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Adherence to UNRWA's anemia treatment guidelines in the Jerash Camp Health Center, Jordan: a retrospective observational study

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Study was designed by YH, NH, SH and MA. Data was analyzed by YH. Results were interpreted by YH and NH. YH drafted the paper and it was revised by all authors. All authors have seen and approved the final version of the paper.

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Abstract

Objective

The United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) provides primary health care to 2.2 million Palestinian refugees in Jordan. This study aimed to measure patient and doctor adherence to the UNRWA guidelines for the prevention and treatment of iron deficiency anemia in moderate to severe anemia children, defined as hemoglobin (Hb) level<10.0 g/dL.

Design, Setting, and Participants

A retrospective observational study was conducted by analyzing the electronic health records of 800 (398 boys and 402 girls) children aged 12-months old in 2018 in the Jerash Camp Health Center, Jordan.

Outcome

Patient adherence to the UNRWA guidelines was calculated by the proportion of health center visits and doctor adherence by the proportions of Hb tests and iron supplementation among moderate to severe anemia children at screening, 1st, 2nd, and 3rd follow-up visits, respectively.

Results

The prevalence of moderate to severe anemia was 15.6% among 12-month-old children. After one-month of iron supplementation, 83.7% of anemic children improved their Hb status: mean ± SD from 9.1 ± 0.6 g/dL to 10.1 ± 1.0 g/dL. Patient and doctor adherence to the UNRWA guidelines was above 80% at the screening visit but progressively decreased at follow-up visits, especially patient adherence at the 3rd follow-up visit of 34.4%. The analysis revealed unnecessary health center visits and iron supplementation being given to mildly anemic children (Hb level=10.0 g/dL–10.9 g/dL). Additionally, children visited the health center at an age significantly later compared to that recommended by the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits (p-value<0.05).

Conclusion

Adherence to the UNRWA guidelines was above 80% at screening but much lower at follow-up visits. Urgent action is needed to improve adherence at follow-up visits and to minimize any unnecessary health center visits and iron supplementation to mildly anemic children.

Strengths and limitations of this study

- This was the first study analyzed the patient and doctor adherence to the UNRWA's guideline on the prevention and treatment of childhood anemia.
- We included all children aged 12-months old, registerd in the Jerash Health Center operated by the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA).
- Potential confounding factors could not be analyzed due to the lack of information in electronic health records.

Keywords

UNRWA; Palestinian Refugees; Anemia; Hemoglobin; Adherence

Background

Anemia is caused by a decreased quantity of red blood cells, diminished hemoglobin level, or altered morphology of red blood cells.[1] It has been estimated that 2 billion people (25% of the world's population) had anemia globally in 2016, and developing countries accounted for more than 89% of the burden.[2,3] The most common cause of anemia is iron deficiency anemia, affecting 1.2 billion (15% of the world population).[1,2] It happens when there are no mobilizable iron stores because of a prolonged negative iron balance,[4] and young children and women are at high risk.[3] High burden of anemia and iron deficiency anemia among children in Jordan were reported. In 2016, World Health Organization (WHO) estimated that prevalence of anemia, defined as Hb level<11.0 g/dL, was 31.1% among children below 5 years old in Jordan.[5] Additionally, a study conducted among children aged 12–23 months old in Jordan reported that prevalence of anemia, defined as Hb level<11.0 g/dL, was 34.4% in 2002.[6] This study further investigated that the prevalence of iron deficiency anemia, defined as Hb level<11.0 g/dL and serum ferritin level<12.0 µg/L, was 21.3% among children aged 12–23 months old. [6] There is evidence that children below 2 years old with iron deficiency anemia are more susceptible to poorer cognitive, motor, social-emotional, and neurophysiologic development.[7,8] Additionally, children with iron deficiency anemia have a higher risk of mortality and infectious

diseases.[9,10] Because anemia caused by depletion of iron status may be irreversible in young children[4], it is crucial to prevent and treat iron deficiency anemia as early as possible before it becomes severe or chronic to maintain normal growth and development.[11]

Mandated by the United Nations General Assembly, the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) began its operation in 1950 to protect and promote the livelihoods of Palestinian refugees in Jordan, Lebanon, Syria, the West Bank, and the Gaza Strip. UNRWA serves more than 5 million Palestinian refugee to achieve their potential in human development in health, education, and social relief.[12] In Jordan, UNRWA provides serves in 10 refugee camps for 2.2 million Palestinian refugees, which is the largest population among five UNRWA regions.[12] Moreover, UNRWA is the main primary health care provider for Palestinian refugees, and it provides health services free of charge.[12] In 2019, UNRWA reported a high burden of anemia among Palestinian refugee children in Jordan; the overall prevalence of anemia, defined as Hb level<11.0 g/dL, was 39% among 12-month-old children, which could be attributed to continuous food insecurity, low iron intake, and poor dietary habits.[13,14]

UNRWA provides guidelines for the prevention and treatment of iron deficiency anemia for 12-month-old Palestinian refugee children, which consist of mandatory

anemia screening and subsequent treatment instructions[4] based on recommendations by the WHO.[15] According to UNRWA prevention and treatment guideline for micronutrient deficiency (UNRWA guidelines), all children registered in UNRWA health centers should complete anemia screening at the age of 12 months. The UNRWA guidelines define the threshold for diagnosing childhood anemia is Hb level<11 g/dL. The severity of childhood anemia was classified with child Hb status as mild (10.0 g/dL–10.9 g/dL), moderate (7.0 g/dL–9.9 g/dL), and severe (<7.0 g/dL) anemia. If the child is diagnosed as moderate to severely anemic, defined as a Hb level<10 g/dL, they receive iron treatment at a dose of 25 mg elemental iron every day for three months. During the three months of treatment, children need to have repeated Hb tests after one month at the age of 13 months old. If the Hb concentration improves compared to the Hb level at the screening visit, each child continues the iron supplementation for two more months until the age of 15 months, along with dietary counseling by trained nursing staff. Six months after completing the treatment, at the age of 21 months old, a reassessment of Hb level is recommended. By contrast, if the Hb concentration does not improve despite patient and doctor adherence with the iron treatment and the absence of any acute illness, further laboratory tests including Complete Blood Cell Count (CBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Red Cell Distribution (RDW)

and/or referral to a specialist is recommended.[4] The flowchart in Additional file 1 summarizes the UNRWA guidelines and procedure for iron deficiency anemia detection and treatment.

No previous study has been conducted to investigate adherence to the UNRWA guidelines in Jerash Palestinian refugee camp, which is the poorest camp in Jordan.[16] The main aim of this study was to investigate adherence to the UNRWA guidelines among patients and doctors in the Jerash Camp Health Center, Jordan.

Methods

Study design

We conducted a retrospective observational study using data from electronic health records from the Jerash Camp Health Center, operated by UNRWA, to measure patient and doctor adherence to the UNRWA guidelines.

Study setting

Jerash camp was established as an emergency camp in Jordan for Palestinian refugees who fled from the Gaza Strip in 1968 as a consequence of the 1967 Arab–Israeli war. The camp covers an area of 0.75 km^2 for 29,000 Palestinian refugees.[17] In 2013, Jerash camp was reported to be the poorest among 10 Palestinian refugee camps in Jordan, with 52.7% of the population having incomes below the national poverty line of 814 Jordanian Dinars per capita per year.[16,17] Additionally, it was estimated that 88% of refugees in Jerash camp did not have health insurance for secondary or tertiary care by governorate, which was the highest proportion across the 10 refugee camps in Jordan.[16,17]

Inclusion and exclusion criteria

The inclusion criteria were Palestinian refugee children who were aged 12 months old in 2018 (i.e. born between 1st January and 31st December 2017) and registered in the Jerash Camp Health Center. Our exclusion criteria were non-Palestinian refugee children born in Jerash.

