International Journal of Medicine, 4 (1) (2016) 26-31

International Journal of Medicine

Website: www.sciencepubco.com/index.php/IJM
doi: 10.14419/ijm.v4i1.5989
Research paper

Risk factors associated with wasting among children aged 6 to 24 months old in Gaza strip

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Abstract

Wasting contributes to morbidity and mortality for children under 5 years of age particularly in the developing countries. This study identified the various risk factors associated with wasting among children aged 6 to 24 months old in Gaza Strip. The study sample consisted of 98 wasted children and 98 control children. A questionnaire interview was used. The World Health Organization Anthro software for assessing nutritional status of the world's children was applied. Data were computer analyzed using SPSS/PC statistical package version 21. Anthropometric data showed that birth weight was significantly lower in cases than controls (2.9±0.8 versus 3.1±0.6 kg, P=0.030). Weight and height were also significantly decreased in cases (P=0.000). Wasting was significantly higher among children of less educated mothers ($\chi2$=8.110, P=0.044) and among children of less family income (OR=4.1, P=0.000). Children not received nutritional help or donation had more frequent wasting than those did (P=0.004). Wasting was significantly higher among non-exclusively breastfed children (OR=2.1, P=0.010) and among children who breastfed ≤12 months (P=0.021). Early introduction of complementary food increased wasting by 2.8 times (OR=2.8, P=0.001). Children with poor appetite had highest frequency of wasting ($\chi2$=6.139, P=0.046). Wasting was significantly higher in respiratory and gastrointestinal tract infected children [OR=2.9, P=0.000 and OR=3.1, P=0.000, respectively). In conclusion, less income, not receive nutritional help or donation, non-exclusive breastfeeding and breastfeeding duration of ≤12 months, early start of complementary food and respiratory and gastrointestinal infections are the predicted risk factors of wasting among children in Gaza Strip.

Keywords: *Children; Gaza Strip; Risk Factors; Wasting.*

1. Introduction

Adequate nutrition is critical to child development particularly in the period from birth to two years of age. Pediatric malnutrition (undernutrition) is defined as an imbalance between nutrient requirements and intake that results in cumulative deficits of energy, protein, or micronutrients that may negatively affect growth, development, and other relevant outcomes (Mehta et al. 2013). Malnutrition continues to be a major health burden and contributes to an estimated 45% of deaths among children under 5 years of age in developing countries, predominantly due to infections (Prendergast 2015). Stunting, wasting and underweight are the most common clinical manifestations of nutritional status for which children are screened in developing countries by anthropometry (Seedhom et al. 2014; Debeko & Goshu 2015).

Wasting is a reduction or loss of body weight in relation to height and is used as an indicator for identifying malnutrition. A wasted child is a child who has a weight-for-height Z-score less than -2.0 standard deviations (United Nations Children's Emergency Fund, UNICEF 2014). Although the prevalence of wasting is difficult to capture because of its more acute and reversible nature, an estimated 52 million (or 8%) children below 5 years of age are wasted worldwide at any point in time (Black et al. 2013). In Gaza strip, the annual report of Ard El Insan Benevolent Association (2010) showed that among the 4820 children aged 6-59 months admitted, the prevalence of wasting was 553 (11.5%).

The main underlying causes of wasting may include poor access to appropriate, timely and affordable health care; inadequate caring and feeding practices e.g. exclusive breastfeeding or low quantity and quality of complementary food; infection or diseases; poor food security; lack of a sanitary environment, including access to safe water, sanitation and hygiene services (Chalabi 2013; Fuchs et al. 2014; Rahman 2016). These factors are strongly related to each other and have a cyclical relationship with wasting. Another suggested risk factor for wasting in childhood is having low birth weight or being small for gestational age (Christian et al. 2013).

In Gaza Strip wasting continues to be a public health problem due to the devastating economic situation as a result of the imposed Israeli siege since the year 2006 which affect all aspects of life. To our best knowledge, only one published study mentioned the importance of breastfeeding in improving wasting among children less than two years old in Gaza strip (Radi et al. 2009). Therefore, the present study was designed to highlight the various risk factors associated with wasting among children aged 6 to 24 months old in Gaza Strip. Identifying of such contributing risk factors is the basic step to set a sustainable and effective nutritional intervention strategy that may prevent subsequent health complications of wasting among the Palestinian children.

