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Complete List of Authors:	AbuKishk, Nada; UNRWA Jordan, health department Turki, Yassir ; UNRWA Jordan, Health Department Hababeh, Majed; UNRWA Jordan, Health Department Saleh, Suha; UNRWA Jordan, Health Department Albaik, Shatha; UNRWA Jordan, Health Department Zeidan, Wafa; UNRWA Jordan, Health Department el-Khatib, Zohair; UNRWA Kassim, Nimer; UNRWA Jordan, Health Department Abu-Diab, Khawalah; UNRWA West Bank Seita, Akihiro; UNRWA Jordan, Health Department
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Anemia prevalence in children newly registered at UNRWA schools: a cross-sectional study

Nada Abu Kishk[1], Yassir Turki[1], Majed Hababeh[1], Suha Saleh[1], Shatha Albaik[1] , Zohair el-Khatib[2], Nimer Kassim[3], Hasan Arab[4], Khawalah abu Daib[5], Wafaa Zeidan[1] and Akihiro Seita[1]

[1] Health Department, United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), Headquarter, Amman –Jordan; [2] Health Programme, UNRWA, Gaza; [3] Health Programme, UNRWA, Lebanon; [4] Health Programme, UNRWA, Syria; [5] Health Programme, UNRWA, West bank

NK (N Abu Kishk, MSc), YT (Y Turki, MSc, PhD), MH (M Hababeh, MD, MPH), SS (S Saleh, MD, MSc), SB (S Albeik, Pharm.D, MSc), ZK (Z Khiteb, MD, MPH), NK (N Kassim, MD, MPH), HA (H Arab, MD, MPH), KD (K abu Daib, RN), WZ (W Zeidan, BSc) and AS (A Seita, MD, MPH).

Authors Contributions

NK designed the study, collected and interpreted data, carried out data management, and wrote the text. YT wrote the abstract and revised the text. MH interpreted data and revised the text. SS analyzed data, and produced tables and figures. ZK, NK, HA and KD collected and interpreted data, and carried out data management. WZ designed the study methodology. AS interpreted data and revised the Abstract. All authors have seen and approved the final version of the text for publication.

Correspondences to: *Nada Abu Kishk, P.O.box:140157 Amman 11814 Jordan*
Nada_abukishk@hms.harvard.edu

Abstract:

Objective:
Children entering first grade at UNRWA schools in West Bank (WB), Gaza, Lebanon, Jordan and Syria complete a comprehensive medical examination at UNRWA health centers (HCs) as a requirement for their acceptance. Our study aimed to assess anemia prevalence and under-nutrition indicators, including underweight, stunting and thinness, among these children which are not currently checked during the medical examination.

Settings: in 2017, we conducted a cross-sectional study in 59 UNRWA HCs, targeting children entering grade one at UNRWA schools in four fields of operation (Gaza, WB, Syria and Lebanon).

Participants: out of the 2,399 calculated sample size, a total of 2,419 have completed the study. The children included boys and girls living inside or outside Palestine refugee camps. Oral consents were taken from their parents

Primary and secondary outcome measures: Sociodemographic and anthropometric data for each child, were collected. Stunting, thinness and being underweight were examined according to WHO growth indicators.

Results
2,419 students (1,278 females and 1141 males) aged 6.1±0.4 years were examined. The prevalence of anemia (hemoglobin (Hb) <11.5 g/dl) was 25.0% (Gaza: 29.3%, WB: 22.0%, Syria: 30.0% and Lebanon: 18.3%). The mean Hb level was 12.0±0.9 g/dl. The overall prevalence of stunting, wasting and underweight were 3.2%, 3.5% and 5.6%, respectively, with the highest levels found in Syria (4.3%, 6.3% and 10.1% respectively). Significant differences were found among fields regarding the undernutrition indicators (P-value:0.001). Also, anemic children had significantly higher prevalence of underweight (5.2%) in comparison to those who were not anemic (P-value:0.01).

Conclusions:
The prevalence of anemia in surveyed children increased to (25.0%), compared to the previous study conducted by UNRWA in 2005. Based on the findings, it was recommended to include hemoglobin

testing and measurement of nutrition indicators in the new school children medical examination to enable informed decisions and interventions wherever is needed.

Keywords:
Anemia, Palestine refugees, school children, health policy

Article Summary

Strengths and limitations of the study:

1. All participants are new school entrees, registered and managed by a humanitarian agency (UNRWA).
2. The study included a large sample size of 2419, in four different countries where UNRWA operates.
3. Due to ethical issues in UNRWA's HCs, the collected sample is larger than the calculated sample size.
4. Children in Palestine refugee camps in Jordan, was not included due to field specific issues. Therefore, Jordan field is not presented in this study.
5. Having different school health team members for data collection, might subject the study to random error.

Introduction:

Palestine refugees (PRs) represent the largest refugee population in the world; currently, over 5·9 million Palestine refugees are registered at the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), in the five fields of its operations including Gaza, West Bank, Syria, Lebanon, and Jordan. Of all registered PRs, over 30% live in refugee camps. UNRWA provides services that include education, primary health care, relief, and social services, infrastructure and camp improvement, and emergency response in situations of armed conflict. UNRWA is the main primary healthcare provider for PRs via a network of 144 primary health care facilities in the five fields of its operations [1,2]. In these fields, UNRWA also operates 702 elementary and preparatory schools, enrolling more than 500,000 students, as well as eight secondary schools in Lebanon [3]. This study investigated the prevalence of anemia among school-aged children, attending UNRWA's schools in four of its field operations.

Globally, the nutritional status of school-aged children (around six years) impacts their health, cognition, and subsequently, their educational achievement [4,5]. Improving the cognitive and physical development of the school-aged children could have life-long benefits[6]. The World Health Organization (WHO) recognized the nutritional status of school-aged children as one of the essential indicators of the nutrition and health of the population [7].

Anemia is one important eliminate of children's health that needs to be examined. It is defined as a low blood hemoglobin concentration. A condition where the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs, which vary by age, sex, altitude, smoking, and pregnancy status [8, 9,10]. It adversely affects the cognitive and motor development of children and causes fatigue and low productivity of affected individuals [11, 12]. Anemia has been shown to be a public health problem that affects low-, middle- and high-income countries [10,11]. It has adverse health consequences and negative impacts on the social and economic development of affected societies [10,12].

In low-income countries, the prevalence of anemia remains high and is an area of priority. Globally, it was found that children have the highest prevalence of anemia (42.6%) [8,9,10]. Eastern Mediterranean Region had the second-highest anemia burden for children. Around 35.7 million children were estimated to be anemic, of whom 48.6% were children aged from 6-59 months [8]. Concerning school-aged children, according to the WHO global database on anemia (1993-2005), it is estimated that 25.0% of school-aged children worldwide are anemic[13]. One of the effective strategies to face this major public health issue is to screen for anemia in the school setting and prompt its therapy [14]. Although anemia is a public health problem worldwide, data on anemia among school children is scarce, and school-aged children are not commonly included in health and nutrition surveys.

Different studies demonstrated the prevalence of anemia among children living in poor and limited resources countries15. For example, in Eastern Nepal, 42.4% of school children (aged 4–13 years) were anemic[15]. In Eastern Ethiopia, 27.1% of school children (aged 5–14 years) were anemic [16]. Whereas in South Ethiopia, a three-year longitudinal study that integrated school health and nutrition approaches, resulted in 23% of anemia among students aged 5-18 years [17]. In Brazil, the prevalence of anemia among school children was found to be higher amongst public school children (10.8 %) than private school children (7.0 %) [18].