Sampling and data collection

There were 800 children registered in the Jerash Camp Health Center who were born in 2017, and all of them were included in the analysis. Because we included the whole study population who met the inclusion criteria in the analysis, we did not conduct a sample size calculation. By accessing the electronic health records from the Jerash Camp Health Center, we collected seven categories of data for each child as shown in Additional file 2. At screening and the 1st, 2nd, and 3rd follow-up visits, the following information was collected: the number of children who visited the health center, age in months at health center visits, the number of children who took the Hb test, their Hb levels, and whether they were prescribed iron supplements. Lastly, for the 1st, 2nd, and 3rd follow-up visits, information on the number of children who took other laboratory tests was also collected. The sex of each child was also recorded from the electronic health records.

Statistical analysis

Relevant electronic health records were extracted from the main UNRWA database and imported into a statistical computing package. Data were summarized using mean and standard deviation (SD) for the continuous variables of child age and child Hb level at each health center visit. For categorical variables, the frequencies and percentages of children who visited the health center, received the Hb test, were diagnosed as anemic, and received iron supplements were calculated. Additionally, for the 1st follow-up visit, the frequencies and percentages of children who improved their Hb status compared to the screening visit were calculated. One-sample t-tests were conducted to investigate whether the mean age at each health center visit was significantly different from the age defined in the UNRWA guidelines, with resulting p-values deemed statistically significant at the 5% level. Based on UNRWA guidelines[4], patient adherence was calculated by the proportion of the health center visits, and doctor adherence was calculated by the proportions of Hb tests and iron supplementation among moderate to severe anemia children at screening, 1st, 2nd, and 3rd follow-up visits, respectively. The definition of patient and doctor adherence is shown in Additional file 3. STATA version 14 was used to conduct the statistical analyses.

Results

Children's flow in Jerash Camp Health Center

Figure 1 illustrates the children's flow of anemia screening and treatment in Jerash Camp Health Center. The electronic health records did not have any information on laboratory values including CBC, MCV, MCH, RDW, or referral to a specialist. Eight hundred children (398 boys and 402 girls) were included in the analysis.

(Figure 1. Children's flow in Jerash Camp Health Center)

Screening visit

Table 1 shows the results of the screening visit. Among 800 children, 717 children (353 boys and 364 girls) came to the screening visit. The mean ± SD age at the screening visit was 12.7 ± 2.2 months old. All 717 children took the Hb test, and 112 (15.6%) children were diagnosed as moderate to severely anemic. Their mean ± SD Hb level was 9.1 ± 0.6 g/dL. Out of 112 children diagnosed as moderate to severely anemic, 91 children received iron supplements. Additionally, out of 247 children diagnosed as mildly anemic, 191 children received iron supplements.

(Table 1. Results of the electronic health record survey for the screening visit)

1st follow-up visit

Table 2 shows the results of the 1st follow-up visit. Out of 112 children diagnosed as moderate to severely anemic at the screening visit, 86 children came to the 1st follow-up visit and their mean ± SD age at the visit was 16.0 ± 3.1 months old. Their mean ± SD Hb level was to 10.1 ± 1.0g/dL. And 72 (83.7%) children improved their Hb level, compared to their screening visit. Out of 72 children who improved their Hb level, 46 children continued to receive iron supplements at the 1st follow-up visit. On the contrary, out of 14 children who did not improve their Hb level, 9 children also received iron supplements. Moreover, out of 247 children diagnosed as mildly at the screening visit, 171 children came to the 1st follow-up visit, respectively.

(Table 2. Results of electronic health record survey for the 1st follow-up visit)

2nd follow-up visit

Table 3 shows the results of the 2nd follow-up visit. Out of 72 anemic children who improved their Hb status at the 1st follow-up visit, 41 children came to the 2nd follow-up visit. Their mean ± SD age at the visit was 20.1 ± 4.9 months old, and the mean ± SD Hb level was further increased to 10.5 ± 1.0 g/dL. There were 8 (20.0%) children who were diagnosed as moderate to severely anemic at the 2nd follow-up visit, and 6 children received iron supplements. Moreover, out of 18 children who were diagnosed as mildly anemic at the 2nd follow-up visit, 17 children received iron supplements.

(Table 3. Results of electronic health record survey for the 2nd follow-up visit)

3rd follow-up visit

Table 4 shows the results of the 3rd follow-up visit. Out of 32 children who were diagnosed as mildly anemic or non-anemic at the 2nd follow-up visit, 11 children came to the 3rd follow-up visit, and their mean ± SD age at the visit was 21.6 ± 3.9 months old. Their mean ± SD Hb level was 10.2 ± 0.9 g/dL, and 3 children (27.2%) were diagnosed as moderate to severely anemic at the 3rd follow-up visit. There were 6 children who received iron supplement at the 3rd follow-up visit.

(Table 4. Results of electronic health record survey for the 3rd follow-up visit)

Overall, we found that children visited the health center at an age significantly later compared to that recommended by the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits (p-value<0.05). However, we did not find a significant delay for the 3rd follow-up visit, compared to the age defined in the UNRWA guidelines (p=0.64).

Adherence to the UNRWA guidelines

Table 5 shows the patient and doctor adherence to the UNRWA guidelines. For the screening visit, patient adherence was 89.6% (95% CI=87.3–91.7). Doctor adherence was

100% for Hb tests and 81.3% (95% CI=72.8–88.0) for iron supplementation. For the 1st follow-up visit, patient adherence was decreased to 76.8% (95% CI=67.9–84.2). Doctor adherence was still 100% for Hb tests; however, iron supplementation was decreased to 63.9% (95% CI=51.7–74.9). For the 2nd follow-up visit, patient adherence was further decreased to 56.9% (95% CI=44.7–68.6). Doctor adherence to Hb tests was slightly decreased to 97.6% (95% CI=87.1–99.9). For the 3rd follow-up visit, patient adherence was further decreased to 34.4% (95% CI=18.6–53.2). Doctor adherence to Hb tests was increased back to 100%.

(Table 5. Adherence to UNRWA guidelines)

Discussion

This study illustrates that patient and doctor adherence to treatment guidelines was above 80% during the screening visit; however, this progressively decreased at follow-up visits, especially patient adherence at the 3rd follow-up visit of 34.4%. Furthermore, the analysis identifies unnecessary health center visits and iron supplement prescriptions to mildly anemic children at the screening and 1st follow-up visit, and children visited the health center at an age significantly later compared to that recommended by the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits (p-value<0.05).

This study shows that there is room to improve patient and doctor adherence to the UNRWA's guidelines. Patient adherence was 89.6% at the screening visit and decreased to 34.4% at the 3rd follow-up visit. Also, doctors adherence to iron supplement was 81.3% at the screening visit and decreased to 63.9% at the 1st follow-up visit. This means that approximately 35% of children at the 1st follow-up visit and 65% of children at the 3rd follow-up visit missed opportunities to be diagnosed and treated for anemia. Additionally, we found that children visited health centers at ages significantly later than recommended in the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits. For example, the mean ± SD age of the 1st follow-up visit was 16.0 ± 3.1 months old, although UNRWA guidelines recommend a 1st follow-up visit at 13 months old.[4] It is

crucial to avoid a delay to health center visits and treatment for anemia because anemia status interferes with normal growth and development[11], otherwise, these impairments may become irreversible[4]. Although patient and doctor adherence to the UNRWA's guidelines should be improved, our study found that the 83.7% of moderate to severely anemic children improved their status through iron supplementation. Therefore, Hb improvement rates via iron supplementation could be increased further if these issues are addressed in the Jerash Camp Health Center.