2. Methods

2.1. Study design

The present study was a case control design. Case-control studies are often used to identify factors that may contribute to a medical condition by comparing subjects who have that condition/disease (the "cases") with patients who do not have the condition/disease but are otherwise similar (the "controls"). Case-control studies are quick, widely used, relatively inexpensive to implement, require comparatively fewer subjects, and allow for multiple exposures or risk factors to be assessed for one outcome (Mann 2003; Song & Chung 2010).

2.2. Target population and study setting

The target population was wasted children aged 6-24 months old attending Ard El Insan Benevolent Association; a Palestinian non-governmental organization in Gaza strip. It provides nutritional and health services to the needy and marginalized children under five years old, their mothers and families.

2.3. Sample size

The sample size calculations were based on the formula for case-control studies (Fleiss 1981). EPI-INFO statistical package version 3.5.1 was used with 95% Cl, 80% power, 50% proportion as conservative and OR=2. The sample size in case of 1:1 ratio of case to control was found to be 89:89. Based on our response expectation of 95%, we multiply 89 by 1.05 (100/95). Therefore, the required sample size was found to be 93. For no response expectation, the sample size was increased to 98 children. The controls were also 98 apparently healthy children. Cases and controls were age and gender matched.

2.4. Exclusion criteria

Children with psychomotor disabilities, thalassemia, endocrine disorders and surgical operation were excluded.

2.5. Ethical consideration

The necessary approval to conduct this study was obtained from Helsinki committee. Informed consent was obtained from children mothers of all participants. A full explanation about the purpose of the study, assurance about confidentiality of information and the right to refuse or to participate in the study was given.

2.6. Questionnaire interview

A meeting interview with child's mother was used for filling in the questionnaire. All interviews were conducted face to face. The questionnaire was based on Ard El Insan Benevolent Association questions and on that used in a similar study with some modifications (Ard El Insan Benevolent Association 2003; Al-Wahaidi & Lec'hvien 2006). Most questions were one of two types: the yes/no question, which offers a dichotomous choice and the multiple choice question, which offers several fixed alternatives (Backestrom & Hursh-Cesar 2012). The questionnaire was validated by four experts in the fields of nutrition, pediatric, public health and epidemiology. The questionnaire was piloted with 10 children' mothers not included in the study sample, and modified as necessary for improving reliability. The modified questionnaire included information about parents' education and employment, family income and nutritional help or donation, breastfeeding (immediate, exclusive or non-exclusive and duration) and introducing complementary food, child feeding status (child appetite and meals/day) and child infection (urinary, respiratory and gastrointestinal tracts infection).

2.7. Anthropometric measurements

Weight was measured in kg (to the nearest 100 g) using an electronic digital scale (Seca model 770, Seca Hamburg, Germany) and its accuracy was periodically verified using reference weights. The child was weighted in light clothing, by determining the mean weights of light clothes dressed, and a correction for the clothing was made during weighing by subtracting 100 g from each child's weight. Length was measured in cm (measured to the nearest mm) using a pediatric measuring board. Children were measured in a recumbent position i.e. lying down (World Health Organization, WHO 2008).

2.8. Nutritional status

The software program for assessing growth and development of the world's children was used to make comparisons to the reference standards (WHO Anthro 2007). The software program combines the raw data on the variables (age, sex, length, weight) to compare a nutritional status indicators such as weight-for-height, weight-for-age and height-for-age. The indicators were calculated by standard deviation (SD) or Z-score for all children. In the present study, a wasted child is a child who has a weight-for-height Z-score less than -2.0 standard deviations.

2.9. Statistical analysis

Data were computer analyzed using SPSS/PC (Statistical Package for the Social Science Inc. Chicago, Illinois USA, version 21.0) statistical package. The independent sample t-test procedure was used. Ranges as minimum and maximum values were also used. The % difference equals the absolute value of the change in value, divided by the average of the 2 numbers, all multiplied by 100. % difference = (| (V1 - V2) | / ((V1 + V2)/2)) * 100. Simple distribution of the study variables and the cross tabulation were applied. Chi-square (χ^2) was used to identify the significance of the relations, associations, and interactions among various variables. Yates's continuity correction test, $\chi^2_{\text{(corrected)}}$, was used when not more than 20% of the cells had an expected frequency of less than five and when the expected numbers were small. Odd Ratios (OR) were applied to explore the magnitude of the difference between cases and controls variables of our concern. Logistic regression by backward stepwise method was also applied. The model was accounted for 85% of variation in the dependent variable (85%). The result was accepted as statistically significant when the P-value was less than 5% (P<0.05).

