


BMJ Open Anaemia prevalence in children newly registered at UNRWA schools: a cross-sectional study

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ABSTRACT

Objective Children entering first grade at the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) schools in West Bank, Gaza, Lebanon, Jordan and Syria complete a comprehensive medical examination at UNRWA health centres (HCs) as a requirement for their acceptance. Our study aimed to assess anaemia prevalence and undernutrition indicators among new entrant school children during their preschool medical examination.

Settings In 2017, we conducted a cross-sectional study in 59 UNRWA HCs, targeting children entering first grade at UNRWA schools in four of UNRWA's countries of operation (known as fields), namely Gaza, West Bank, Syria and Lebanon.

Participants 2419 completed the study. Boys and girls living inside or outside Palestine refugee camps were included. Verbal consent was obtained from their parents.

Primary and secondary outcome measures

Sociodemographic and anthropometric data on each child were collected. Underweight (weight-for-age z-score <−2 SD), stunting (height-for-age z-score <−2 SD), thinness (body mass index-for-age z-score <−2 SD) and obesity (body mass index-for-age z-score >+2 SD) were examined according to WHO growth indicators (5–10 years).

Results 2419 students (1278 girls and 1141 boys) aged 6.1±0.4 years were examined. The prevalence of anaemia (haemoglobin (Hb) <11.5 g/L) was 25.0% (Gaza: 29.3%; West Bank: 22.0%; Syria: 30.0%; Lebanon: 18.3%). The mean Hb level was 12.0±0.9 g/L. The overall prevalence of stunting, thinness and underweight was 3.2%, 3.5% and 5.6%, respectively, with the highest levels found in Syria (4.3%, 6.3% and 10.1%, respectively). The highest prevalence of overweight was in Lebanon (8.6%), and the lowest was in Gaza (2.6%). Significant differences were found among fields with regard to undernutrition indicators (p=0.001). Also, children with anaemia had significantly higher prevalence of being underweight (5.2%) in comparison with those without anaemia (p=0.001).

Conclusions The prevalence of anaemia among the surveyed children increased to 25.0%, compared with the previous study conducted by UNRWA in 2005 (19.5%). Thus, it is recommended that Hb testing be included in the medical examination of new entrant school children attending UNRWA schools.

Strengths and limitations of this study

- All participants are new school entrants, registered and managed by the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA).
- The study included a large sample size of 2419, in four of UNRWA's countries of operations.
- A limitation 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, namely Gaza, West Bank, Syria, Lebanon and Jordan. UNRWA is the main primary healthcare provider for Palestine refugees, via a network of 143 primary healthcare centres 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 6 years) impacts their health, cognition and subsequently their educational achievement.^{4 5} Improving the cognitive and physical development of school-aged children could have lifelong benefits.⁶ WHO recognised the nutritional status of school-aged children as one of the essential indicators of nutrition and health of the population.⁷

Anaemia is defined as a low blood haemoglobin concentration, a condition where the number of red blood cells or their oxygen-carrying capacity is insufficient to meet physiological needs.^{8–10} It adversely affects the

cognitive and motor development of children and causes fatigue and low productivity among affected individuals.^{11 12} Anaemia is a public health problem that affects low-income, middle-income and high-income countries.^{10 11}

Globally, it has been found that children have the highest prevalence of anaemia (42.6%).⁸⁻¹⁰ The Eastern Mediterranean Region had the second highest anaemia burden among children. Around 35.7 million children were estimated to have anaemia, of whom 48.6% were aged 6–59 months.⁸

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

In Gaza, the prevalence of anaemia among preschool children in 2012 was 59.7%, with 46.5% of these children having mild anaemia and 13.5% with moderate anaemia.¹⁵ In 2005, UNRWA conducted a study to assess anaemia among UNRWA schools' first-grade students. It was found that the prevalence of anaemia 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%.¹⁶

Many governments and organisations recognise that good health and nutrition contribute to children's educational achievement, growth and development. However, there is a lack of data that reflect the actual nutritional status of primary school children in countries with poor or limited resources. Furthermore, school-aged children are often not included in health and nutrition surveys, as most of the surveys focus on malnutrition among children younger than 5 years of age. For the Eastern Mediterranean Region, only few studies of anaemia among school-aged children can be found.⁴