Our analysis identified unnecessary health center visits and iron supplementation in mildly anemic children. For example, out of 247 children who were diagnosed as mildly anemic at the screening visit, 191 children received iron supplements and 171 children came to the 1st follow-up visit. It has been pointed out that UNRWA's health center tends to be overcrowded, and this may negatively affect the quality of care provided.[18] Furthermore, UNRWA has faced a financial crisis since 2018 by donors ceasing their financial support, and this has negatively affected UNRWA's operation.[19] Thus, it is very important to avoid unnecessary health center visits and iron supplementation to utilize the available resources efficiently.

This study found that the burden of childhood anemia was higher in Jerash Camp Health Center, compared to non-refugee Jordanian children and Palestinian refugee

children in other Jordan's refugee camps. The mean ± SD Hb level at the 12-month-old screening in Jerash Camp Health Center was 10.7 ± 0.9 g/dL, which was lower than the mean ± SD Hb level among non-refugee children aged 12–23 months old in Jordan of 11.2 ± 0.16 g/dL as reported in 2002.[6] Additionally, we found that half of 12-month-old children had an Hb level<11.0 g/dL in Jerash Camp Health Center, which was higher than 12-month-old Palestinian children registered by UNRWA in Jordan of 39.0% as reported in 2019.[13] Palestinian refugees face poor intake of iron source food due to food insecurity[13], and Jerash camp in particular has a higher poverty rate[16], which increases the risk of anemia. UNRWA recommends 6-month exclusive breastfeeding because breast milk contains highly bioavailable iron that helps to restore iron and protect children from infectious diseases[4]. In 2005, a survey conducted by UNRWA reported that only 25% of Palestinian children had exclusive breastfeeding up to 4 months in Jordan which was the lowest proportion among five UNRWA regions.[20] Additionally, a study conducted in Jerash camp reported that mothers could not afford iron rich foods and diverse food to feed their children due to economic hardship.[21] Some mother gave tea to their infants, which is known as an inhibitor of iron absorption.[21,4] This was because mothers faced lactation failure due to their own undernutrition but could not afford to buy formula milk.[21]

This study has important implications for Jerash Camp Health Center; efforts should be made to improve adherence to the UNRWA guidelines, avoid a delay of health center visits, and decrease unnecessary health center visits and iron supplementation. Further studies are needed to understand the reason why adherence was decreased at the follow-up visits, whether mothers were informed about when their children should visit the health center for anemia screening and treatment, and whether doctors correctly understood UNRWA guidelines on when to prescribe iron supplements, especially regarding treatment thresholds between mild anemia and moderate to severe anemia.

This study had several limitations. First, our analysis did not consider potential confounding factors such as socioeconomic status[22–24], food security[10], child anthropometric status[24], and parent's smoking status[23] because there was no such information available in electronic health record, which may be associated with patients adherence to UNRWA's guidelines. Second, the analysis of electronic health records included all children born in 2017 and registered in Jerash Camp Health Center, assuming all of them continued to live in Jerash until 2018 due to lack of data availability. Therefore, the study population (n=800) could be smaller in reality, which would lead to underestimation of adherence to health center visits for the screening visit. Lastly, this study was conducted in Jerash Camp Health Center only, and so findings may not be

readily generalizable to other UNRWA health centers in Jordan or other regions due to the poor economic condition among Palestinian refugees, especially in Jerash camp. Nevertheless, our results provide sufficient stimulus for the need for public health intervention to improve adherence to UNRWA guidelines at follow-up visit and to minimize any unnecessary health center visits and iron supplementation.

Conclusion

We conducted a retrospective observational study to investigate patient and doctor adherence to UNRWA guidelines in Jerash Camp Health Center by analyzing electronic health records. The patient and doctor adherence was progressively decreased at the follow-up visits especially patient adherence at the 3rd follow-up visit. Children visited health center at a significantly later age compared to that recommended by the UNRWA guidelines. Also, the analysis identified unnecessary health center visits and iron supplementation for mildly anemic children. Further studies are needed to understand why patient and doctor adherence to UNRWA guidelines is lower at follow-up visits, and whether similar patterns are observed in other UNRWA health centers. Furthermore, in order to maximize efficacy of scant UNRWA resources, urgent action is required to improve the adherence to the UNRWA's guidelines and minimize unnecessary health center visits and iron supplementation.

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Competing interests

The authors declare that they have no competing interests.

Patient consent for publication

No patient involved.

Ethics approval

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the

research review board of UNRWA Headquarters in Amman. There was no potential harm expected in the study. There was no reference number for the ethics approval because UNRWA did not have a system to give identification numbers when this study was approved by the research review board.

Data availability statement

All data relevant to the study are included in the article or as supplementary information. Some restrictions will apply for the availability of data.

Word count

3133 words

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Figures

Figure 1. Children's flow in Jerash Camp Health Center

Tables

Table 1. Results of the electronic health record survey for the screening visit

	Children registered in Jerash Camp Health Center (n=800)		
Visit to the health center, n		717	
Mean age in months, (SD)		12.7 (2.2)[1)]	
Children who received Hb test, n		717	
Mean Hb level in g/dL, (SD)		10.7 (0.9)	
	Non-anemia (Hb ≥ 11.0g/dL)	Mild anemia (Hb=10.0–10.9 g/dL)	Moderate to severe anemia (Hb<10.0 g/ dL)
Anemia status at the screening visit, n (%)	358 (49.9)	247 (34.4)	112 (15.6)
Mean Hb level in g/dL, (SD)	11.4 (0.3)	10.4 (0.2)	9.1 (0.6)
Children who received iron supplements, n	19	191	91

1) p-value<0.05, compared to the recommended age of 12 months by the UNRWA guidelines

Table 2. Results of the electronic health record survey for the 1st follow-up visit

	Children diagnosed as moderate to severely anemic at the screening visit (n=112)	
Visits to the health center, n	86	
Mean age in months, (SD)	16.0 (3.1)[1)]	
Children who received Hb test, n	86	
Mean Hb level in g/dL, (SD)	10.1 (1.0)	
Children with improved Hb, n (%)	72 (83.7)	
	Improved Hb (n=72)	Not improved Hb (n=14)
Children who received iron supplements, n	46	9

1) p-value<0.05, compared to the recommended age of 13 months by the UNRWA guidelines

Table 3. Results of the electronic health record survey for the 2nd follow-up visit

	Children with improved Hb at the 1st follow-up visit (n=72)		
Visit to the health center, n	41		
Mean age in months (SD)	20.1 (4.9)[1)]		
Children who received Hb test, n	40		
Mean Hb level in g/dL, (SD)	10.5 (1.0)		
	Non-anemia (Hb ≥ 10.0g/dL)	Mild anemia (Hb=10.0–10.9 g/dL)	Moderate to severe anemia (Hb<10.0 g/ dL)
Anemia status at the 2nd follow-up visit, n (%)	14 (35.0)	18 (45.0)	8 (20.0)
Mean Hb level in g/dL, (SD)	11.5 (0.4)	10.4 (0.3)	9.0 (0.7)
Children who received iron supplements, n	3	17	6

1) p-value<0.05, compared to the recommended age of 15 months by the UNRWA guidelines

Table 4. Results of the electronic record survey for the 3rd follow-up visit

	Children diagnosed as mildly anemic or non-anemia at the 2nd follow-up visit (n=32)		
Visit to the health center, n		11	
Mean age in months (SD)		21.6 (3.9)[1)]	
Children who received Hb test, n		11	
Mean Hb level in g/dL, SD		10.2 (0.9)	
	Non-anemia (Hb ≥ 10.0g/dL)	Mild anemia (Hb=10.0–10.9 g/dL)	Moderate to severe anemia (Hb<10.0 g/ dL)
Anemia status at the 3rd follow-up visit	3 (27.3)	5 (45.5)	3 (27.3)
Mean Hb level in g/dL, (SD)	11.2 (0.1)	10.4 (0.4)	9.0 (0.5)
Children who received iron supplements, n	1	4	1