3. Results

The average age of the control children (n=98; 49 males and 49 females) was 10.1±3.2 months old whereas that of cases (n=98; 49 males and 49 females) was 9.8±3.7 months old.

3.1. Anthropometric data of the study population

Table 1 indicates that birth weight was significantly lower in cases compared to controls (2.9±0.8 versus 3.1±0.6 kg, % difference=6.7, P=0.030). Weight and height were also significantly decreased in cases than controls (6.6±1.0 kg and 68.8±4.8 cm versus 9.6±1.8 kg and 76.1±5.4 cm) with % differences=37.0 and 10.1 and P=0.000, respectively.

3.2. Distribution of wasting among children by parents' education and employment

Analysis of the educational status of children parents' showed that 5 (5.1%) and 8 (8.2%) mothers of controls and cases had passed primary school, 19 (19.4%) and 26 (26.5%) mothers had finished preparatory school, 48 (49.0%) and 53 (54.1%) had finished secondary school and 26 (26.5%) and 11 (11.2%) had a university degree (Table 2). The maternal education level showed significant difference between mothers of controls and cases (χ^2=8.110, P=0.044), with wasting was more prevalent among children of less educated mothers. On the other hand, father's education showed no significant difference between various educational levels (χ^2=3.981, P=0.264). Regarding occupation, there was no significant difference between employed and unemployed parents of controls and cases (P>0.05).

Table 1: Anthropometric Data of the Study Population

Parameter	Control (n=98) mean±SD	Case (n=98) mean±SD	% Difference	t	P-value
Birth weight (kg) (min-max)	3.1±0.6 (1.4-4.2)	2.9±0.8 (1.0-4.3)	6.7	-2.186	0.030
Weight (kg) (min-max)	9.6±1.8 (7.0-17.5)	6.6±1.0 (4.6-10.6)	37.0	-14.770	0.000
Height (cm) (min-max)	76.1±5.4 (67-89)	68.8±4.8 (53-83)	10.1	-10.141	0.000

P<0.05: Significant

Table 2: Distribution of Wasting Among Children by Parents' Education and Employment

Item	Father Control (n=98) No. (%)	Case (n=98) No. (%)	χ^2	p-value	Mother Control (n=98) No. (%)	Case (n=98) No. (%)	χ^2	p-value
Education								
Primary school	10 (10.2)	20 (20.4)	3.981	0.264	5 (5.1)	8 (8.2)	8.110	0.044
Preparatory school	32 (32.7)	28 (28.6)			19 (19.4)	26 (26.5)		
Secondary school	38 (38.8)	33 (33.7)			48 (49.0)	53 (54.1)		
University	18 (18.4)	17 (17.3)			26 (26.5)	11 (11.2)		
Employment								
Yes	51 (52.0)	50 (51.0)	0.020	0.888	2 (2.0)	5 (5.1)	0.593	0.441*
No	47 (48.0)	48 (49.0)			96 (98.0)	93 (94.9)		

*P-value of $\chi^2_{\text{(corrected)}}$ test.
P<0.05: Significant, P>0.05: Not significan

Table 3: Distribution of Wasting Among Children by Family Income and Nutritional Help or Donation

Item	Control (n=98) No. (%)	Case (n=98) No. (%)	χ^2	p-value
Family income/month*				
Less than 400	60 (61.2)	85 (86.7)	16.565	0.000
400-700	38 (38.8)	13 (13.3)		
Nutritional help or donation				
Received regularly	56 (57.1)	38 (38.8)	11.111	0.004
Received interrupted	5 (5.1)	18 (18.4)		
Not received	37 (37.8)	42 (42.9)		

* United States Dollars (US$)
P<0.05: Significant

Table 4: Distribution of Wasting Among Children by Breastfeeding and Introducing of Complementary Food