UNRWA implements several programmes at its schools using the School Health Strategy (SHS) approach.¹⁷ These programmes include early detection and management of disabilities, psychosocial well-being of school children, and guidelines for medical examination of new school entrants. This medical examination is a requirement for acceptance at UNRWA schools, and 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 haemoglobin level is not assessed during this medical examination. Also, there are no recent data available on the prevalence of anaemia among preschool children attending the new entrants' medical examination at UNRWA health centres (HCs).^{16 17}

Therefore, this study was conducted to assess the prevalence of anaemia among children attending UNRWA HCs during the medical examination required for acceptance

at UNRWA schools for scholastic year 2017/2018. This was recognised as an essential step to obtain new baseline data on the prevalence of anaemia among the target population and to enable UNRWA health programme management to make appropriate interventions and improvements on policies and guidelines governed by SHS 2012.

METHODOLOGY

Study design and setting

In summer 2017, a cross-sectional study was conducted at 59 UNRWA 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 were expected to be enrolled in first grade at UNRWA schools for scholastic year 2017/2018. Any child who was sick or had 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 in the following:

In the first stage, using Epi Info V.2000, a weighted sample of 2399 was calculated (Gaza: 961; West Bank: 982; Syria: 334; Lebanon: 622) based on UNRWA's 2005 study on the prevalence of anaemia among UNRWA schools' first-grade children (22.3% in Lebanon, 9.1% in Syria, 36.4% in Gaza and 14.6% in West Bank). We used UNRWA's 2005 data on prevalence of anaemia as a reference point for the same population.¹⁶ In addition to that we used the total number of children enrolled as first graders in UNRWA schools for the scholastic year 2016/2017, which was 47515 (24281 girls and 23234 boys), considering a confidence level at 95% and a precision at 3%.¹

In the second stage, with the knowledge that each field of UNRWA operations is divided into several areas, the number of which varies from one field to another, the number of students in the sample was calculated to represent each area. This was done using the following:

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

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

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

The rationale for schools' selection from each area was to ensure geographical representation of the sample, as selected schools were distributed among different administrative areas in the fields. It also took into consideration the presence of UNRWA HCs nearby the selected schools, including schools from outside and inside Palestine refugee 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 number of first-grade students (2016/2017)* | Field sample† | Selected schools in each field (n) | | | | Total number of students selected from schools in each area | | | | | | |
|-----------|---|---------------|------------------------------------|-------|---------------------|-------|---|-------|-------|-------|------|------|------|
| | | | Boys | Girls | Coeducation schools | Total | Coeducation schools | | Total | | | | |
| | | | | | | | Boys | Girls | Boys | Girls | Both | | |
| Syria | 5887 | 334 | 3 | 1 | 21 | 25 | 34 | 9 | 120 | 171 | 144 | 180 | 324 |
| Lebanon | 3869 | 622 | 6 | 7 | 25 | 38 | 95 | 106 | 214 | 207 | 252 | 313 | 565 |
| West Bank | 4979 | 482 | 14 | 14 | 5 | 33 | 159 | 249 | 30 | 44 | 189 | 293 | 482 |
| Gaza | 32780 | 961 | 14 | 13 | 40 | 67 | 204 | 175 | 295 | 287 | 499 | 462 | 961 |
| Total | 47515 | 2399 | 37 | 35 | 91 | 163 | 492 | 539 | 659 | 709 | 1151 | 1248 | 2399 |

*The study population included school children in first grade during school year 2016/2017, as a reference point.

†Prevalence rate using the previously reported rate 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 first-grade students' names and their registration numbers in each of the selected schools. They also provided a list of the names of health centres that are closest to the selected schools. A data collection sheet, especially designed for this study, was used to collect sociodemographic and anthropometric data for each participating child. In each of the involved health centres, the practical nurse completed the data collection sheet for each student from the selected schools on his/her attendance to the health centre for new entrants' medical examination. Then, the laboratory technicians performed the complete blood count test for each of the participating 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 the UNRWA Headquarters in Amman (HQA)-Jordan for validation and data analysis processes. We used the UNICEF's manual for anthropometry as guidance to perform child anthropometric measurements.¹⁸

Patient and public involvement

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

Case definition

Haemoglobin readings cut-off points were categorised based on WHO's anaemia guidelines for 5–11 years old (2011),¹⁹ as described in table 2.