In Gaza, in 2012, the prevalence of anemia among pre-school children was 59.7%, with 46.5% of them had mild anemia, and 13.5% of them had moderate anemia [19]. In 2005, UNRWA conducted an agency-wide cross-sectional study to assess the prevalence of anemia among 1st-grade students, attending UNRWA schools in the five fields of its operations. It was found that the prevalence of anemia among these students was 14.4% in Jordan, 22.3% in Lebanon, 9.1% in Syria, 36.4% in Gaza and 14.6% in West Bank, while the Agency-wide prevalence was 19.5%. The prevalence of anemia for all fields except Jordan was 20.9% [20].

Many governments, multilateral and bilateral organizations, recognize that children with good health and nutrition during their primary school years can contribute to their educational achievement, growth, and development. Despite the continuous advocacy for good nutrition and health services in the primary schools, yet, there is lack of data collection that reflects the actual nutritional status of primary school children, in the poor-limited resources countries. Furthermore, school-aged children are often not often included in health and nutrition surveys research, as most of the surveys focus on malnutrition among young children less than five years of age. For the Eastern Mediterranean Region, only medium- and low-quality studies of anemia in school-aged children could be found [4].

UNRWA implements several programs at its schools within a system-wide approach According to its School Health Strategy (SHS) 2013 [21]. These programs include early detection and management of disabilities, psychosocial wellbeing of school children and guidelines for a complete and comprehensive medical examination at UNRWA health centers of children entering first grade at UNRWA schools. This is called the new entrants' medical examination. This medical examination is a requirement for the acceptance at UNRWA schools, and it involves measuring weight and height and checking all body systems including vision, squint, hearing, congenital malformations, heart diseases, respiratory diseases, and physical disability. Nevertheless, the hemoglobin level is not assessed during this medical examination. In addition, there is no recent data available on the anemia prevalence among pre-school children attending the new entrants' medical examination at UNRWA health centers [22].

Therefore, this study was conducted with the aim to assess anemia prevalence among children attending UNRWA health centers for the medical examination required for their acceptance at UNRWA schools for the scholastic year 2017/2018. This was recognized as an essential step to have new base-line data about anemia prevalence among the target population and to enable UNRWA health program management to make appropriate interventions and improvements on policies and guidelines governed by the SHS 2012.

Methodology

Study design and settings:

In summer 2017, a cross-sectional study was conducted at 59 UNRWA's health centers in four fields of the Agency`s operations (Gaza, West Bank, Syria and Lebanon). All male and female school children, who live inside or outside Palestine refugee camps, and expected to be enrolled in the 1st grade at UNRWA schools for the scholastic year 2017/2018 were targeted in the study. Exclusion criteria: any child who was sick or had a chronic illness, was excluded from the study.

Sampling and sample size:

The sampling technique was a multistage sampling process that was carried out in several stages as described below:

First stage, using Epi-Info V2000, a weighted sample of 2,399 was calculated (Gaza: 961, West Bank: 982, Syria: 334 & Lebanon: 622) based on the prevalence of anemia among 1st grade UNRWA schools' children (22.3% in Lebanon, 9.1% in Syria, 36.4% in Gaza and 14.6% in West Bank) [20], and the total number of children enrolled as 1st graders in UNRWA schools for the scholastic year 2016/2017 which was 47,515 children (24,281 Girls and 23,234 Boys), considering confidence level at 95% and precision at 3%.

Second stage: knowing that each field of UNRWA operations is divided into several areas, the number of which varies from field to another, the second stage was to calculate the number of students in the sample to represent each area. This was done by:

$$\frac{\text{total number of 1st grade students in area}}{\text{total number of 1st grade students in the field}} * \text{the weighted sample size of that field}$$

Third stage, the number of students to be included in the study from each one of the selected schools was calculated by:

$$\frac{\text{total number of 1st grade students in that school during the scholastic year } (\frac{2017}{2018})}{\text{total number of students at the area where it is present}}$$

The rational for schools' selection from each area was to ensure geographical representation of the sample, as selected schools were distributed among the different administrative areas in the fields. It also took into consideration the presence of UNRWA's health centers nearby the selected school, including schools from outside and inside camps. The distribution of the sample size by field, area and school is shown in Table 1.

Table 1: Distribution of sample size by field, area and school

Field	*Total No. of 1st grade students (2016/2017)	**Field Sample	No. of selected schools in each Field				Total No. of students selected from schools in each area				
			Boys	Girls	Coeducation schools	Total	Boys	Girls	Coeducation schools		Total
									Boys	Girls	
Syria	5,887	334	3	1	21	25	34	9	120	171	334

Lebanon	3,869	622	6	7	25	38	95	106	214	207	622
West Bank	4,979	482	14	14	5	33	159	249	30	44	482
Gaza	32,780	961	14	13	40	67	204	175	295	287	961
total	**47,515**	**2,399**	**37**	**35**	**91**	**163**	**492**	**539**	**659**	**709**	**2399**

* Study population is the school children in 1st grade school year 2016/2017

** Prevalence rate using the previous reported in 2005, 9.1%, 22.3%, 14.6%, and 36.4% in Syria, Lebanon, West Bank and Gaza

Data collection procedure

In each field, the field Family Health Officer was requested to send a list of 1st-grade students' names and their registration numbers in each of the selected schools. Also, they provided lists of the names of health centers that are closest to the selected schools. A data collection sheet, specially designed for this study, was used to collect sociodemographic and anthropometric data for each participating child. In each of the concerned health centers, the Practical Nurses completed the data collection sheet for each student from the selected schools upon his/her attendance to the health center for the new entrants' medical examination. The laboratory technicians at the concerned health centers performed the Complete Blood Count (CBC) test for each of the selected students. The completed data collection sheets were validated and double-checked at the field level, then forwarded on a weekly basis to the Health Department at UNRWA headquarter in Amman, Jordan for validation and data analysis processes.

Patient and Public Involvement

Patients were not involved in none of the study development processes, such as study design, recruitment process, outcome measures or the dissemination of the study results.

Case definition

Hemoglobin readings cut-off points were categorized according to 2011 WHO's anemia guidelines for 5-11 years old [23], as described in Table 2.

Table 2: WHO criteria to diagnose anemia at sea level (g/l) based on hemoglobin cut-off points

Population	Normal	Anemic		
	Non-anemic	Mild	Moderate	Severe
Children (5-11 years old)	115 or higher	110-114	80-109	Lower than 80

In addition, according to the WHO Nutrition Landscape Information System for the country profile, several indicators were used to measure nutritional imbalance resulting in undernutrition (assessed via underweight, stunting and thinness) and overweight. These indicators were defined as follows [9]:

- Weight-for-age z-score (WAZ) < –2 standard deviations (SD) of the WHO Child Growth Standards median is considered underweight.
- Height-for-age z-score (HAZ) < –2 SD of the WHO Child Growth Standards median is considered stunting.
- Body Mass Index (BMI)-for-age z-score (BAZ) < –2 SD of the WHO Child Growth Standards median is considered thinness.
- BAZ > +2 SD of the WHO Child Growth Standards median is considered overweight.

