Determinants of Anemia in Pre-School Children in the Occupied Palestinian Territory

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Summary

This paper presents the main findings of an analysis linking the dependent variable – anemia in pre-school children – to its determinants, to identify priority groups for action. The study was a cross sectional survey of randomly selected pre-school children 6–59 months ($n = 3331$) in the occupied Palestinian territory during the current uprising. Anemia (Hb <11 g/dl) in children was determined by a blood sample. Other indicators were examined; 24 variables related to the family, housing, maternal and child characteristics, in addition to changes in income and food intake that occurred during the uprising. Multivariate analysis revealed that anemia was independently related to reduction in income, iron intake, infrequent gastrointestinal infections, stunting and current breast feeding status. In addition, region was an independent risk factor for anemia – in the West Bank there were fewer anemic children in the age group 6–35 months compared to children from the same age group living in the Gaza Strip.

Introduction

Since the beginning of the current uprising (Intifada) in September 2000, living conditions in the occupied Palestinian territory (oPt) have worsened considerably as there have been widespread closures (A military order where people are not allowed to move in or out of the area), curfews (A military order where people are forced to stay behind closed doors for days, weeks, or months and are only allowed out for a few hours every several days) and various military measures from September 2000 to the present time.

These measures have disrupted the daily life of the Palestinians impeding their access to health care, schools and work.[1] Poverty, as reported by the World Bank has reached high levels with an increasing concern that high rates of anemia might be associated with the current situation.[2] Consequently, the UNICEF office in Jerusalem and the Ministry of Health (MoH) in the oPt commissioned the Palestinian Central Bureau of Statistics (PCBS) to undertake a survey to estimate the prevalence of anemia in children 6–59 months and to identify risk factors to anemia.

Acknowledgement

This survey was conducted as part of a cooperative work between the Palestinian Central Bureau of Statistics, UNICEF office in Jerusalem and the Palestinian Ministry of Health.

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Material and Method

The survey included 5228 households, with 2994 from the West Bank (WB) and 2334 from the Gaza Strip (GS).

The sample is a stratified multi-stage random sample with stratification by governorate; place of residence comprising urban, rural and refugee camps; locality, composed of three strata based on household ownership of durable goods within these localities; and size of locality (number of households). A compact cluster design was adopted because the sample frame was not up-to-date. Overall, 85 per cent of the questionnaires were completed; 80.6 per cent in the WB, and 90.9 per cent in the GS. The total response rate was 95.7 per cent; 93.5 per cent in the WB and 98.3 per cent in the GS.

Anemia in children <5 years of age is defined as HB < 11 g/dl.[3] Stunting was defined as height for age z-score below −2.

Questionnaire

The survey questionnaire included groups of variables that may influence anemia in pre-school children. These were age, sex, birth order of the child, pre-term and low birth weight children, children who had more than two gastric infections in the last 6 months, children who suffer from chronic diseases such as asthma, heart disease, etc, and breast-feeding

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practice including duration, age at introducing other milk, and type of milk introduced. Additional dietary questions considered type of complementary foods in the first year of life, iron intake and tea drinking. Other questions dealt with the availability of piped drinking water, piped sewage and in-house toilet as a predictor of water and food contamination. Variables related to the mother include mothers' age, education and hemoglobin level. The socioeconomic status of the family was assessed using source of main income, durable goods at home, and crowding. In addition to recent changes in quality and quantity of food consumed by the family and coping mechanism used for adjustment, such as borrowing money, using savings to buy food, or becoming dependent on social aid. Demographic variables of region and locality were also included.

Data collection

All fieldworkers, 128 were women. They undertook a 12-day intensive training course. Anthropometric measurements were based on the standardized method of WHO[7] and UNICEF.[8] Height was measured to the nearest 0.1 cm on a scale with a separate wooden bar. Height for age was expressed in z scores and calculated using Epi-info 2000 (Centre for Diseases Control and Prevention, Atlanta). Whole blood is drawn up into the micro-cuvette by capillary action and inserted into HemeCue photometer. Results are then displayed after 45–60 s in g/dl on an LCD display.