1) p-value=0.64, compared to the recommended age of 21 month by the UNRWA guidelines

Table 5. Adherence to UNRWA guidelines

	Screening visit	1st follow-up visit	2nd follow-up visit	3rd follow-up visit
Patient adherence				
Health center visits, % (95% CI)	89.6 (87.3–91.7)	76.8 (67.9–84.2)	56.9 (44.7–68.6)	34.4 (18.6–53.2)
Doctor adherence				
Hb tests, % (95% CI)	100.0	100.0	97.6 (87.1–99.9)	100.0
Iron supplementation, % (95% CI)	81.3 (72.8–88.0)	63.9 (51.7–74.9)	N/A	N/A

Additional Files

Additional file 1. Flow chart of the UNRWA guidelines

Additional file 2. Data collected for each child from the electronic health records

Additional file 3. Case definition of electronic health record

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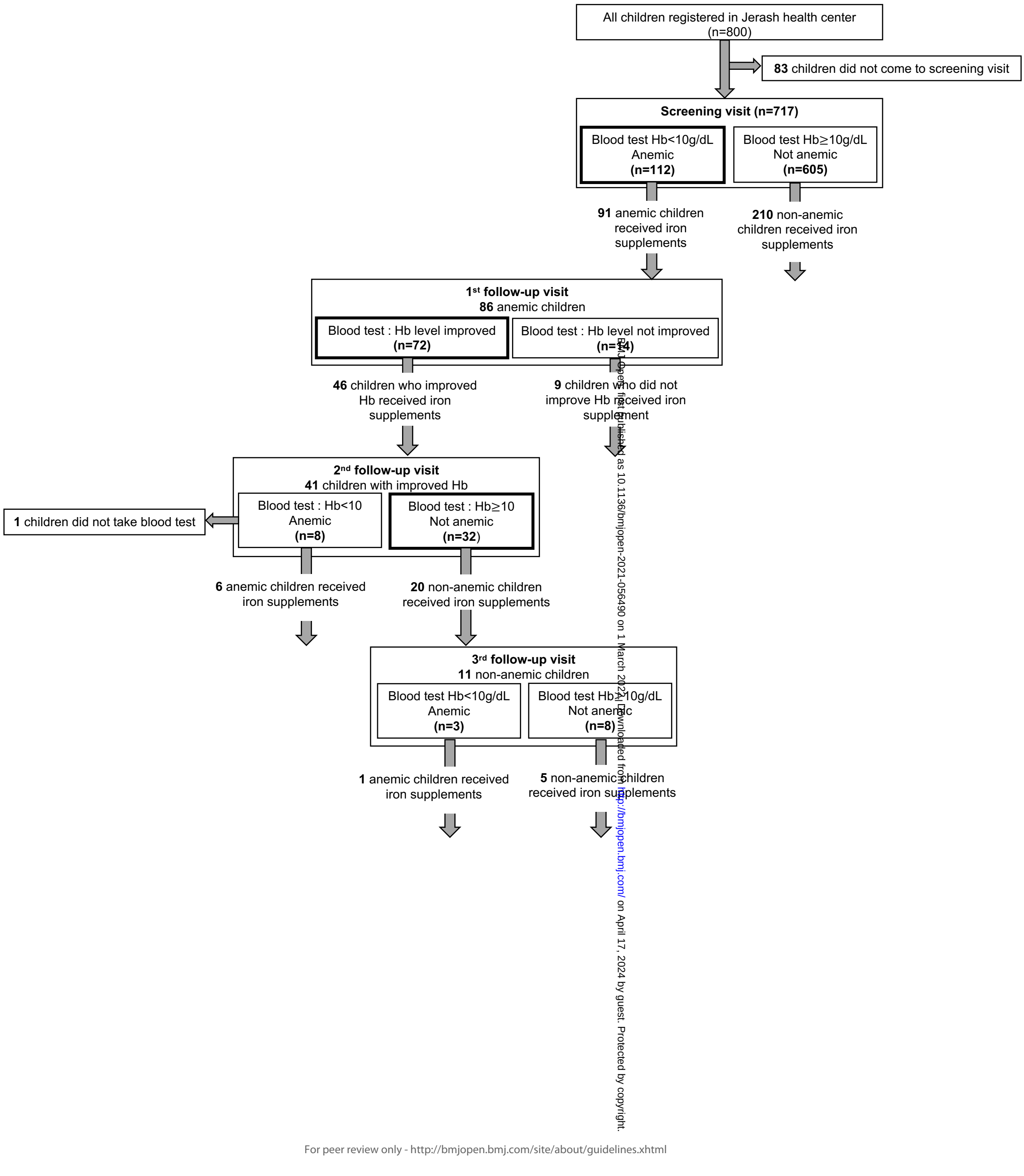
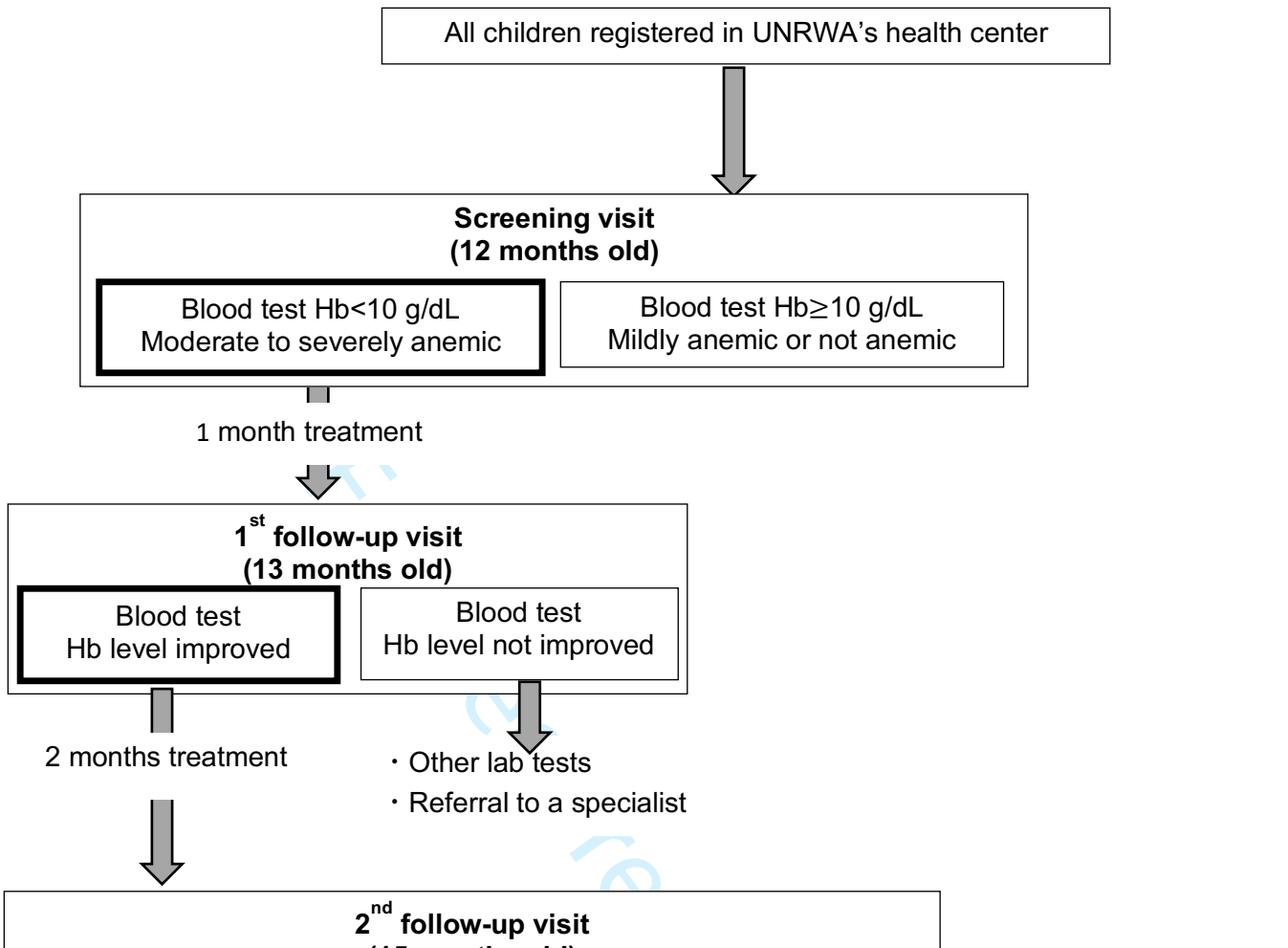
Figure 1. Children's flow in Jerash Camp Health Center