Data Analysis:

Data entry was done on Excel sheets, and the analysis was carried out using Statistical Package for the Social Sciences (SPSS) software V22. Descriptive statistics were used to describe the sample characteristics, in which frequency and percentage were used for categorical variable, while mean and standard deviation were used for numerical variables. Pearson Chi-Square test was used to assess the differences between anemia status and the collected sociodemographic variables along with the undernutrition indicators (underweight, stunting and thinness), Chi-Square test was also conducted to compare the differences between the under-nutrition indicators and the socio-demographic variables along with anemia status at the level of all the four fields, then at the level of each field. The significance was set at *P-value* ≤0.05. Missing data was not included in the analysis. In order to measure the under-nutrition indicators, the Child Growth z-scores of WAZ, HAZ and BAZ, were calculated using WHO Anthroplus-software used to monitor the growth of school-age children and adolescents (age group 5-19 years) [24]. Flagged data, which are considered extreme or potentially incorrect z-score value (SD ≥+5 or SD≤-5) was included in the descriptive analysis and excluded from the cross-tabulation.

Ethical considerations

The study protocol was approved by the UNRWA Health Department Ethical Review Committee; moreover, verbal consents were taken from the parents of students included in the study. Participation in the study was voluntary, and the identity of participating students was treated with extreme confidentiality by the researchers. Any case of detected with moderate or severe anemia was referred for receiving curative anemia treatment at UNRWA health centers, as a requirement set in UNRWA's relevant policies which emphasizes that such individuals should be treated properly before they develop the complications of moderate and severe anemia as an ethical responsibility towards its Palestine refugee beneficiaries of all age group.

Results

Sociodemographic

A total of 2,419 new entrants had participated in this study, 20 students more than the weighted sample size could be reached, they were distributed through the four fields as follows; 959 (39.6%) from Gaza, 472(19.5%) from West Bank, 347 (14.3%) from Syria and 641(26.5%) from Lebanon. Out of the total number of participants, 1278 (52.8%) were females and 1141 (47.2%) were males. The mean age of participants was 6.1±0.4 years. 57.8% of the mothers and 55.1% of the fathers of participating children had a secondary and high school level of education. In addition, 52.3% of the participants lived inside camps and 47.7% lived outside camps.

Anthropometric measurements

As described in Table 3.1, the mean weight of all participants was 20.4kg. Syria had the lowest mean weight (19.5kg) and Lebanon had the highest mean weight (22.0kg). Moreover, the mean height of all participants was 115.6cm, and West Bank had the lowest mean height (114.5cm), while Lebanon had the highest mean height (117.5cm). It was found that Syria and Gaza had the lowest mean WAZ (-0.4 for each). In addition, Gaza and West Bank had the lowest mean HAZ (-0.2 for each), and Syria had the lowest mean BAZ in comparison to the other fields (-0.7).

Table 3.1 Anthropometric measurements of the study participants in the four Fields of operation

Variable	Gaza	West Bank	Syria	Lebanon	Total Fields
Mean weight in kg (SD)	19.7 (2.8)	20.3 (3.4)	19.5 (3.3)	22 (4.5)	20.4 (3.6)
Mean height in cm (SD)	114.8 (5.3)	114.5 (5.6)	115.4 (5.9)	117.5 (5.3)	115.6 (5.6)
Mean WAZ (SD)	-0.4 (1.0)	-0.1 (1.1)	-0.4 (1.1)	0.1 (1.3)	-0.2 (1.1)
Mean HAZ (SD)	-0.2 (1.0)	-0.2 (1.1)	-0.04 (1.1)	-0.02 (1.0)	-0.1 (1.0)
Mean BAZ (SD)	-0.4(1.1)	-0.05 (1.4)	-0.7 (1.4)	0.1 (1.5)	-0.2 (1.3)

*Abbreviations: SD standard deviation, WAZ weight-to-age z-score, HAZ height-to-age z-score and BAZ body mass index-to-age z-score.

The percentages of children with normal z-score at the level of the four fields were: 67.1% for WAZ, 67.5% for HAZ and 60.4% for BAZ. Table 3.2 illustrates the distribution of underweight, stunting, and thinness among the children in the four fields. It shows that 3.5% were underweight, 3.2% were stunted and 5.6% suffered from thinness.

The highest percentages of underweight, stunting, and thinness were found among children from Syria (6.3%, 4.3%, and 10.1% respectively); while the lowest percentages were among those form Lebanon (2.5%, 1.7%, and 4.2% respectively). In Gaza, 3.1% of the children were underweight,

4.3% was stunted and 5.2% suffered from thinness. The percentages of children in West Bank, who had underweight, stunting, and thinness, were 3.4%, 2.3%, and 5.1% respectively.

Flagged results for WAZ, HAZ, and BAZ were found among the four fields as follows: for Gaza (1.4%, 0.4%, and 2.0% respectively), for West Bank (0.8%, 1.1%, and 4.2% respectively), for Syria (1.7%, 0.9%, 6.1% respectively), and for Lebanon (3.0%, 0.3%, and 3.7% respectively). The total flagged data in the four field were (1.7%, 0.6% and 3.5% respectively).

Table 3.2: Distribution of underweight, stunting and thinness among the participants in the four Fields of operations

Field	Underweight n (%)	Stunting n (%)	Thinness n (%)
Gaza	30 (3.1%)	41 (4.3%)	50 (5.2%)
West Bank	16 (3.4%)	11 (2.3%)	24 (5.1%)
Syria	22 (6.3%)	15 (4.3%)	35 (10.1%)
Lebanon	16 (2.5%)	11 (1.7%)	27 (4.2%)
Total fields	84 (3.5%)	78 (3.2%)	136 (5.6%)

*Abbreviations: n frequency, (%) percentage

Anemia prevalence

The overall mean of hemoglobin level for all participants was 12.1± 0.9 g/dl. The overall prevalence of anemia was 25.0% (605 out 2416). The distribution of anemia prevalence across the four field was as follows: in Gaza 29.3%, in West Bank 22.0%, in Syria 30.0%, and in Lebanon 18.3%. Table 4 describes the prevalence of different classes of anemia among the participants in the four fields.

Table 4: Distribution of hemoglobin level among the participants according to WHO cut-off points

Hb level	Gaza (N=959)	West Bank (N=469)**	Syria (N=347)	Lebanon (N=641)	Total Fields (N=2416)
Normal n (%)	678 (70.7%)	366(78.0%)	243(70.0%)	524(81.7%)	1811(75.0%)
Mild n (%)	171 (17.8%)	63(13.4%)	53(15.3%)	76(11.9%)	363(15.0%)
Moderate n (%)	110 (11.5%)	40(8.5%)	51(14.7%)	40(6.2%)	241(10.0%)
Severe n (%)	-	-	-	1(0.2%)	1(0.0004%)

*Abbreviations: N total, n frequency, % percentage

** Three participants with missing data were found in West Bank

Table 5 shows the presence of significant differences in the anemia status among the participants in the four fields (P=0.000). The highest prevalence of anemia among participants was found in Syria (30.0%) followed by Gaza (29.3%) compared to the other fields.