Data Processing

The statistical package BLAIS was used in data entry. SPSS for Windows (version 10.0) and specialized health and demographic analysis programs were used to perform final tabulations of results. Multivariate analyses were implemented using SAS PROC LOGISTIC (version 8.03). Several variables were recoded to facilitate analysis, those were: Hemoglobin, coded into two variables, anemic (Hb <11 g/dl) and non-anemic; intake of supplementary food, coded into two categories: one containing supplementary food rich in iron and protein (Cerelac, eggs and meat/chicken/fish) and the other containing the rest of the food items; breast-feeding status was coded into two categories: children who are currently breast-feeding and the others who were never breast fed or weaned off breast milk; locality (used in the multivariate analysis only) was coded using two categories: refugee camps and others; finally, and due to major changes observed in sources of income during the uprising, a new variable was constructed based on our own observations and World Bank reports.[9,10] The new variable has three categories: the first group included families whose main income was adequate to start with and was marginally reduced during the uprising (employees of the Government, United Nations Relief and Works Agency (UNRWA), Non Governmental Organizations (NGOs), and the private sector, those working in family business or in Israel). The second group included families whose main income was small and was greatly reduced (those working in farming/fishing, received remittance from abroad or locally and those on social welfare or others) and the third group included families with no main source of income.

Data Analysis

Univariate analysis consisted of simple frequency distributions of selected variables. Preliminary analyses to explore bivariate relationships between the outcomes, anemia ('yes' vs. 'no'), and independent variables were calculated using measures of correlation appropriate for the scale of measurement of the variables. Because the outcome is dichotomous, bivariate relationships are described using the χ^2 or Fisher's exact 2-tailed tests of association when the independent variables have three or more categories or two categories, respectively.

The relationship of anemia with other subject characteristics was examined using multivariate logistic regression using the appropriate weights for cases based upon the experimental design. Variables found to have an association with a significance level of at most 0.2 were considered and a backwards elimination process was then implemented to obtain the final model. Possible interactions between independent variables were also considered.

Results

Sex distribution was almost equal in the sample with one third of children anemic at less than 11 mg/dl and 9 per cent stunted (Table 1). Most

TABLE 1
Demographic, hematological and anthropometric indices (n = 3331)

Factor	Number of cases (%)
West Bank	2034 (61.1)
Gaza Strip	1297 (38.9)
City	1511 (45.4)
Village	1023 (30.7)
Camp	797 (23.9)
Male	1694 (50.9)
Female	1637 (49.1)
Anemic (hemoglobin less than 11 mg/dl.)	1234 (37.9)
Stunting[a]	299 (9)
Breast feeding	3187 (95.8)
Median duration of breast feeding (months)	14
Median duration of exclusive breast feeding (months)	3

[a] Height for age z score < -2.

of the mothers' (95.8 per cent) breast fed their children with a median duration of breast feeding at 14 months, yet exclusive breast feeding is short at 3 months, compared to the WHO recommendation of 6 months.[11]

Bivariate analysis examined the association of anemia with each of the 24 socio demographic, maternal and child related variables. Of those, 12 were significantly associated with anemia at 95 per cent confidence level (Table 2). These

TABLE 2
Bivariate associations between anemia and other characteristics (n = 3331)

Factors	Anemia		Significance level[b]
	Yes Number[a] cases (%)	No Number cases (%)	
Age Group:			
6 to 11 months	206 (56.7)	157 (43.3)	<0.0001
12 to 23 months	397 (53.4)	346 (46.6)	
24 to 35 months	275 (37.7)	454 (62.3)	
36 to 47 months	215 (30.4)	492 (69.6)	
48 to 59 months	142 (19.8)	574 (80.2)	
Locality:			
City	545 (36.8)	935 (63.2)	0.03
Village	362 (36.3)	635 (63.7)	
Camp	327 (41.9)	453 (58.1)	
Region:			
West Bank	698 (35.5)	1269 (64.5)	<0.0001
Gaza Strip	537 (41.6)	754 (58.4)	
High protein and iron diet in the first year:			
Cerelac, eggs and meat	483 (35.7)	871 (64.3)	0.03
All others	751 (39.5)	1152 (60.5)	
Income:			
No income	193 (38.8)	305 (61.2)	0.03
Income affected by the situation	240 (42.6)	324 (57.4)	
Income not affected	800 (36.5)	1394 (63.5)	
Iron intake:			
On iron	492 (41.9)	682 (58.1)	<0.0001
Not on iron	731 (35.5)	1329 (64.5)	
Tea drinking:			
Yes	767 (33.6)	1518 (66.4)	<0.0001
No	464 (47.9)	504 (52.1)	
Duration of breast feeding			
Never breast fed and up to 4 months	172 (34.8)	322 (65.2)	<0.0001
5–12 months	371 (37.1)	630 (62.9)	
13–60 months	387 (30.8)	871 (69.2)	
Still breast feeding	305 (60.4)	200 (39.6)	
Stunting			
Yes	146 (49.2)	151 (50.8)	
No	1088 (36.8)	1872 (63.2)	<0.0001
Type of milk intake			
Breast fed only	589 (40.7)	858 (59.3)	0.01
Infant formula	514 (35.7)	925 (64.3)	
Other milk	130 (35.1)	240 (64.9)	
Gastro intestinal infections			
Children with 2 or more GI infections in 6 months	118 (32.1)	250 (67.9)	0.01
Other children	1116 (38.6)	1773 (61.4)	
Birth order			
3 or more	888 (39.0)	1389 (61.0)	0.04
2 or less	343 (35.2)	632 (64.8)	