Item	Control (n=98) No. (%)	Case (n=98) No. (%)	χ^2	p-value
Immediate breastfeeding*				
Yes	67 (68.4)	77 (78.6)	2.618	0.106
No	31 (31.6)	21 (21.4)		
Breastfeeding (First 6 months)				
Exclusive**	57 (58.2)	39 (39.8)	6.615	0.010
Non-exclusive***	41 (41.8)	59 (60.2)		
Duration of breastfeeding				
≤12 months	34 (34.7)	50 (51.0)	5.333	0.021
>12 months	64 (65.3)	48 (49.0)		
Introducing complementary food				
≤6 months	49 (50.0)	72 (73.5)	11.425	0.001
>6 months	49 (50.0)	26 (26.5)		

*Immediate breastfeeding: children received breast milk within the first half an hour of birth.
** Exclusive breastfeeding: feeding infants only breast milk, be it directly from breast or expressed, with no addition of any liquid or solids apart from drops or syrups consisting of vitamins, mineral supplements or medicine, and nothing else (Sonko and Worku 2015).
***Non-exclusive breastfeeding: children received drinks/foods with breast milk.
P<0.05: Significant, P>0.05: Not significant

Table 5: Distribution of Wasting Among Children by Child Feeding Status

Item	Control (n=98) No. (%)	Case (n=98) No. (%)	χ^2	p-value
Child appetite				
Good	45 (45.9)	31 (31.6)	6.139	0.046
Poor	47 (48.0)	53 (54.1)		
Fair	6 (6.1)	14 (14.3)		
Meals/day				
1-3	51 (52.0)	49 (50.0)	0.055	0.973*
4-6	43 (43.9)	46 (46.9)		
>6	4 (4.1)	3 (3.1)		

*P-value of $\chi^2_{\text{(corrected)}}$ test.
P<0.05: Significant, P>0.05: Not significant

Table 6: Distribution of Wasting Among Children by Infection

Infection	Control (n=98) No. (%)	Case (n=98) No. (%)	χ^2	p-value
Urinary tract infection				
Yes	4 (4.1)	9 (9.2)	1.318	0.251*
No	94 (95.9)	89 (90.8)		
Respiratory tract infection				
Yes	27 (27.6)	51 (52.0)	12.266	0.000
No	71 (72.4)	47 (48.0)		
Gastrointestinal tract infection				
Yes	19 (19.4)	42 (42.9)	12.591	0.000
No	79 (80.6)	56 (57.1)		

*P-value of $\chi^2_{\text{(corrected)}}$ test.
P<0.05: Significant, P>0.05: Not significant

Table 7: Logistic Regression Model for Independent Variables

Factor	B	S.E.	Wald	P-value	OR*	95% CI for OR	
						Lower	Upper
Less income**	1.421	0.363	15.334	0.000	4.141	2.033	8.433
Not received nutritional help or donation	1.154	0.554	10.105	0.006	3.171	1.072	9.385
Non-exclusive breastfeeding	0.743	0.291	6.539	0.011	2.103	1.190	3.718
Duration of breastfeeding***	0.673	0.293	5.280	0.022	1.961	1.104	3.482
Introducing complementary food****	1.019	0.305	11.136	0.001	2.769	1.522	5.037
Child appetite	1.220	.541	5.922	0.052	1.637	.896	2.991
Respiratory tract infection	1.049	0.303	11.949	0.001	2.853	1.575	5.171
Gastrointestinal infection	1.137	0.327	12.094	0.001	3.118	1.643	5.920

* Adjusted Odd Ratio.
** Income <400 US$/month
*** Duration of breastfeeding ≤12 months
**** Introducing complementary food ≤6 months
P<0.05: Significant, P>0.05: Not significant

3.3. Distribution of wasting among children by family income and nutritional help or donation

Table 3 shows that 60 (61.2%) of controls and 85 (86.7%) of cases had family income less than 400 US$/month whereas 38 (38.8%) of controls and 13 (13.3%) of cases had family income 400-700 US$/month. The difference between the two groups was significant (χ^2=16.565, P=0.000) with wasting was 4.1 times higher among children of less family income [OR=4.1, 95% CI (2.0-8.4)]. Nutritional help or donation was received regularly by 56 (57.1%) controls and 38 (38.8%) cases while 5 (5.1%) controls and 18 (18.4%) cases received interrupted nutritional help or donation. However, 37 (37.8%) controls and 42 (42.9%) cases did not received. The difference between the three groups was significant (χ^2=11.111, P=0.004), implying that wasting was more frequent among children who did not received nutritional help or donation.