Chi-Square test was used to compare sociodemographic variables and anemia status at the level of each field. In West Bank, the prevalence of anemia among males was higher than females (28.6% vs. 17.8%) (P=0.006). In Syria, the prevalence of anemia was significantly higher among participants living inside camps compared to those living outside camps (36.3% vs. 19.7%) (P=0.001).

Significant differences were found among fields regarding the undernutrition indicators. Syria had the highest prevalence for each of them compared to the other fields (underweight: 6.5%, stunting: 4.4%, and thinness: 10.8%) as shown in table 5.

Table 5: Distribution of the prevalence of anemia and undernutrition status by Field

Variable		Field				
		Gaza n (%)	WB n (%)	Syria n (%)	Lebanon n (%)	*P*-value [a]
Anemia status N=2416	Anemic	281(29.3%)	103(22.0 %)	104(30.0 %)	117(18.3%)	<0.001
	None-anemic	678(70.7%)	366(78.0 %)	243(70.0 %)	524(81.7%)	
Underweight N=2377	Yes	30(3.2%)	16(3.4%)	22(6.5%)	16(2.6%)	0.014
	No	916(96.8%)	452(96.6%)	319(93.5%)	606(97.4%)	
Stunting N=2400	Yes	41(4.3%)	11(2.4%)	15(4.4%)	11(1.7%)	0.014
	No	911(95.7%)	455(97.6%)	328(95.6%)	628(98.3%)	
Thinness N=2330	Yes	50(5.3%)	24(5.3%)	35(10.8%)	27(4.4%)	<0.001
	No	887(94.7%)	427(94.7%)	290(89.2%)	590(95.6%)	

[a] Chi-Square test was applied

Abbreviations: N total, n frequency, (%) percentage

It was observed that participants with anemia from all fields had significantly higher prevalence of underweight (5.2%) in comparison to those who were not anemic (3%) (P=0.010). Moreover, those who lived outside camps had significantly higher prevalence of stunting (4.2%) compared to those who lived inside camps (2.4%) (P=0.013). In West Bank only, it was found that participants living outside camps had a higher prevalence of thinness (12.6%) compared to those living inside camps (2.7%) (P<0.001).

Discussion:

This cross-sectional study aimed to assess the anemia prevalence among children undergoing UNRWA's medical exam as a prerequisite for being accepted at 1st-grade in its schools in four of the five fields of UNRWA's operations, namely Gaza, West Bank, Syria, and Lebanon. The study reviled that the prevalence of anemia among the target population was 25.0%; distributed as mildly anemic (15.0%) and moderately (10.0%) anemic children. The highest prevalence of anemia was in Syria (30.0%), and the lowest prevalence was in Lebanon (18.3%), while the prevalence of anemia was 29.3% in Gaza and 22.3% in West Bank. Comparing these results to UNRWA's 2005 anemia survey [20]; we noticed there was an increase in the anemia prevalence among 1st-grade school children in Syria from 9.1% to 30.0% and from 14.6% to 22.0% in West Bank, with a decrease in the prevalence of anemia in Gaza from 36.4% to 29.3% and Lebanon from 22.3% to 18.3%. WHO-adopted criteria for the classification of public health significance of anemia in a given population, includes the following categories: "normal" if the prevalence is <4.9%, "mild" if the prevalence is 5.0-19.9%, "moderate" if the prevalence is 20.0-39.9%, and "severe" if the prevalence is >40.0%. Based on this classification, and since the overall prevalence of anemia in the four fields is 25.0%, the public health significance of anemia in the current study is considered as "moderate" [23].

It was recognized that there is scarcity in the available literature on the prevalence of anemia in the Eastern Mediterranean Region, and more specifically in the countries where UNRWA operates. In addition, concerning the available literature on this issue, a clear variation was found in published research studies concerning the target population considered in those studies and the cut-off points used for hemoglobin levels to define anemia.

In 2011, a cross-sectional study assessed the prevalence of anemia among school-aged children in Gaza strip. Which reported a prevalence of 35.3%. They have used 12 g/dl as a cut-off points for hemoglobin level and included children aged 6-11 years. While, in our study we have followed the WHO cut-off point for hemoglobin levels for the diagnosis anemia, which Hb<11.5g/dl for children 5-11 years of age. This difference in the hemoglobin cut-off point may explain the higher prevalence of anemia in their study compared to ours (35.3% vs. 29.3%) [25]. Comparing our result with a study conducted in rural Sudanese school children, which used similar WHO hemoglobin cut-off points, the prevalence of anemia among these children was 29.7% [5].This level of anemia prevalence is similar to those observed in our study in Syria (30.0%) and Gaza (29.3%). The higher prevalence of anemia found in Syria and Gaza, might be due to the harsh living conditions of Palestine refugees who were living for ten years under siege in Gaza and seven years of war in Syria.

High prevalence of anemia is observed among camp-based refugee population anemia. Surveys conducted for Syrian refugees displaced to Iraq, Jordan, and Lebanon showed that Syrian refugee children, particularly those in Za'atri refugee camp in Jordan, experienced an elevated prevalence of anemia (48.4%). In particular, the prevalence of anemia among non-camp refugee children aged 24–59 months in Lebanon was in the range of 13.9% to 25.8 % [26]. The prevalence of anemia among Palestine refugee children in Lebanon observed in this study (18.3%), falls within the same range of the prevalence of anemia in that study. Even though our target group age (1st-grade children) is different from that in the study above; both findings may be compared with each other since there are no previous studies were found about the prevalence of anemia among refugees 1st-grade children in Lebanon. According to a study conducted in the occupied Palestine territories (West Bank and Gaza) during 2005, anemia prevalence was 37.9% in pre-school children aged 6–59 months, where a hemoglobin level cut-off point used was <11 g/dl [27]. The prevalence of anemia in that study was higher than the prevalence found in the current study for Gaza and West Bank, knowing that both studies are not comparable due to the difference in the age group of the target population and the difference in the cut-off point for hemoglobin.

Suffering from under- or over-nutrition during the school years can inhibit a child's physical and mental development. Stunting (low height-for-age, HAZ <–2 SD) as an indicator for chronic malnutrition, is associated with long-term consequences, such as impaired intellectual achievement and school performance, and also leads to a reduction in adult body size and, subsequently, reduced work capacity and obstetric complications. Thinness (low body mass index BAZ <–2 SD) in school-aged children can result in delayed maturation [4,28,29,30]. Comparing the results on under-nutrition indicators of a study that was conducted in a Sudanese rural school, where the prevalence of stunting was 7.1% and that of thinness was 23.1% 5, with the results of the current study, Palestine refugee children included in this study had lower levels of stunting and thinness (stunting: 3.2% and thinness: 5.6%). This might be because Sudan is one of the poorest countries in Africa, in which children suffer from many nutritional problems; such as anemia, thinness and stunting [31].

The overall prevalence of stunting in the current study (3.2%) was lower than that reported in a study conducted during 2016 among Syrian refugee children living in Za'atri camp in Jordan (16.7%), and also lower than the prevalence of stunting reported about children living in Syrian refugee camps in Lebanon and Iraq which ranged from 14.1%-21.0% [26].