Table 2 WHO criteria to diagnose anaemia at sea level (g/L) based on haemoglobin cut-off points

| Population | Non-anaemic | Anaemic | | |
|---------------------------|---------------|---------|----------|---------------|
| | Normal | 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 follows⁹:

- ▶ Weight-for-age z-score (WAZ) <−2 SD of the WHO Child Growth Standards median is considered underweight.
- ▶ Height-for-age z-score (HAZ) <−2SD of the WHO Child Growth Standards median is considered stunting.
- ▶ Body mass index-for-age z-score (BAZ) <−2SD of the WHO Child Growth Standards median is considered thinness.
- ▶ BAZ >+2SD of the WHO Child Growth Standards median is considered obese.⁹

We have adopted the WHO criteria for the classification of public health significance of anaemia 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) V.22 software. Descriptive statistics were used to describe the sample characteristics, in which frequency and percentage were used for categorical variables, while mean and SD were used for numerical variables. Missing data were not included in the analysis. To measure undernutrition indicators, the child growth z-scores of WAZ, HAZ and BAZ were calculated using WHO AnthroPlus software, which is used to monitor the growth of school-aged children and adolescents (age group 5–19 years).²⁰ Flagged data, which are considered extreme or potentially incorrect z-score values ($SD \geq +5$ or $SD \leq -5$), were included in the descriptive analysis and excluded from the cross-tabulation.



Pearson χ^2 test was used to assess differences between anaemia status and the collected sociodemographic variables, along with the undernutrition indicators (underweight, stunting and thinness). χ^2 test was also conducted to compare differences between the undernutrition indicators and the sociodemographic variables, along with anaemia status, at the level of all the four fields and then at the level of each field. Significance was set at $p \leq 0.05$. We conducted multivariable logistic regression to explore the association between having anaemia and the following covariates, for each field: child comorbidity, place of residence, child sex, mother's education and father's education.

Ethical considerations

The study protocol was reviewed by the health department experts at the headquarters and fields level, specifically the health policy and research officers, chief of health protection and promotion, and 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 Subjects of Research and the UNRWA Child Protection Framework when dealing with children in the study. During data collection, analyses and reporting, the research team were obligated to follow the United Nations Global Pulse 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 front-line health staff were rigorously monitored by the health department staff during the data collection process, from the headquarters and fields level. There is not an official number/identification of approval for our study from the UNRWA Research Review Board (RRB), since the RRB was established 2 years after our study was conducted, to issue legal and data security approvals, especially for studies conducted by non-UNRWA staff who did not go through the above-mentioned agency frameworks and protocols.

Verbal consent was obtained from the parents of the participating students, since they did not feel comfortable signing a document or even a consent, especially those who were illiterate. Also, this is UNRWA's norm in most of their operational surveys and research. Participation in

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

RESULTS

Sociodemographics

The calculated sample size was at least 2399. Therefore, the researchers tried to involve as many children as possible to participate in the study. Accordingly, the total number of new entrants who participated in the study was 2419, which was 20 students 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.

Of the total number of participants, 1278 (52.8%) were girls and 1141 (47.2%) were boys. The mean age of participants was 6.1 ± 0.4 SD and ranged from 4.2 to 8.6 years. With regard to parents' education, 57.8% of the mothers and 55.1% of the fathers had a secondary and high school level of education. In addition, 52.3% of the participants lived inside camps while 47.7% lived outside camps.

Comorbidity was 245 (10.1%) among all participating students.

Anaemia prevalence

The overall mean haemoglobin level of the participants was 12.1 ± 0.9 g/L. The overall prevalence of anaemia was 25.0% (605 out of 2416). The distribution of anaemia 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 anaemia among participants was found in Syria and Gaza. Table 3 describes the prevalence of different classes of anaemia among the participants in the four fields, according to WHO cut-off points. We found significant differences in anaemia status and classification among participants in

Table 3 Distribution of different classes of anaemia among participants in the four fields

| Anaemia level | Gaza (N=959) | West Bank (N=469)* | Syria (N=347) | Lebanon (N=641) | Total fields (N=2416) | P value |
|-----------------|--------------|--------------------|---------------|-----------------|-----------------------|---------|
| 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 anaemia | 281 (29.3) | 103 (22.0) | 104 (30.0) | 117 (18.3) | 605 (25) | |

N means total; n means frequency.

χ^2 test was applied and $p < 0.05$ was considered significant.

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

the four fields ($p < 0.001$), except for severe anaemia, as almost no cases of severe anaemia were found in the four fields.