3.4. Distribution of wasting among children by breastfeeding and introducing of complementary food

As indicated in Table 4, immediate breast feeding was initiated in 67 (68.4%) of controls compared to 77 (78.6%) of cases (χ^2=2.618, P=0.106). In addition, 57 (58.2%) of controls and 39 (39.8%) of cases were exclusively breastfed during the first six months whereas 41 (41.8%) controls and 59 (60.2%) cases were non-exclusively breastfed. Significant difference was found between the two groups (χ^2=6.615, P=0.010), with wasting was 2.1 times higher among non-exclusively breastfed children than among those who were exclusively breastfed [OR=2.1, 95% CI (1.2-3.7)]. A total of 34 (34.7%) controls and 50 (51.0%) cases were breastfed for one year or less and 64 (65.3%) controls and 48 (49.0%) cases were breastfed for more than one year. Wasting was 2.0 times higher among children with shorter duration of breastfeeding [OR=2.0, 95% CI (1.1-3.5), P=0.021]. Complementary food was introduced to 49 (50.0%) of controls during the first six months compared to 72 (73.5%) cases. Children who received their complementary food after six months were 49 (50.0%) controls and 26 (26.5%) cases. Significant difference was also observed between both groups (χ^2=11.425, P=0.001), with wasting was 2.8 times higher among children who received their complementary food during the first six months [OR=2.8, 95% CI (1.5-5.0)].

3.5. Distribution of wasting among children by child feeding status

The control children who had good, poor and fair appetite were 45 (45.9%), 47 (48.0%) and 6 (6.1), respectively compared to 31 (31.6%), 53 (54.1) and 14 (14.3%) cases (Table 5). Significant difference was found among the three groups (χ^2=6.139, P=0.046), with wasting was the highest among children with poor appetite. However, the number of meals/day showed no significant difference between controls and cases ($\chi^2_{\text{(corrected)}}$=0.055, P=0.973).

3.6. Distribution of wasting among children by infection

Table 6 points out that respiratory and gastrointestinal tract infections were significantly lower among controls 27 (27.6%) and 19 (19.4%), respectively compared to their counterparts of 51 (52.0%) and 42 (42.9%) with χ^2=12.266, P=0.000 and χ^2=12.591, P=0.000, respectively. Wasting was 2.9 times higher in respiratory tract infected children [OR=2.9, 95% CI (1.8-5.2)] and 3.1 times higher in gastrointestinal tract infected children [OR=3.1, 95% CI (1.6-5.9)] than non-infected children. Conversely, no significant difference was observed between controls and cases in terms of urinary tract infection ($\chi^2_{\text{(corrected)}}$ =1.318, P=0.251).

3.7. Logistic regression model for independent variables

As illustrated in Table 7, the adjusted odd ratios with 95% CI for all independent variables revealed that the predicted risk factors of wasting among children in Gaza Strip were less income, not receive nutritional help or donation, non-exclusive breastfeeding and breastfeeding duration of ≤12 months, early start of complementary food (≤6 months) and respiratory and gastrointestinal infections.