Additional file 1. Flow chart of the UNRWA guidelines



Additional file 2. Data collected for each child from the electronic health records

	Collected data	Stage of information
1	Children aged 12 months old in 2018	Screening visit
2	Children who visited the health center	Screening visits, 1st, 2nd, 3rd follow-up visit
3	Age in months of health center visits	Screening visits, 1st, 2nd, 3rd follow-up visit
4	Children who took the Hb test	Screening visits, 1st, 2nd, 3rd follow-up visit
5	Children's Hb level	Screening visits, 1st, 2nd, 3rd follow-up visit
6	Children who took other laboratory tests	1st, 2nd, 3rd follow-up visit
7	Children who were prescribed the iron supplements	Screening visits, 1st, 2nd, 3rd follow-up visit

Additional file 3. Case definition of electronic health record

1. Patient adherence by health center visits (%)

$$\text{Screening visit} = \frac{\text{Number of children at the screening visit}}{\text{Number of children aged 12 months old}} \times 100$$

$$1^{st} \text{ follow-up visit} = \frac{\text{Number of children at the 1st follow-up visit}}{\text{Number of moderate to severely anemic children at the screening visit}} \times 100$$

$$2^{nd} \text{ follow-up visit} = \frac{\text{Number of children at the 2nd follow-up visit}}{\text{Number of children who improved their Hb level}} \times 100$$

$$3^{rd} \text{ follow-up visit} = \frac{\text{Number of children at the 3rd follow-up visit}}{\text{Number of mildly anemic or non-anemic children at the 2nd follow-up visit}} \times 100$$

2. Doctor adherence by Hb tests (%)

$$\text{Screening visit} = \frac{\text{Number of children receiving Hb tests at the screening visit}}{\text{Number of children at the screening visit}} \times 100$$

$$1^{st} \text{ follow-up visit} = \frac{\text{Number of children receiving Hb tests at the 1st follow-up visit}}{\text{Number of children at the 1st follow-up visit}} \times 100$$

$$2^{nd} \text{ follow-up visit} = \frac{\text{Number of children receiving Hb tests at the 2nd follow-up visit}}{\text{Number of children at the 2nd follow-up visit}} \times 100$$

$$3^{nd} \text{ follow-up visit} = \frac{\text{Number of children receiving Hb tests at the 3rd follow-up visit}}{\text{Number of children at the 3rd follow-up visit}} \times 100$$

3. Doctor adherence by iron supplementation (%)

$$\text{Screening visit} = \frac{\text{Number of children receiving iron supplements at the screening visit}}{\text{Number of moderate to severely anemic children at the screening visit}} \times 100$$

$$1^{st} \text{ follow-up visit} = \frac{\text{Number of children receiving iron supplements at the 1st follow-up visit}}{\text{Number of children with increased Hb level at the 1st follow-up visit}} \times 100$$

Doctor adherence to iron supplementation for the 2nd and 3rd follow-up visits was not defined because children should not receive iron supplements at the 2nd and 3rd follow-ups visits, as defined in the UNRWA guidelines.

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	Title (P1) Abstract (P2)	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	1.1 Title (P1), Abstract (P2) 1.2 Abstract (P2) 1.3 N/A
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction (P7-10)		
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction (P10)		
Methods					
Study Design	4	Present key elements of study design early in the paper	Method (P11)		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Method (P11-12)		

Participants	6	*(a) Cohort study* - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study* - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study* - Give the eligibility criteria, and the sources and methods of selection of participants *(b) Cohort study* - For matched studies, give matching criteria and number of exposed and unexposed *Case-control study* - For matched studies, give matching criteria and the number of controls per case	Method (P11-12)	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided. RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided. RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	6.1 Method (P12) 6.2 N/A 6.3 N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	Method (P12)	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	Method (P12) Additional file 3
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	Method (P12)		

Bias	9	Describe any efforts to address potential sources of bias	N/A		
Study size	10	Explain how the study size was arrived at	Method (P12)		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Method (P13) Additional file 3		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) *Cohort study* - If applicable, explain how loss to follow-up was addressed *Case-control study* - If applicable, explain how matching of cases and controls was addressed *Cross-sectional study* - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	Method (P13)		
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.	12.1Method (P12)

				RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	12.2Method (P13)
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	N/A
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (*e.g.*, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	Result (P14-16)	RECORD 13.1: Describe in detail the selection of the persons included in the study (*i.e.,* study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	Result (P14-16) Figure1
Descriptive data	14	(a) Give characteristics of study participants (*e.g.*, demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) *Cohort study* - summarise follow-up time (*e.g.*, average and total amount)	Result (P14-16)		
Outcome data	15	*Cohort study* - Report numbers of outcome events or summary measures over time *Case-control study* - Report numbers in each exposure	Result (P14-16)		

		category, or summary measures of exposure *Cross-sectional study* - Report numbers of outcome events or summary measures			
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Result (P16)		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	N/A		
Discussion					
Key results	18	Summarise key results with reference to study objectives	Discussion (P18)		
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	Discussion (P21)	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	Discussion (P21)
Interpretation	20	Give a cautious overall interpretation of results considering objectives,	Discussion (P21)		

		limitations, multiplicity of analyses, results from similar studies, and other relevant evidence			
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion (P21)		
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	P21		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	P25

*Reference: Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.

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Adherence to UNRWA's anemia treatment guidelines in the Jerash Camp Health Center, Jordan: a retrospective observational study

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Contributors

YH, NK, SH, MA and MH designed the study. YH analyzed data. YH and NK interpreted results. YH drafted the paper and NK, SH, MA, MH, SA, KN, MH, RH, and AS have seen and approved the final version of the paper.

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Abstract

Objective

The United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) provides primary health care to 2.2 million Palestinian refugees in Jordan. This study aimed to measure patient and doctor adherence to the UNRWA guidelines for the prevention and treatment of iron deficiency anemia in moderate to severe anemia children, defined as hemoglobin (Hb) level<10.0 g/dL.

Design, Setting, and Participants

A retrospective observational study was conducted by analyzing the electronic health records of 717 children (353 boys and 364 girls) children aged 12-months old in 2018 in the Jerash Camp Health Center, Jordan.

Outcome

Patient adherence to the UNRWA guidelines was calculated by the proportion of health center visits and doctor adherence by the proportions of Hb tests and iron supplementation among moderate to severe anemia children at screening, 1st, 2nd, and 3rd follow-up visits, respectively using STATA.