According to a study conducted in 2012 to assess the factors associated with under-nutrition and over-nutrition in 22 schools run by either UNRWA or the Palestinian government targeting school children aged 5 to 16 years in West Bank, the prevalence of stunting was found to be 6.6% and that of underweight was 2.9% for the 1st grade children [32]. Compared to the current study, these results demonstrated higher stunting (6.6% vs. 2.3%) and a lower underweight prevalence (2.9% vs. 3.4%). In the same study, they found that one of the factors associated with being underweight was male sex, whereas in the current there were no significant differences between being underweight and being male or female. In order to explain the reasons behind such differences, more investigation should be conducted.

A study was conducted in Pakistan to assess the prevalence of anemia and iron deficiency and their association with weight and height among 1st-grade school children. No significant differences were found between hemoglobin and ferritin levels and different categories of height and weight [33]. In contrast, significant differences were found in the current study between being anemic and being underweight in the four fields.

Conclusion and recommendations:

The prevalence of anemia among 1st-grade children in the four fields of UNRWA operations included in this study was 25.0%, which is can be classified based on WHO criteria as moderate public health significance of anemia. Further studies should be conducted to investigate the factors associated with anemia prevalence among Palestine refugee young students, especially in Syria and Gaza so that proper interventions could be implemented to reduce the prevalence of anemia among them.

One intervention that has been decided on by UNRWA health department is to include hemoglobin testing as part of the compulsory medical examination for children willing to join UNRWA`s schools as 1st graders in all fields. This decision has been included in the latest version of UNRWA's School Health Technical Guidelines.

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	i
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	i
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2,3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4,5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4,5,6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). ~~Describe comparability of assessment methods if there is more than one group~~	*5*
Bias	9	Describe any efforts to address potential sources of bias	1,5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. ~~If applicable, describe which groupings were chosen and why~~	5,6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	1
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	5,6
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7,8
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8,9

		(*b*) Report category boundaries when continuous variables were categorized	8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10,11
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Anemia prevalence in children newly registered at UNRWA schools: a cross-sectional study

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Anemia prevalence in children newly registered at UNRWA schools: a cross-sectional study

Nada Abu Kishk[1], Yassir Turki[1], Suha Saleh[1], Shatha alBaik[1], Majed Hababeh[1], Zoheir elkhatib[2], Nimer Kassim[3], Hasan Arab[4], Khawalah abu Daib[5], Wafaa Zeidan[1] and Akihiro Seita[1]

[1] Health Department, United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), Headquarter, Amman –Jordan; [2] Health Programme, UNRWA, Gaza; [3] Health Programme, UNRWA, Lebanon; [4] Health Programme, UNRWA, Syria; [5] Health Programme, UNRWA, West bank

NK (N Abu Kishk, MSc), YT (Y Turki, MSc, PhD), SS (S Saleh, MD, MSc), SB (S alBeik, Pharm.D, MSc), MH (M Hababeh, MD, MPH), ZK (Z elKhatib, MD, MPH), NK2 (N Kassim, MD, MPH), HA (H Arab, MD, MPH), KD (K abu Daib, RN), WZ (W Zeidan, BSc) and AS (A Seita, MD, MPH).

Authors Contributions

NK designed the study, collected and interpreted data, carried out data management, and wrote the text. YT wrote the abstract and revised the text. SS analyzed data, produced tables and figures, and revised the transcript. SB analyzed data, produced tables and figures. MH interpreted data and revised the text. ZK, NK2, HA and KD collected and interpreted data, and carried out data management. WZ designed the study methodology. AS interpreted data and revised the abstract. All authors have seen and approved the final version of the text for publication.

Correspondences to: *Nada Abu Kishk, P.O.box:140157 Amman 11814 Jordan*
n.abu-kishk@unrwa.org/ nada_abukishk@hms.harvard.edu

Abstract:

Objective:

Children entering first grade at United Nations Relief Work Agency for Palestine refugees in the Near East (UNRWA) schools in West Bank (WB), Gaza, Lebanon, Jordan and Syria, complete a comprehensive medical examination at UNRWA health centers (HCs) as a requirement for their acceptance. Our study aimed to assess anemia prevalence and under-nutrition indicators, among newly entrant school children, during their pre-school medical examination.

Settings: in 2017, we conducted a cross-sectional study in 59 UNRWA HCs, targeting children entering grade one at UNRWA schools in four of UNRWA's countries of operation (known as fields), which are Gaza, WB, Syria and Lebanon.

Participants 2,419 have completed the study. Boys and girls, living inside or outside Palestine refugee camps, were included. Verbal consents were taken from their parents

Primary and secondary outcome measures: Sociodemographic and anthropometric data for each child, were collected. Underweight (Weight-for-Age Z-score < –2 SD), stunting (Height-for-Age Z-score < –2 SD), thinness (BMI-for-Age Z-score < –2 SD), and Obesity (BMI-for-Age Z-score > +2 SD), were examined according to WHO growth indicators (5-10 years).

Results

2,419 students (1,278 females and 1141 males) aged 6.1±0.4 years were examined. The prevalence of anemia (hemoglobin (Hb) <11.5 g/dl) was 25.0% (Gaza: 29.3%, WB: 22.0%, Syria: 30.0% and Lebanon: 18.3%). The mean Hb level was 12.0±0.9 g/dl. The overall prevalence of stunting, thinness and underweight were 3.2%, 3.5% and 5.6%, respectively, with the highest levels found in Syria (4.3%, 6.3% and 10.1% respectively). Significant differences were found among fields regarding the undernutrition indicators (*P* value = 0.001). Also, anemic children had significantly higher prevalence of underweight (5.2%) in comparison to those who were not anemic (*P* value = 0.001).

Conclusions:

The prevalence of anemia among surveyed children increased to (25.0%), compared to the previous study conducted by UNRWA in 2005 (19.5%). Thus, it was recommended to include hemoglobin testing in the medical examination for the newly entrant school children, attending UNRWA's schools.

Keywords:
Anemia, Palestine refugees, school children, health policy

Article Summary

Strengths and limitations of this study:

1. All participants are new school entrees, registered and managed by United Nation Relief and Work Agency for Palestine Refugees (UNRWA).
2. The study included a large sample size of 2419, in four of UNRWA's countries of operations.
3. One limitation of this study is that Jordan field was not included in the study.

INTRODUCTION:

Palestine refugees represent the largest refugee population in the world; currently, over 5.6 million Palestine Refugees are registered at the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA), in the five host countries where UNRWA operates including Gaza, West Bank, Syria, Lebanon, and Jordan. UNRWA is the main primary healthcare provider for Palestine Refugees via a network of 143 primary health care centers in the five fields of its operations.[1,2] In these fields, UNRWA also operates 702 elementary and preparatory schools, enrolling more than 500,000 students, as well as eight secondary schools in Lebanon.[3]

Globally, the nutritional status of school-aged children (around six years) impacts their health, cognition, and subsequently, their educational achievement.[4,5] Improving the cognitive and physical development of the school-aged children could have life-long benefits.[6] The World Health Organization (WHO) recognized the nutritional status of school-aged children as one of the essential indicators of the nutrition and health of the population.[7]

Anemia is defined as a low blood hemoglobin concentration. A condition where the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiologic needs.[8-10] It adversely affects the cognitive and motor development of children and causes fatigue and low productivity of affected individuals.[11, 12] Anemia is a public health problem that affects low-, middle- and high-income countries.[10,11]

Globally, it was found that children have the highest prevalence of anemia (42.6%).[8-10] Eastern Mediterranean Region had the second-highest anemia burden for children. Around 35.7 million children were estimated to be anemic, of whom 48.6% were children aged from 6-59 months.[8]

Concerning school-aged children, it is estimated that 25.0% of school-aged children worldwide are anemic.[13] One of the effective strategies to face this major public health issue is to screen for anemia in the school setting and prompt its therapy.[14] Although anemia is a public health problem worldwide, data on anemia among school children is scarce, and school-aged children are not commonly included in health and nutrition surveys.

