mean (SD)</b>		
Age (months)	15.6 (15.4)		26.4 (19.7)		< 0.001
Weight (kg)	8.9 (3.4)		11.7 (4.8)		< 0.001
Height(length) (cm)	73.4 (14.5)		83.4 (17.7)		< 0.001
	<b>No.</b>	<b>%</b>	<b>No.</b>	<b>%</b>	
<b>Sex</b>					0.021
Male	123	64.7	102	53.1	
Female	67	35.3	90	46.9	
<b>Feeding</b>					0.196
Exclusive breastfeeding	66	34.7	84	43.8	
Bottle feeding	49	25.8	42	21.9	
Mixed feeding	75	39.5	66	34.4	
<b>Weight-for-age on growth chart</b>					0.104
Normal	143	75.3	161	83.9	
< 5th percentile	34	17.9	21	10.9	
> 95th percentile	13	6.8	10	5.2	
<b>Height (length)-for-age on growth chart</b>					0.104
Normal	150	78.9	156	81.3	
< 5th percentile	25	13.2	14	7.3	
> 95th percentile	15	7.9	22	11.5	
<b>Weight-for-height (length) (Z scores)</b>					0.150
3SD below	21	11.1	11	5.7	
Normal	165	86.8	175	91.1	
3SD above	4	2.1	6	3.1	
<b>Welcome classification</b>					0.007
Normal	144	75.8	165	85.9	
60%–80%	40	21.1	27	14.1	
< 60%	6	3.2	0	0.0	
<b>Waterlow classification</b>					0.062
Normal	133	70.0	153	79.7	
Mild	30	15.8	27	14.1	
Moderate	22	11.6	10	5.2	
Severe	5	2.6	2	1.0	
<b>Gomez classification</b>					0.001
Normal	110	57.9	146	76.0	
Mild	52	27.4	36	18.8	
Moderate	24	12.6	10	5.2	
Severe	4	2.1	0	0.0	

SD = standard deviation.

2 categories (exclusive breastfeeding versus other feeding patterns). This in agreement with previous studies in Iraq by Albargish and Hasony [14] and Yousef and Khaleq [4] in which

breastfeeding had no clear protective effect against infection, whereas Al-Jassar found in another study in Iraq that breastfeeding prevented severe forms of ARI [15], while other studies

in other developing countries showed that children under 5 years with ARI were mainly, partially or not breastfed up to 6 months [11,16]. Again, Arifeen et al. compared exclusive breastfeeding



in the first few months of life with partial or no breastfeeding and its effect on ARI as mortality rate increase by 2.23 fold in those with no exclusive breastfeeding [17].

Children with lower mean weight and height (or length) were more likely to have ARI than the control group and this agrees with studies in which malnutrition and underweight were risks for acute LRTI in children < 5 years old [7,18,19]. However, weight-for-age and height-for-age were not statistically significantly related to ARI. ARI was more likely in underweight children assessed according to the Gomez and Welcome criteria, with the risk around 2-fold higher compared with the control

group (OR = 1.95; 95% CI: 1.15–3.30 and OR = 2.30; 95% CI: 1.49–3.58 respectively). Wahed and Islam showed that most children with pneumonia had mild protein–energy malnutrition according to Gomez criteria [11]; in our study, 57.9% were normal and 27.4% had mild protein–energy malnutrition according to Gomez classes. Malnutrition by Gomez criteria was shown to be more frequent among children with ARI than other diseases, and more frequent in children aged < 5 years with LRTI rather than URTI [20]. Tupasi et al. found that malnourishment was significantly associated with increased risk of ARI morbidity [13], while a study in a Bombay hospital reveal that the severity

of undernutrition correlated with severity of ARI, with 23.9%, 21.6% and 4.5% of ARI cases having grade I, II, III malnutrition respectively according to Gomez criteria [12]. We found no significant relation between ARI and underweight according to Waterlow criteria.

## Conclusion

Most cases of ARI in this hospital in Erbil occurred below the age of 1 year and boys were more prone to ARI than girls. Malnutrition according to Gomez and Welcome criteria significantly increase the risk of having ARI among children < 5 years of age.

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