Results

The prevalence of moderate to severe anemia was 15.6% among 12-month-old children. After one-month of iron supplementation, 83.7% of anemic children improved their Hb status: mean ± SD from 9.1 ± 0.6 g/dL to 10.1 ± 1.0 g/dL. Patient and doctor adherence to the UNRWA guidelines was above 80% at the screening visit but progressively decreased at follow-up visits, especially patient adherence at the 3rd follow-up visit of 34.4%. The analysis revealed unnecessary health center visits and iron supplementation being given to mildly anemic children (Hb level=10.0 g/dL–10.9 g/dL). Additionally, children visited the health center at an age significantly later compared to that recommended by the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits (p-value<0.05).

Conclusion

Adherence to the UNRWA guidelines was above 80% at screening but much lower at follow-up visits. Urgent action is needed to improve adherence at follow-up visits and to minimize any unnecessary health center visits and iron supplementation to mildly anemic children.

Strengths and limitations of this study

- This was the first study analyzed the patient and doctor adherence to the UNRWA's guideline on the prevention and treatment of childhood anemia.
- We included all children aged 12-months old, registerd in the Jerash Health Center operated by the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA).
- Potential confounding factors could not be analyzed due to the lack of information in electronic health records.

Keywords

UNRWA; Palestinian Refugees; Anemia; Hemoglobin; Adherence

Background

Anemia is caused by a decreased quantity of red blood cells, diminished hemoglobin level, or altered morphology of red blood cells.[1] It has been estimated that 2 billion people (25% of the world's population) had anemia globally in 2016, and developing countries accounted for more than 89% of the burden.[2,3] The most common cause of anemia is iron deficiency anemia, affecting 1.2 billion (15% of the world population).[1,2] It happens when there are no mobilizable iron stores because of a prolonged negative iron balance,[4] and young children and women are at high risk.[3] High burden of anemia and iron deficiency anemia among children in Jordan were reported. In 2016, World Health Organization (WHO) estimated that prevalence of anemia, defined as Hb level<11.0 g/dL, was 31.1% among children below 5 years old in Jordan.[5] Additionally, a study conducted among children aged 12–23 months old in Jordan reported that prevalence of anemia, defined as Hb level<11.0 g/dL, was 34.4% in 2002.[6] This study further investigated that the prevalence of iron deficiency anemia, defined as Hb level<11.0 g/dL and serum ferritin level<12.0 µg/L, was 21.3% among children aged 12–23 months old. [6] There is evidence that children below 2 years old with iron deficiency anemia are more susceptible to poorer cognitive, motor, social-emotional, and neurophysiologic development.[7,8] Additionally, children with iron deficiency anemia have a higher risk of mortality and infectious

diseases.[9,10] Because anemia caused by depletion of iron status may be irreversible in young children[4], it is crucial to prevent and treat iron deficiency anemia as early as possible before it becomes severe or chronic to maintain normal growth and development.[11,12]

In Jordan, the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) provides serves in 10 refugee camps for 2.2 million Palestinian refugees.[13] UNRWA is the main primary health care provider for Palestinian refugees, and it provides health services free of charge.[13] In 2019, UNRWA reported a high burden of anemia among Palestinian refugee children in Jordan; the overall prevalence of anemia, defined as Hb level<11.0 g/dL, was 39% among 12-month-old children, which could be attributed to continuous food insecurity, low iron intake, and poor dietary habits.[14,15]

UNRWA provides guidelines for the prevention and treatment of iron deficiency anemia for 12-month-old Palestinian refugee children, which consist of mandatory anemia screening and subsequent treatment instructions[4] based on recommendations by the WHO.[16] According to UNRWA prevention and treatment guideline for micronutrient deficiency (UNRWA guidelines), all children registered in UNRWA health centers should complete anemia screening at the age of 12 months. The UNRWA guidelines define the threshold for diagnosing childhood anemia is Hb level<11 g/dL. The severity

of childhood anemia was classified with child Hb status as mild (10.0 g/dL–10.9 g/dL), moderate (7.0 g/dL–9.9 g/dL), and severe (<7.0 g/dL) anemia. If the child is diagnosed as moderate to severely anemic, defined as a Hb level<10 g/dL, they receive iron treatment at a dose of 25 mg elemental iron every day for three months. During the three months of treatment, children need to have repeated Hb tests after one month at the age of 13 months old. If the Hb concentration improves compared to the Hb level at the screening visit, each child continues the iron supplementation for two more months until the age of 15 months, along with dietary counseling by trained nursing staff. Six months after completing the treatment, at the age of 21 months old, a reassessment of Hb level is recommended. By contrast, if the Hb concentration does not improve despite patient and doctor adherence with the iron treatment and the absence of any acute illness, further laboratory tests including Complete Blood Cell Count (CBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Red Cell Distribution (RDW) and/or referral to a specialist is recommended.[4] The flowchart in Additional file 1 summarizes the UNRWA guidelines and procedure for iron deficiency anemia detection and treatment.

No previous study has been conducted to investigate adherence to the UNRWA guidelines in Jerash Palestinian refugee camp, which is the poorest camp in Jordan.[17] The

main aim of this study was to investigate adherence to the UNRWA guidelines among patients and doctors in the Jerash Camp Health Center, Jordan.

Methods

Study design

A retrospective observational study was conducted using data from electronic health records from the Jerash Camp Health Center, operated by UNRWA, to measure patient and doctor adherence to the UNRWA guidelines.

Study setting

Jerash camp was established as an emergency camp in Jordan for Palestinian refugees who fled from the Gaza Strip in 1968 as a consequence of the 1967 Arab–Israeli war. The camp covers an area of 0.75 km^2 for 29,000 Palestinian refugees.[18] In 2013, Jerash camp was reported to be the poorest among 10 Palestinian refugee camps in Jordan, with 52.7% of the population having incomes below the national poverty line of 814 Jordanian Dinars per capita per year.[17,18] Additionally, it was estimated that 88% of refugees in Jerash camp did not have health insurance for secondary or tertiary care by governorate, and 42% of the population were reported to experience catastrophic health expenditure.[17–19]

Eligibility criteria and sampling

The inclusion criteria were Palestinian refugee children who were aged 12 months old in 2018 (i.e. born between 1st January and 31st December 2017) and registered in the Jerash Camp Health Center. Our exclusion criteria were non-Palestinian refugee children born in Jerash. There were 800 children registered in the Jerash Camp Health Center who were born in 2017, and all of them were included in the analysis. Because we included the whole study population who met the inclusion criteria in the analysis, we did not conduct a sample size calculation. By accessing the electronic health records from the Jerash Camp Health Center, we collected seven categories of data for each child as shown in Additional file 2. At screening and the 1st, 2nd, and 3rd follow-up visits, the following information was collected: the number of children who visited the health center, age in months at health center visits, the number of children who took the Hb test, their Hb levels, and whether they were prescribed iron supplements. Lastly, for the 1st, 2nd, and 3rd follow-up visits, information on the number of children who took other laboratory tests was also collected. The sex of each child was also recorded from the electronic health records.

Statistical analysis

Relevant electronic health records were extracted from the main UNRWA database and imported into a statistical computing package. Data were summarized using mean and

standard deviation (SD) for the continuous variables of child age and child Hb level at each health center visit. For categorical variables, the frequencies and percentages of children who visited the health center, received the Hb test, were diagnosed as anemic, and received iron supplements were calculated. Additionally, for the 1st follow-up visit, the frequencies and percentages of children who improved their Hb status compared to the screening visit were calculated. One-sample t-tests were conducted to investigate whether the mean age at each health center visit was significantly different from the age defined in the UNRWA guidelines, with resulting p-values deemed statistically significant at the 5% level. Based on UNRWA guidelines[4], patient adherence was calculated by the proportion of the health center visits, and doctor adherence was calculated by the proportions of Hb tests and iron supplementation among moderate to severe anemia children at screening, 1st, 2nd, and 3rd follow-up visits, respectively. The definition of patient and doctor adherence is shown in Additional file 3. STATA version 14 was used to conduct the statistical analyses.