[a] The frequencies may not sum up to the total 3331 due to missing values.
[b] Significance level for a two-tail test of the null hypothesis of independence of the factor with anemia using a χ-squared test or a Fisher's test when the independent variables have three or more categories or two categories, respectively.

TABLE 3
The multivariate association of anemia (yes, no) with children's characteristics after adjusting for all other factors

Factor	OR[a]	95 per cent CI[b]
Gastro-Intestinal Infection:		
Fewer than two infections in the last 6 months	1.32	[1.03, 1.69]
Two or more infections in the last 6 months (reference)	1.00	
Iron intake:		
On iron intake	1.24	[1.06, 1.46]
Not on iron intake (reference)	1.00	
Income:		
No income	1.06	[0.85, 1.32]
Income affected by situation	1.37	[1.11, 1.69]
Income not affected by situation (reference)	1.00	
Breast feeding:		
Stopped breast feeding	0.61	[0.48, 0.78]
Still breast feeding	1.00	
Stunting:		
Yes	1.59	[1.22, 2.04]
No (reference)	1.00	
Age: 6 to 23 months	0.54	[0.41, 0.69]
Region:	1.00	
West Bank		
Gaza (reference)		
Age: 24 to 35 months		
Region	0.71	[0.52, 0.98]
West Bank	1.00	
Gaza (reference)		
Age: 36 to 47 months		
Region:	1.22	[0.87, 1.73]
West Bank	1.00	
Gaza (reference)		
Age: 48 to 59 months		
Region:	1.23	[0.83, 1.84]
West Bank	1.00	
Gaza (reference)		

[a] OR signifies the odds ratio for being anemic vs. not being anemic; for example an odds ratio greater than 1 signifies that there is a greater likelihood of anemia.
[b] CI denotes confidence interval.

were: children less than 24 months compared to other ages; children living in refugee camps compared to other localities (urban and rural), living in the Gaza Strip vs. the West Bank; children not consuming a diet high in protein and iron in the first year of life; those whose income was affected by the Israeli military measures during the uprising; children consuming iron medication compared to those who were not; children not drinking tea; children who are still breast feeding; of a birth order higher than three compared to those at two or less and children who have fewer than two gastric infections.

A regression of anemia (yes vs. no) upon subject characteristics (Table 3) demonstrates that the risk of anemia is higher in children who had fewer than two gastric infections in the last 6 months, those taking iron, are currently breast feeding, stunted and those whose family's income was affected by the Israeli military measures during the current uprising. The relationship of anemia with region differed; 6–35 month children from the WB had fewer anemia compared to children of the same age group from the GS.

Discussion

The current survey is the first national study on the prevalence of anemia and its determinants in pre-school children in the oPt. The prevalence of anemia, 37.9 per cent, is consistent with other local surveys undertaken by UNRWA clinics working in refugee camps,[12,13] by the Ministry of Health[14] and other independent researchers,[15] mainly due to iron deficiency as shown by local research[4,5] and other research of similar populations.[16] And is slightly lowers than figures quoted from other developing countries[16–19] with anemia almost twice as high in children aged 6–23 months as in children aged 24–59 months, (54.5 per cent vs. 29.3 per cent, $p < 0.0001$),[20,21] reflecting the vulnerability of the younger ages to iron depletion.