χ^2 test was used to compare the sociodemographic variables and anaemia status at the level of each field. In West Bank, the prevalence of anaemia among boys was higher than girls (28.6% vs 17.8%) ($p = 0.006$). In Syria, the prevalence of anaemia was significantly higher among participants living inside camps compared with 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 anaemia in all fields, in comparison with those without anaemia (3.0%) ($p = 0.01$). Moreover, those who lived outside camps had a significantly higher prevalence of stunting (4.2%) compared with 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 with those living inside camps (2.7%) ($p < 0.001$). After adjusting for child comorbidity, place of residence, sex, mother's education and father's education for each field, we have identified a significant increase in the OR of having anaemia with child comorbidity in Gaza and Lebanon (adjusted (OR) aOR: 0.46, CI 0.22 to 0.86, $p = 0.01$). There was a significant increase in the OR of having anaemia among girls compared with boys in West Bank (aOR: 0.53, CI 0.34 to 0.83, $p = 0.006$), and there was a significant increase in the OR of having anaemia among children living inside camps compared with those living outside camps in Syria (aOR: -0.42, CI 0.25 to 0.71, $p < 0.0001$), whereas no significance in OR was found in Lebanon.

Anthropometric measurements

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

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 among UNRWA's four fields.

The highest prevalence of underweight, stunting and thinness was found among children from Syria (6.3%, 4.3% and 10.1%, respectively), while the lowest prevalence was 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%).

DISCUSSION

We found that the prevalence of anaemia among first-grade school-aged children attending UNRWA schools in four of its field operations was 25.0%. According to the WHO public health classification of anaemia, the public health significance of anaemia for this study is considered moderate.¹⁹

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

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

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

| Field | Gaza | West Bank | Syria | Lebanon | Total field | 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 |

n means frequency.

χ^2 test was applied and $p < 0.05$ was considered significant.



We believe that the high prevalence of anaemia found in Syria and Gaza might be due to the harsh living conditions of Palestine refugees who have been living for 10 years under siege in Gaza and 7 years of war in Syria. In 2016, the prevalence of different levels of anaemia 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 anaemia in a study conducted in Lebanon.²²

According to a study conducted in the occupied Palestinian Territory, which includes West Bank and Gaza, in 2005, the prevalence of anaemia was 37.9% among preschool children aged 6–59 months (with a cut-off point <11 g/L haemoglobin level), which is higher than our study findings for Gaza and West Bank.²³ However, they had different age groups and haemoglobin cut-off points.

Undernutrition or overnutrition during the school years can inhibit a child's physical and mental development. Stunting as an indicator of 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 among school-aged children can result in delayed maturation.^{4 24–26}

The overall prevalence of stunting in the current study was low compared with a study conducted in 2016 among Syrian refugee children living in the 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 undernutrition and overnutrition among school children aged 5–16 years in West Bank, the prevalence of stunting was found to be 6.6% and of underweight was 2.9% for first-grade children.²⁷ These results demonstrated a higher prevalence of stunting and a lower prevalence of underweight compared with 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 anaemia and iron deficiency and their association with weight and height among first-grade school children. No significant differences were found between haemoglobin and ferritin levels and different categories of height and weight.²⁸ In contrast, significant differences were found in the current study between being anaemic and being underweight in the four fields.

Limitations

The study design is cross-sectional and therefore cannot show the cause–effect association between variables. Due to an internal operational issue in UNRWA Jordan, the data that were provided were not reliable, which led us to exclude Jordan from the start 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 anaemia among first-grade children in the four fields of UNRWA operations included in this study was 25.0%. One intervention that has been decided on by the UNRWA health department is to include haemoglobin testing in all fields as part of the compulsory medical examination for Palestine refugee children willing to join UNRWA schools as first graders.

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

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Contributors NA designed the study, collected and interpreted the data, carried out data management, and wrote the text. YT wrote the abstract and revised the text. SS analysed the data, produced the tables and revised the transcript. SA analysed the data and produced the tables. MH interpreted the data and revised the text. ZK, NK, HA and KA-D collected and interpreted the data, and carried out data management. WZ designed the study methodology. AS interpreted the data and revised the abstract. All authors have seen and approved the final version of the text for publication.

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Data availability statement No data are available. Data are not available due to the nature of this research being in a refugee settings and UNRWA's legal restrictions.

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