Patient and Public Involvement

No patients or members of the public were involved in the design of this study.

Results

Children's flow in Jerash Camp Health Center

Figure 1 illustrates the children's flow of anemia screening and treatment in Jerash Camp Health Center. The electronic health records did not have any information on laboratory values including CBC, MCV, MCH, RDW, or referral to a specialist. Eight hundred children (398 boys and 402 girls) were included in the analysis.

(Figure 1. Children's flow in Jerash Camp Health Center)

Screening visit

Table 1 shows the results of the screening visit. Among 800 children, 717 children (353 boys and 364 girls) came to the screening visit so these 717 children were included in the analysis. The mean ± SD age at the screening visit was 12.7 ± 2.2 months old. All 717 children took the Hb test, and 112 (15.6%) children were diagnosed as moderate to severely anemic. Their mean ± SD Hb level was 9.1 ± 0.6 g/dL. Out of 112 children diagnosed as moderate to severely anemic, 91 children received iron supplements. Additionally, out of 247 children diagnosed as mildly anemic, 191 children received iron supplements.

(Table 1. Results of the electronic health record survey for the screening visit)

1st follow-up visit

Table 2 shows the results of the 1st follow-up visit. Out of 112 children diagnosed as moderate to severely anemic at the screening visit, 86 children came to the 1st follow-up visit and their mean ± SD age at the visit was 16.0 ± 3.1 months old. Their mean ± SD Hb level was to 10.1 ± 1.0g/dL. And 72 (83.7%) children improved their Hb level, compared to their screening visit. Out of 72 children who improved their Hb level, 46 children continued to receive iron supplements at the 1st follow-up visit. On the contrary, out of 14 children who did not improve their Hb level, 9 children also received iron supplements. Moreover, out of 247 children diagnosed as mildly at the screening visit, 171 children came to the 1st follow-up visit, respectively.

(Table 2. Results of electronic health record survey for the 1st follow-up visit)

2nd follow-up visit

Table 3 shows the results of the 2nd follow-up visit. Out of 72 anemic children who improved their Hb status at the 1st follow-up visit, 41 children came to the 2nd follow-up visit. Their mean ± SD age at the visit was 20.1 ± 4.9 months old, and the mean ± SD Hb level was further increased to 10.5 ± 1.0 g/dL. There were 8 (20.0%) children who were diagnosed as moderate to severely anemic at the 2nd follow-up visit, and 6 children

received iron supplements. Moreover, out of 18 children who were diagnosed as mildly anemic at the 2nd follow-up visit, 17 children received iron supplements.

(Table 3. Results of electronic health record survey for the 2nd follow-up visit)

3rd follow-up visit

Table 4 shows the results of the 3rd follow-up visit. Out of 32 children who were diagnosed as mildly anemic or non-anemic at the 2nd follow-up visit, 11 children came to the 3rd follow-up visit, and their mean ± SD age at the visit was 21.6 ± 3.9 months old. Their mean ± SD Hb level was 10.2 ± 0.9 g/dL, and 3 children (27.2%) were diagnosed as moderate to severely anemic at the 3rd follow-up visit. There were 6 children who received iron supplement at the 3rd follow-up visit.

(Table 4. Results of electronic health record survey for the 3rd follow-up visit)

Overall, we found that children visited the health center at an age significantly later compared to that recommended by the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits (p-value<0.05). However, we did not find a significant delay for the 3rd follow-up visit, compared to the age defined in the UNRWA guidelines (p=0.64).

Adherence to the UNRWA guidelines

Table 5 shows the patient and doctor adherence to the UNRWA guidelines. For the screening visit, patient adherence was 89.6% (95% CI=87.3–91.7). Doctor adherence was 100% for Hb tests and 81.3% (95% CI=72.8–88.0) for iron supplementation. For the 1st follow-up visit, patient adherence was decreased to 76.8% (95% CI=67.9–84.2). Doctor adherence was still 100% for Hb tests; however, iron supplementation was decreased to 63.9% (95% CI=51.7–74.9). For the 2nd follow-up visit, patient adherence was further decreased to 56.9% (95% CI=44.7–68.6). Doctor adherence to Hb tests was slightly decreased to 97.6% (95% CI=87.1–99.9). For the 3rd follow-up visit, patient adherence was further decreased to 34.4% (95% CI=18.6–53.2). Doctor adherence to Hb tests was increased back to 100%.

(Table 5. Adherence to UNRWA guidelines)

Discussion

This study illustrates that patient and doctor adherence to treatment guidelines was above 80% during the screening visit; however, this progressively decreased at follow-up visits, especially patient adherence at the 3rd follow-up visit of 34.4%. Furthermore, the analysis identifies unnecessary health center visits and iron supplement prescriptions to mildly anemic children at the screening and 1st follow-up visit, and children visited the health center at an age significantly later compared to that recommended by the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits (p-value<0.05).

This study shows that there is room to improve patient and doctor adherence to the UNRWA's guidelines. Patient adherence was 89.6% at the screening visit and decreased to 34.4% at the 3rd follow-up visit. Also, doctors adherence to iron supplement was 81.3% at the screening visit and decreased to 63.9% at the 1st follow-up visit. This means that approximately 35% of children at the 1st follow-up visit and 65% of children at the 3rd follow-up visit missed opportunities to be diagnosed and treated for anemia. Additionally, we found that children visited health centers at ages significantly later than recommended in the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits. For example, the mean ± SD age of the 1st follow-up visit was 16.0 ± 3.1 months old, although UNRWA guidelines recommend a 1st follow-up visit at 13 months old.[4] It is

crucial to avoid a delay to health center visits and treatment for anemia because anemia status interferes with normal growth and development[11], otherwise, these impairments may become irreversible[4]. Although patient and doctor adherence to the UNRWA's guidelines should be improved, our study found that the 83.7% of moderate to severely anemic children improved their status through iron supplementation. Therefore, Hb improvement rates via iron supplementation could be increased further if these issues are addressed in the Jerash Camp Health Center.

Our analysis identified unnecessary health center visits and iron supplementation in mildly anemic children. For example, out of 247 children who were diagnosed as mildly anemic at the screening visit, 191 children received iron supplements and 171 children came to the 1st follow-up visit. It has been pointed out that UNRWA's health center tends to be overcrowded, and this may negatively affect the quality of care provided.[20] Furthermore, UNRWA has faced a financial crisis since 2018 by donors ceasing their financial support, and this has negatively affected UNRWA's operation.[21] Thus, it is very important to avoid unnecessary health center visits and iron supplementation to utilize the available resources efficiently.