In Gaza, the prevalence of anemia among pre-school children in 2012 was 59.7%, with 46.5% of them had mild anemia, and 13.5% of them had moderate anemia .[15] In 2005, UNRWA conducted a study to assess anemia among UNRWA schools' 1st-grade students. It was found that the prevalence of anemia among those students was 14.4% in Jordan, 22.3% in Lebanon, 9.1% in Syria, 36.4% in Gaza and 14.6% in West Bank, while the Agency-wide prevalence was 19.5%.[16]

Many governments and organizations recognize that good health and nutrition contribute to children's educational achievement, growth, and development. However, there is a lack of data that reflects the actual nutritional status of primary school children in the poor-limited resources countries. Furthermore, school-aged children are often not included in health and nutrition surveys, as most of the surveys focus on malnutrition among young children less than five years of age. For the Eastern Mediterranean Region, only few studies of anemia in school-aged children could be found.[4]

UNRWA implements several programs at its schools, using the School Health Strategy (SHS) approach.[17] These programs include early detection and management of disabilities, psychosocial wellbeing of school children, and the guidelines for medical examination of the new school entrants. This medical examination is a requirement for the acceptance at UNRWA schools, and it involves measuring weight and height and checking all body systems including vision, squint, hearing, congenital malformations, heart diseases, respiratory diseases, and physical disability. Nevertheless, the hemoglobin level is not assessed during this medical examination. Also, there is no recent data available on anemia prevalence among pre-school children attending the new entrants' medical examination at UNRWA HCs.[16,17]

Therefore, this study was conducted to assess anemia prevalence among children attending UNRWA HCs for the medical examination required for their acceptance at UNRWA schools for the scholastic year 2017/2018. This was recognized as an essential step to have new base-line data about anemia prevalence among the target population and to enable UNRWA health program management to make appropriate interventions and improvements on policies and guidelines governed by the SHS 2012.

METHODOLOGY

Study design and settings:

In summer 2017, a cross-sectional study was conducted at 59 UNRWA's HCs in the four fields of operations (Gaza, West Bank, Syria and Lebanon). This study targeted all male and female school children, who live inside or outside Palestine refugee camps, and expected to be enrolled in the 1st-grade at UNRWA schools for the scholastic year 2017/2018. Any child who was sick or had a chronic illness, was excluded from the study.

Sampling and sample size:

The sampling technique was a multistage sampling process that was carried out in several stages as described below:

The first stage, using Epi-Info V2000, a weighted sample of 2,399 was calculated (Gaza: 961, West Bank: 982, Syria: 334 & Lebanon: 622) based on the prevalence of UNRWA's 2005 anemia study among 1st-grade UNRWA schools' children (22.3% in Lebanon, 9.1% in Syria, 36.4% in Gaza and 14.6% in West Bank). We used the 2005 UNRWA's prevalence of anemia, to have a reference point for the same population.[16] The total number of children enrolled as 1st graders in UNRWA schools for the scholastic year 2016/2017 which was 47,515 children (24,281 girls and 23,234 boys), considering confidence level at 95% and precision at 3%.[1]

The second stage, knowing that each field of UNRWA operations is divided into several areas, the number of which varies from field to another, the second stage was to calculate the number of students in the sample to represent each area. This was done by:

$$\frac{\text{total number of 1st} - \text{grade students in an area}}{\text{total number of 1st} - \text{grade students in the field}} * \text{ the weighted sample size of that field}$$

The third stage, the number of students to be included in the study from each one of the selected schools was calculated by:

$$\frac{\text{total number of 1st} - \text{grade students in that school during the scholastic year 2017/2018}}{\text{total number of 1st} - \text{ grade students at the area where the selected school is present}}$$

The rationale for schools' selection from each area was to ensure geographical representation of the sample, as selected schools were distributed among the different administrative areas in the fields. It also took into consideration the presence of UNRWA's HCs nearby the selected schools, including schools from outside and inside camps. The distribution of the sample size by field, area and school is shown in Table 1.

Table 1: Distribution of sample size by field, area and school

Field	*Total No. of 1st-grade students (2016/2017)	**Field Sample	No. of selected schools in each Field				Total No. of students selected from schools in each area						
			Boys	Girls	Coeducation schools	Total	Boys	Girls	Coeducation schools		Total		
									Boys	Girls	Boys	Girls	Both
Syria	5,887	334	3	1	21	25	34	9	120	171	144	180	324
Lebanon	3,869	622	6	7	25	38	95	106	214	207	252	313	565
West Bank	4,979	482	14	14	5	33	159	249	30	44	189	293	482
Gaza	32,780	961	14	13	40	67	204	175	295	287	499	462	961
total	**47,515**	**2,399**	**37**	**35**	**91**	**163**	**492**	**539**	**659**	**709**	**1,151**	**1,248**	**2,399**

* Study population is the school children in 1st-grade school year 2016/2017

** Prevalence rate using the previous reported in 2005, 9.1%, 22.3%, 14.6%, and 36.4% in Syria, Lebanon, West Bank and Gaza respectively

Data collection procedure

In each field, the Field Family Health Officer was requested to send a list of 1st-grade students' names and their registration numbers in each of the selected schools. Also, they provided lists of the names of health centers that are closest to the selected schools. A data collection sheet, specially designed for this study, was used to collect sociodemographic and anthropometric data for each participating child. In each of the involved health centers, the Practical Nurse completed the data collection sheet for each student from the selected schools upon his/her attendance to the health center for the new entrants' medical examination. Then, the laboratory technicians performed the Complete Blood Count (CBC) test for each of the participating student. The completed data collection sheets were validated and double-checked at the field level, then forwarded on a weekly basis to the Health Department at UNRWA headquarters in Amman (HQA)- Jordan, for validation and data analysis processes. We used the UNICEF's manual for anthropometry as a guidance to perform the child anthropometric measurements.[18]

Patient and public involvement

Patients and public were not involved in any of the study development processes including; study design, recruitment process, outcome measures and the dissemination of the study results.

Case definition

Hemoglobin readings cut-off points were categorized based on WHO's anemia guidelines for 5-11 years old (2011),[19] as described in Table 2.