4. Discussion

Although wasting remains to be a major health problem for children in Gaza Strip, the etiopathogenesis underlying this condition was not fully identified. To our best knowledge, only one published study mentioned the importance of breastfeeding in improving wasting among children in Gaza strip (Radi et al. 2009). Therefore, this study is carried out to assess various risk factors contributed to wasting among children aged 6 to 24 months old in Gaza Strip. Focusing on such children age in terms of wasting seems to be logic as the first two years of life are crucial for children present and future health and nutritional status and, more specifically, for their mental, physical, and emotional development (Prado & Dewey 2012). In the present study, anthropometric measurements demonstrated that birth weight, weight and height of wasted children was significantly lower than controls. Several authors highlighted low birth weight as a risk factor for early childhood wasting (Peiris & Wijesinghe 2011; Correia et al. 2014). Wasting was more prevalent among children of less educated mothers. Although this gradient effect disappeared when adjusting for other independent variables, it merely reflects the fact that maternal illiteracy could contribute not only to wasting but also to other different health related behaviors and problems (Yassin & Lubbad 2010). This result is consistent with the literature that higher levels of maternal education reduced the odds of child wasting (Sengupta et al. 2010; Makoka & Masibo 2015). At relatively high levels of maternal education, mothers tend to have acquired the necessary health knowledge and are more able to practice recommended feeding practices for their children (Eunice & Sarah 2013). In addition, relatively educated women tend to have relatively fewer children and are able to provide better care and support to their children (Makoka & Masibo 2015), all of which positively impact on children's nutritional outcomes. Socioeconomic status showed that wasting was significantly higher among children of less family income as well as among children who not received nutritional help or donation. Similar results were obtained (Edris 2007; Roy et al. 2015). The gradient effect of family income as well as of not received nutritional help or donation persists when adjusting for other independent variables. Low income levels in Gaza strip beside the current sharp increase in prices limits the kinds and the amounts of food available for consumption. This situation increases the likelihood of wasting among children in this poor area. Therefore, poverty alleviation programme must be launched at regular basis and must focus on the low income families to improve their economic status and thereby the health conditions.

In comparison to exclusive breastfeeding, non-exclusive breastfeeding was more associated with wasting. This means that exclusive breastfed children growth was better than those who were non-exclusive breastfed in terms of weight and length gain i.e. exclusive breastfeeding protects against the development of wasting among the children. This result is in agreement with that previously reported (Onsa & Ahmed 2014; Roy et al. 2015). The gradient effect of non-exclusive breastfeeding persists as a risk factor of wasting when adjusting for other independent variables. It is widely accepted that exclusive breastfeeding during the first six months of life is crucial to promote growth and development (UNICEF/World Food Programme/WHO 2010; Jara-Palacios et al. 2015). It is interesting to find out that wasting was less frequent even among children who were breastfed for more than one year that is, the longer duration of breastfeeding, the lower frequency of wasting. The gradient effect of breastfeeding duration ≤12 months also persists. Despite that, complementary food should be introduced after six months of exclusive breastfeeding to protect against wasting as indicated in our results. Higher prevalence of wasting was noticed in infants in whom complementary feeding was initiated before six months (Sreedhara & Banapurmath 2013; Kakati & Baruah 2015). However, the exact age at which to introduce complementary food, duration of complementary, appropriate frequency of feeding, content and factors affecting intake of complementary food are beyond the scope of the current study and require further investigation. Therefore, mothers should have knowledge and practice that for optimal growth and development of their children, exclusive breastfeeding must be completed for the first six months and complementary foods should be started at 6 months of age while maintaining frequent breastfeeding for more than one year.

As reported by mothers, wasting was the highest among children with poor appetite. In our culture most of mothers either stayed with their children or taking care of them most of the time as the majority of them are unemployed as indicated in our results. So, they can easily recall the feeding status of their children even since long period of time which minimize the recall bias. Previous studies have shown that children's appetites were associated with weight status and this more likely contribute to wasting (Webber et al. 2009; Adeba et al. 2014). However, the number of meals/day was not found to be associated with wasting indicating that child appetite may be a candidate to be related to wasting rather than food frequency intake.

Distribution of wasting was significantly higher in respiratory and gastrointestinal tracts infected children than non-infected children, whereas no significant difference was observed between controls and cases in terms of urinary tract infection. The gradient effect of respiratory and gastrointestinal tracts infection persists when adjusting for other independent variables. A consistent association has been demonstrated in the literature between wasting and respiratory and gastrointestinal tracts infection among children (Gupta 2014; Geberetsadik et al. 2015; Upadhyay et al. 2015). Infections, particularly diarrheal and upper respiratory diseases, occur most frequently during the first 2-3 years of life when immunocompetence is impaired and when, at the same time, children are first being exposed to disease pathogens (Rodríguez et al. 2011). Infection can suppress appetite and directly affect nutrient metabolism, leading to poor nutrient utilization (Bloss et al. 2004; Dewey & Mayers 2011). Indeed, children with poor appetite showed the highest prevalence of wasting as indicated in our results.

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