Local studies found anemia in children is associated with lack of breast feeding, male sex, maternal illiteracy, stunting and a recent or current episode of diarrhea.[22] Other local studies did confirm these findings,[23] except for gender differences, which were not observed.[24,25]Variables found not to be associated with anemia were income, locality or refugee status,[26] and socioeconomic status of high, medium and low levels.[27] Some of these findings are consistent with our study, such as correlation of anemia with stunting (odds ratio = 1.59, 95 per cent CI = [1.22, 2.04]) and lack of correlation of anemia with socioeconomic status and sex. Other findings are very different as for example maternal illiteracy in our study was found not to be associated with anemia while locality was. In addition, variables commonly associated with anemia such as tea drinking, lack of breast feeding and two or more gastric infections were found to be associated with lower levels of anemia, contrary to expectations. This is possible, as Palestinians by tradition are non-vegetarians, therefore unlikely to be affected by tea, which inhibits the absorption of non-haem iron from the diet. At the same time, age seems to be a confounder in this relation as older children, who are less anemic, tend to drink more tea than younger ones. As for gastric infections, it is related to poor hygiene in developing countries, causing parasitic infestations and anemia. This is less observed in the oPt now as indicated by the 2000 District Health

Survey – 83 per cent use clean piped water[28] and diarrhea has affected 6.7 per cent of children under 5 years in the preceding two weeks.[29] This may indicate that frequent gastric infection in children in the oPt, is associated with an increase in visits to the health center,[30] which is associated with low prevalence of anemia.[31]

A similar discussion can be made for lack of breast feeding, as it has been associated in the literature with increase in gastric infections due to poor hygiene resulting in malnutrition and anemia. But in this study it has been associated with lower levels of anemia compared to those children weaned off or never breast fed, independent of all other variables. This finding has been observed in research from developed countries – suggesting that breast feeding with late introduction of complementary feeding or lack of supplementary iron will result in significant iron deficiency and iron deficiency anemia,[32–36] compared to children who are on formula milk. This is supported by the finding that children in the oPt under the age of 12 months, 50.9 per cent were given other milk in addition to breast milk, of which 93 per cent was infant formula.

As significantly more anemia was found in children taking iron regardless of duration of iron intake, this confirms our observation of the ineffective policies of UNRWA[37] and the MoH in managing anemia in pre-school children over many years. It is speculated that lack of response to iron can possibly relate to availability of the drug, palatability, affordability, side effects, mother's perception,[38]and possibly association of anemia with chronic malnutrition and multiple micronutrient deficiencies,[39] all of which deserve further enquiry.

The finding of more anemia in children under the age of 3 years living in the GS than those living in the WB, although expected, is difficult to interpret as it doesn't seem to link to social, economic or demographic variables. From the literature, regional variation has been reported to stem from a variety of sources, nutritional, parasitic infestation, hereditary factors or environmental pollutants. Environmental pollution in the form of lead poisoning is known to cause anemia and this is one possibility, which needs further investigation. The source of lead exposure might be from vehicles,[40] soil contamination[41,42] brought home on clothes or other home activities such as soldering.[43] Locally there are two studies that looked at lead levels.[44,45] Both of which confirmed high blood lead in children in the oPt, suggesting the possibility of differential rates of blood lead contributing to the differing risk of anemia in the GS compared to the WB.

Children exhibiting stunting, implying chronic malnutrition were significantly more anemic than children of normal height. This finding, reported in many studies,[46] is alarming, as stunting has been increasing in the oPt from 1996–2002,[47] indicating that chronic malnutrition is escalating and will continue to do so if no immediate intervention strategies are implemented.

Family income addressed a newly evolving economic issue during the current uprising due to frequent military siege and curfew, preventing people from reaching their work place, harvesting and selling their crops or fishing. After controlling for other factors, the result shows children of families whose income was reduced moderately or severely during the uprising have the highest level of anemia. This was not observed in families with no income or who had a reduction in quality and quantity of food, possibly because of food reduction and access to food aid were not specifically measured within each variable to account for those families who received food aid or did not have sever reduction in quality and quantity of food.

Conclusions

This study confirmed the high prevalence of anemia in pre-school children 6–59 months, especially in those less than two years. Anemia is independently related to pre-school children 6–59 months whose families experienced a major reduction in income during the current uprising, who are stunted, with fewer visits to the health clinic, on iron medication, currently breast feeding, and in children 6–35 months living in the GS.

Several strategies are suggested to address the incidence of anemia in children under the age of five. First, further research is needed; to consider causes of anemia in the GS such as micronutrient deficiencies, hereditary disorders and environmental pollution, and; to investigate the causes for lack of effectiveness of iron supplementation in the oPt in general. Second, there is a need to promote good feeding practices among mothers; such as the introduction of quality complementary feeding at six months of age, or early iron supplementation.[48] Third, health care professionals should look for anemia in certain groups such as stunted children, children whose family has had a reduction in their income, and those who visit the health centre infrequently.

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