Table 2: WHO criteria to diagnose anemia at sea level (g/l) based on hemoglobin cut-off points

Population	Normal	Anemic		
	Non-anemic	Mild	Moderate	Severe
Children (5-11 years old)	115 or higher	110-114	80-109	Lower than 80

In addition, according to the WHO Nutrition Landscape Information System for the country profile, several indicators were used to measure nutritional imbalance resulting in undernutrition (assessed via underweight, stunting and thinness) and overweight. These indicators were defined as follows:[9]

- Weight-for-age z-score (WAZ) < –2 standard deviations (SD) of the WHO Child Growth Standards median is considered underweight.
- Height-for-age z-score (HAZ) < –2 SD of the WHO Child Growth Standards median is considered stunting.
- Body Mass Index (BMI)-for-age z-score (BAZ) < –2 SD of the WHO Child Growth Standards median is considered thinness.
- BAZ > +2 SD of the WHO Child Growth Standards median is considered obesity.[9]

We have adopted the WHO criteria for the classification of public health significance of anemia in a given population, which includes the following categories: “normal” if the prevalence is <4.9%, “mild” if the prevalence is 5.0-19.9%, “moderate” if the prevalence is 20.0-39.9%, and “severe” if the prevalence is >40.0% .[19]

Data analysis:

Data entry was done on excel sheets, and the analysis was carried out using Statistical Package for the Social Sciences (SPSS) software V22. Descriptive statistics were used to describe the sample characteristics, in which frequency and percentage were used for categorical variable, while mean and standard deviation were used for numerical variables. Missing data was not included in the analysis. In order to measure the under-nutrition indicators, the Child Growth z-scores of WAZ, HAZ and BAZ, were calculated using WHO AnthroPlus-software used to monitor the growth of school-age children and adolescents (age group 5-19 years).[20] Flagged data, which are considered extreme or potentially incorrect z-score value (SD ≥+5 or SD≤-5) was included in the descriptive analysis and excluded from the cross-tabulation.

Pearson Chi-Square test was used to assess the differences between anemia status and the collected sociodemographic variables along with the undernutrition indicators (underweight, stunting and

thinness), Chi-Square test was also conducted to compare the differences between the under-nutrition indicators and the socio-demographic variables along with anemia status at the level of all the four fields, then at the level of each field. The significance was set at *P-value* ≤0.05. We conducted a multivariable logistic regression to explore the association between having anemia and the following covariates; child comorbidity, place of residence, child sex, mother's education, and father's education, for each field.

Ethical considerations

The study protocol was approved by the UNRWA Health Department Ethical Review Committee. As it was reviewed by the health department experts at headquarters and fields level, specifically; the health policy and research officers, chief of health protection and promotion, chiefs of health department in the four fields of the study and finally approved by the director of health department. All UNRWA health staff are obligated to follow the guidance of the Belmont Report on Ethical Principles and Guidelines for the protection of human subject of Research, and UNRWA's Child Protection Framework when dealing with children in the study. During the process of data collection, analyzing and reporting; research team were obligated to follow the UN GlobalPulse principles of Data Protection and Disclosure Policy that UNRWA is adapting for their beneficiaries, mainly the principles of respect, beneficence, non-maleficence and fairness. Thus, UNRWA's frontline health staff was rigorously monitored by the health department staff during the data collection process, from headquarters and fields level. There isn't an official number/ID of approval for our study from the UNRWA Research Review Board, since the RRB was establish two years after our study was conducted, to issue legal and data security approvals, especially for studies conducted by non-UNRWA staff, who didn't go through the above mention agency frameworks and protocols.

Moreover, verbal consents were taken from the parents of the participated students, since they did not feel comfortable to sign a document or even a consent, especially if they were illiterate. Also, this is UNRWA's norms in most of their operational surveys and research. Participation in the study

was voluntary, and the identity of participated students was treated with extreme confidentiality by the researchers. Any detected case with moderate or severe anemia was referred to receive curative anemia treatment at UNRWA HCs, by giving iron supplement and constant follow-up with the health center staff.[1] This is a requirement set in UNRWA's relevant policies which emphasizes that such individuals should be treated properly before they develop the complications of moderate and severe anemia as an ethical responsibility towards its Palestine refugee beneficiaries of all age groups.

RESULTS

Sociodemographic

The calculated sample size was at least 2,399. Therefore, the researcher tried to involve as many children as possible to participate in the study. Accordingly, the total number of new entrants who had participated in this study was 2,419, which is 20 students were higher than the weighted sample size.

They were distributed among the four fields as follows; 959 (39.6%) from Gaza, 472(19.5%) from West Bank, 347 (14.3%) from Syria and 641(26.5%) from Lebanon.

Out of the total number of participants, 1278 (52.8%) were females and 1141 (47.2%) were males. The mean age of participants was 6.1±0.4SD and ranged (4.2-8.6) years of age. 57.8% of the mothers and 55.1% of the fathers of participating children had a secondary and high school level of education. In addition, 52.3% of the participants lived inside camps and 47.7% lived outside camps. Comorbidity was 245 (10.1%) among all participating students.

Anemia prevalence

The overall mean of hemoglobin level for all participants was 12.1± 0.9 g/dl. The overall prevalence of anemia was 25.0% (605 out of 2416). The distribution of anemia prevalence across the four fields was as follows: in Gaza 29.3%, in West Bank 22.0%, in Syria 30.0%, and in Lebanon 18.3%, the highest prevalence of anemia among participants was found in Syria and Gaza. Table 3 describes the prevalence of different classes of anemia among the participants in the four fields, according to WHO cut-off points. We found significant differences in the anemia status and classification among participants in the four fields (P<0.001), except for the severe anemia level, as almost no cases of severe anemia were found in the four fields.

Table 3: Distribution of different classes of anemia among the participants in the four fields.

Anemia levels	Gaza (N=959)	West Bank (N=469)**	Syria (N=347)	Lebanon (N=641)	Total Fields (N=2416)	*P*-values
Mild n (%)*	171 (17.8%)	63(13.4%)	53(15.3%)	76(11.9%)	363(15.0%)	<0.001
Moderate n (%)	110 (11.5%)	40(8.5%)	51(14.7%)	40(6.2%)	241(10.0%)	0.007
Severe n (%)	-	-	-	1(0.2%)	1(0.0004%)	0.428
Total anemia	281(29.3%)	103(22.0 %)	104(30.0 %)	117(18.3%)	605 (25%)	

*Abbreviations: N total, n frequency, % percentage, Chi-Square test was applied and p-value (<0.05) considered significant.
** Three participants with missing data were found in West Bank

Chi-Square test was used to compare sociodemographic variables and anemia status at the level of each field. In West Bank, the prevalence of anemia among males was higher than females (28.6% vs. 17.8%) (P=0.006). In Syria, the prevalence of anemia was significantly higher among participants living inside camps compared to those living outside camps (36.3% vs. 19.7%) (P=0.001).

Bivariate analysis showed a significantly higher prevalence of underweight (5.2%) among those with anemia in all fields, in comparison to those who were not anemic (3.0%) (P=0.01). Moreover, those who lived outside camps had a significantly higher prevalence of stunting (4.2%) compared to those who lived inside camps (2.4%) (P=0.013). In West Bank only, it was found that participants living outside camps had a higher prevalence of thinness (12.6%) compared to those living inside camps (2.7%) (P<0.001). After adjusting for the child comorbidity, place of residence, sex,

mother's education, and father's education, for each field; we have identified a significant increase in the odds ratio of having anemia with child comorbidity in Gaza and Lebanon fields (aOR: 0.46, CI: 0.22- 0.86, *P*=0.01). There is a significant increase in the odds ratio of being anemic among females compared to males in WB field (aOR: 0.53, CI: 0.34 -0.83, *P*=0.006), and there is a significant increase in the odds ratio of being anemic among children living inside the camp compared to those living outside the camp in Syria field (aOR: -0.42, CI: 0.25- 0.71, *P*<0.0001). Whereas, no significance in the odds ratio was found in the Lebanon field.

Anthropometric measurements

The mean weight of all participants was 20.4kg. Syria had the lowest mean weight (19.5kg) and Lebanon had the highest mean weight (22.0kg). Moreover, the mean height of all participants was 115.6cm, and West Bank had the lowest mean height (114.5cm), while Lebanon had the highest mean height (117.5cm).

The percentages of children with normal z-score at the level of the four fields were: 67.1% for WAZ, 67.5% for HAZ and 60.4% for BAZ. Table (4) Illustrates the distribution of underweight, stunting, thinness and overweight among the children in the four fields. It shows that 3.5% were underweight, 3.2% were stunted, 5.6% suffered from thinness, and 5% were overweight with a significant difference between the UNRWA's four fields.

The highest prevalence of underweight, stunting, and thinness were found among children from Syria (6.3%, 4.3%, and 10.1% respectively); while the lowest prevalence were among those from Lebanon (2.5%, 1.7%, and 4.2% respectively). The highest prevalence of overweight was in Lebanon (8.6%), and the lowest was in Gaza (2.6%).

Table 4: Distribution of underweight, stunting and thinness among the participants in the four Fields of operations

Field	Gaza	West Bank	Syria	Lebanon	Total fields	P-value
Underweight n (%)	30 (3.1%)	16 (3.4%)	22 (6.3%)	16 (2.5%)	84 (3.5%)	0.014

Stunting n (%)	41 (4.3%)	11 (2.3%)	15 (4.3%)	11 (1.7%)	78 (3.2%)	0.014
Thinness n (%)	50 (5.2%)	24 (5.1%)	35 (10.1%)	27 (4.2%)	136 (5.6%)	<0.001
Overweight n (%)	25 (2.6%)	27 (5.7%)	14 (4%)	55 (8.6%)	121 (5%)	<0.001

*Abbreviations: n frequency, (%) percentage. Chi-Square test was applied and p-value (<0.05) considered significant

DISCUSSION:

We found that the prevalence of anemia among 1st-grade school-aged children, attending UNRWA's schools in four of its field operations, was 25%. According to the WHO public health classification of anemia, the public health significance of anemia for this study is considered as moderate.[19]

Comparing our results to the UNRWA's 2005 anemia survey;[16] we noticed that there is an increase in the prevalence of anemia among 1st-grade school children in Syria (9.1% in 2005 study vs. 30.0% in our study) and in West Bank (14.6% in 2005 to 22.0% in our study), with a decrease in the prevalence of anemia in Gaza from (36.4%in 2005 vs. to 29.3% in our study) and Lebanon from (22.3% in 2005 vs. to 18.3% in our study).

It was recognized that the available literature is scarce on the prevalence of anemia in the Eastern Mediterranean Region, and more specifically in the countries where UNRWA operates. Also, a clear variation was found on the cut-off points used for hemoglobin levels to define anemia. For example, in 2011, the prevalence of anemia among school-aged children in Gaza strip was 35.3%. The researchers used (12 g/dl) as a cut-off point for hemoglobin levels among children of 6-11 years of age. While in our study, we followed the WHO cut-off point for hemoglobin levels to diagnose anemia, which is Hb <11.5g/dl for children of 5-11 years of age. This difference in the hemoglobin cut-off point may explain the higher prevalence of anemia in their study compared to ours (35.3% vs. 29.3%).[21] Comparing our result with a study conducted in rural Sudanese school children, the prevalence of anemia was 29.7%, which is similar to those observed in our study in Syria (30.0%) and Gaza (29.3%).[5]

We believe that the high prevalence of anemia found in Syria and Gaza might be due to the harsh living conditions of Palestine Refugees who were living for ten years under siege in Gaza and seven years of war in Syria. In 2016, the different levels of anemia prevalence among refugee children aged 24–59 months living outside camps in Lebanon, ranged from 13.9% to 25.8 %, whereas in our study it was 18.3%, which falls within the same range of the prevalence of anemia for the study conducted in Lebanon.[22]

According to a study conducted in the occupied Palestinian Territory (oPT), that includes West Bank and Gaza, in 2005, the prevalence of anemia was 37.9% among pre-school children aged 6–59 months (with a cut-off point <11 g/dl hemoglobin level), which is higher than our study findings for Gaza and West Bank.[23] However, they had different age group and hemoglobin cut-off points.

Suffering from under- or over-nutrition during the school years can inhibit a child's physical and mental development. Stunting as an indicator for chronic malnutrition, is associated with long-term consequences, such as impaired intellectual achievement and school performance, and it also leads to a reduction in adult body size and, subsequently, reduced work capacity and obstetric complications. Thinness in school-aged children can result in delayed maturation.[4,24-26]

The overall prevalence of stunting in the current study was low compared to a study conducted, in 2016, among Syrian refugee children living in Za'atri camp in Jordan and in Syrian refugee camps located in Lebanon and Iraq.[22]

According to a study conducted in 2012, aimed to assess the factors associated with under-nutrition and over-nutrition among school children, aged 5 to 16 years, in West Bank, the prevalence of stunting was found to be 6.6% and underweight was 2.9%, for the 1st-grade children.[27] These results demonstrated a higher prevalence of stunting and a lower prevalence underweight, compared to our study, (6.6% vs. 2.3%) and (2.9% vs. 3.4%), respectively.

A study was conducted in Pakistan to assess the prevalence of anemia and iron deficiency and their association with weight and height among 1st-grade school children. No significant differences were found between hemoglobin and ferritin levels and different categories of height and weight.[28] In contrast, significant differences were found in the current study between being anemic and being underweight in the four fields.

Limitations:

The study design is cross sectional, and based on this, it cannot show the cause-effect association between the variables. Due to an internal operational issue in UNRWA's Jordan field, the results of the provided data were not reliable, which led us to exclude Jordan field from the beginning of the study. Having different school health team members for data collection, might subject the study to random error.

CONCLUSION AND RECOMMENDATIONS

The prevalence of anemia among 1st-grade children in the four fields of UNRWA operations included in this study was 25%. One intervention that has been decided on by UNRWA health department is to include hemoglobin testing as part of the compulsory medical examination for Palestine refugee children willing to join UNRWA`s schools as 1st graders in all fields.

Further studies should be conducted to investigate the factors associated with anemia prevalence among Palestine refugee young students, especially in Syria and Gaza, so that proper interventions could be implemented to reduce the prevalence of anemia among them.

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Competing interests: None declared.

Patient consent: for publication Obtained.

Data availability statement: No additional data available.

Word count: 3555

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	i
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	i
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2,3
Objectives	3	State specific objectives, including any prespecified hypotheses	3
Methods			
Study design	4	Present key elements of study design early in the paper	4
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	4,5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	4
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4,5,6
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). ~~Describe comparability of assessment methods if there is more than one group~~	*5*
Bias	9	Describe any efforts to address potential sources of bias	1,5
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. ~~If applicable, describe which groupings were chosen and why~~	5,6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	5
		(*c*) Explain how missing data were addressed	1
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	5,6
		(*e*) Describe any sensitivity analyses	
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	7
		(b) Give reasons for non-participation at each stage	
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7,8
		(b) Indicate number of participants with missing data for each variable of interest	
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8,9

		(*b*) Report category boundaries when continuous variables were categorized	8
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	10
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	10,11
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.