This study found that the burden of childhood anemia was higher in Jerash Camp Health Center, compared to non-refugee Jordanian children and Palestinian refugee

children in other Jordan's refugee camps. The mean ± SD Hb level at the 12-month-old screening in Jerash Camp Health Center was 10.7 ± 0.9 g/dL, which was lower than the mean ± SD Hb level among non-refugee children aged 12–23 months old in Jordan of 11.2 ± 0.16 g/dL as reported in 2002.[6] Additionally, we found that half of 12-month-old children had an Hb level<11.0 g/dL in Jerash Camp Health Center, which was higher than 12-month-old Palestinian children registered by UNRWA in Jordan of 39.0% and 6-12 months children in Jerash governorate of 36.9% in 2019.[14,22] Palestinian refugees face poor intake of iron source food due to food insecurity[14], and Jerash camp in particular has a higher poverty rate[17], which increases the risk of anemia. UNRWA recommends 6-month exclusive breastfeeding because breast milk contains highly bioavailable iron that helps to restore iron and protect children from infectious diseases[4]. In 2005, a survey conducted by UNRWA reported that only 25% of Palestinian children had exclusive breastfeeding up to 4 months in Jordan which was the lowest proportion among five UNRWA regions.[23] Additionally, a study conducted in Jerash camp reported that mothers could not afford iron rich foods and diverse food to feed their children due to economic hardship.[24] Some mother gave tea to their infants, which is known as an inhibitor of iron absorption.[24,4] This was because mothers faced lactation failure due to their own undernutrition but could not afford to buy formula milk.[24]

This study has important implications for Jerash Camp Health Center; efforts should be made to improve adherence to the UNRWA guidelines, avoid a delay of health center visits, and decrease unnecessary health center visits and iron supplementation. Further studies are needed to understand the reason why adherence was decreased at the follow-up visits, whether mothers were informed about when their children should visit the health center for anemia screening and treatment, and whether doctors correctly understood UNRWA guidelines on when to prescribe iron supplements, especially regarding treatment thresholds between mild anemia and moderate to severe anemia.

This study had several limitations. First, our analysis did not consider potential confounding factors such as socioeconomic status[25–27], food security[10], child anthropometric status[27], and parent's smoking status[26] because there was no such information available in electronic health record, which may be associated with patients adherence to UNRWA's guidelines. Second, the analysis of electronic health records included all children born in 2017 and registered in Jerash Camp Health Center, assuming all of them continued to live in Jerash until 2018 due to lack of data availability. Therefore, the study population (n=800) could be smaller in reality, which would lead to underestimation of adherence to health center visits for the screening visit. Lastly, this study was conducted in Jerash Camp Health Center only, and so findings may not be

readily generalizable to other UNRWA health centers in Jordan or other regions due to the poor economic condition among Palestinian refugees, especially in Jerash camp. Nevertheless, our results provide sufficient stimulus for the need for public health intervention to improve adherence to UNRWA guidelines at follow-up visit and to minimize any unnecessary health center visits and iron supplementation.

Conclusion

We conducted a retrospective observational study to investigate patient and doctor adherence to UNRWA guidelines in Jerash Camp Health Center by analyzing electronic health records. The patient and doctor adherence was progressively decreased at the follow-up visits especially patient adherence at the 3rd follow-up visit. Children visited health center at a significantly later age compared to that recommended by the UNRWA guidelines. Also, the analysis identified unnecessary health center visits and iron supplementation for mildly anemic children. Further studies are needed to understand why patient and doctor adherence to UNRWA guidelines is lower at follow-up visits, and whether similar patterns are observed in other UNRWA health centers. Furthermore, in order to maximize efficacy of scant UNRWA resources, urgent action is required to improve the adherence to the UNRWA's guidelines and minimize unnecessary health center visits and iron supplementation.

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Funding

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Competing interests

The authors declare that they have no competing interests.

Patient consent for publication

No patient involved.

Ethics approval

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the

research review board of UNRWA Headquarters in Amman. There was no potential harm expected in the study. There was no reference number for the ethics approval because UNRWA did not have a system to give identification numbers when this study was approved by the research review board.

Data availability statement

All data relevant to the study are included in the article or as supplementary information. Some restrictions will apply for the availability of data.

Word count

3133 words

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Figures

Figure 1. Children's flow in Jerash Camp Health Center

Tables

Table 1. Results of the electronic health record survey for the screening visit

	Children registered in Jerash Camp Health Center (n=800)		
Visit to the health center, n		717	
Mean age in months, (SD)		12.7 (2.2)[1]	
Children who received Hb test, n		717	
Mean Hb level in g/dL, (SD)		10.7 (0.9)	
	Non-anemia (Hb ≥ 11.0g/dL)	Mild anemia (Hb=10.0–10.9 g/dL)	Moderate to severe anemia (Hb<10.0 g/ dL)
Anemia status at the screening visit, n (%)	358 (49.9)	247 (34.4)	112 (15.6)
Mean Hb level in g/dL, (SD)	11.4 (0.3)	10.4 (0.2)	9.1 (0.6)
Children who received iron supplements, n	19	191	91

1) p-value<0.05, compared to the recommended age of 12 months by the UNRWA guidelines

Table 2. Results of the electronic health record survey for the 1st follow-up visit

	Children diagnosed as moderate to severely anemic at the screening visit (n=112)	
Visits to the health center, n	86	
Mean age in months, (SD)	16.0 (3.1)[1)]	
Children who received Hb test, n	86	
Mean Hb level in g/dL, (SD)	10.1 (1.0)	
Children with improved Hb, n (%)	72 (83.7)	
	Improved Hb (n=72)	Not improved Hb (n=14)
Children who received iron supplements, n	46	9

1) p-value<0.05, compared to the recommended age of 13 months by the UNRWA guidelines

Table 3. Results of the electronic health record survey for the 2nd follow-up visit

	Children with improved Hb at the 1st follow-up visit (n=72)		
Visit to the health center, n	41		
Mean age in months (SD)	20.1 (4.9)[1)]		
Children who received Hb test, n	40		
Mean Hb level in g/dL, (SD)	10.5 (1.0)		
	Non-anemia (Hb ≥ 10.0g/dL)	Mild anemia (Hb=10.0–10.9 g/dL)	Moderate to severe anemia (Hb<10.0 g/ dL)
Anemia status at the 2nd follow-up visit, n (%)	14 (35.0)	18 (45.0)	8 (20.0)
Mean Hb level in g/dL, (SD)	11.5 (0.4)	10.4 (0.3)	9.0 (0.7)
Children who received iron supplements, n	3	17	6

1) p-value<0.05, compared to the recommended age of 15 months by the UNRWA guidelines

Table 4. Results of the electronic record survey for the 3rd follow-up visit

	Children diagnosed as mildly anemic or non-anemia at the 2nd follow-up visit (n=32)		
Visit to the health center, n		11	
Mean age in months (SD)		21.6 (3.9)[1)]	
Children who received Hb test, n		11	
Mean Hb level in g/dL, SD		10.2 (0.9)	
	Non-anemia (Hb ≥ 10.0g/dL)	Mild anemia (Hb=10.0–10.9 g/dL)	Moderate to severe anemia (Hb<10.0 g/ dL)
Anemia status at the 3rd follow-up visit	3 (27.3)	5 (45.5)	3 (27.3)
Mean Hb level in g/dL, (SD)	11.2 (0.1)	10.4 (0.4)	9.0 (0.5)
Children who received iron supplements, n	1	4	1

1) p-value=0.64, compared to the recommended age of 21 month by the UNRWA guidelines

Table 5. Adherence to UNRWA guidelines

	Screening visit	1st follow-up visit	2nd follow-up visit	3rd follow-up visit
Patient adherence				
Health center visits, % (95% CI)	89.6 (87.3–91.7)	76.8 (67.9–84.2)	56.9 (44.7–68.6)	34.4 (18.6–53.2)
Doctor adherence				
Hb tests, % (95% CI)	100.0	100.0	97.6 (87.1–99.9)	100.0
Iron supplementation, % (95% CI)	81.3 (72.8–88.0)	63.9 (51.7–74.9)	N/A	N/A

Additional Files

Additional file 1. Flow chart of the UNRWA guidelines

Additional file 2. Data collected for each child from the electronic health records

Additional file 3. Case definition of electronic health record

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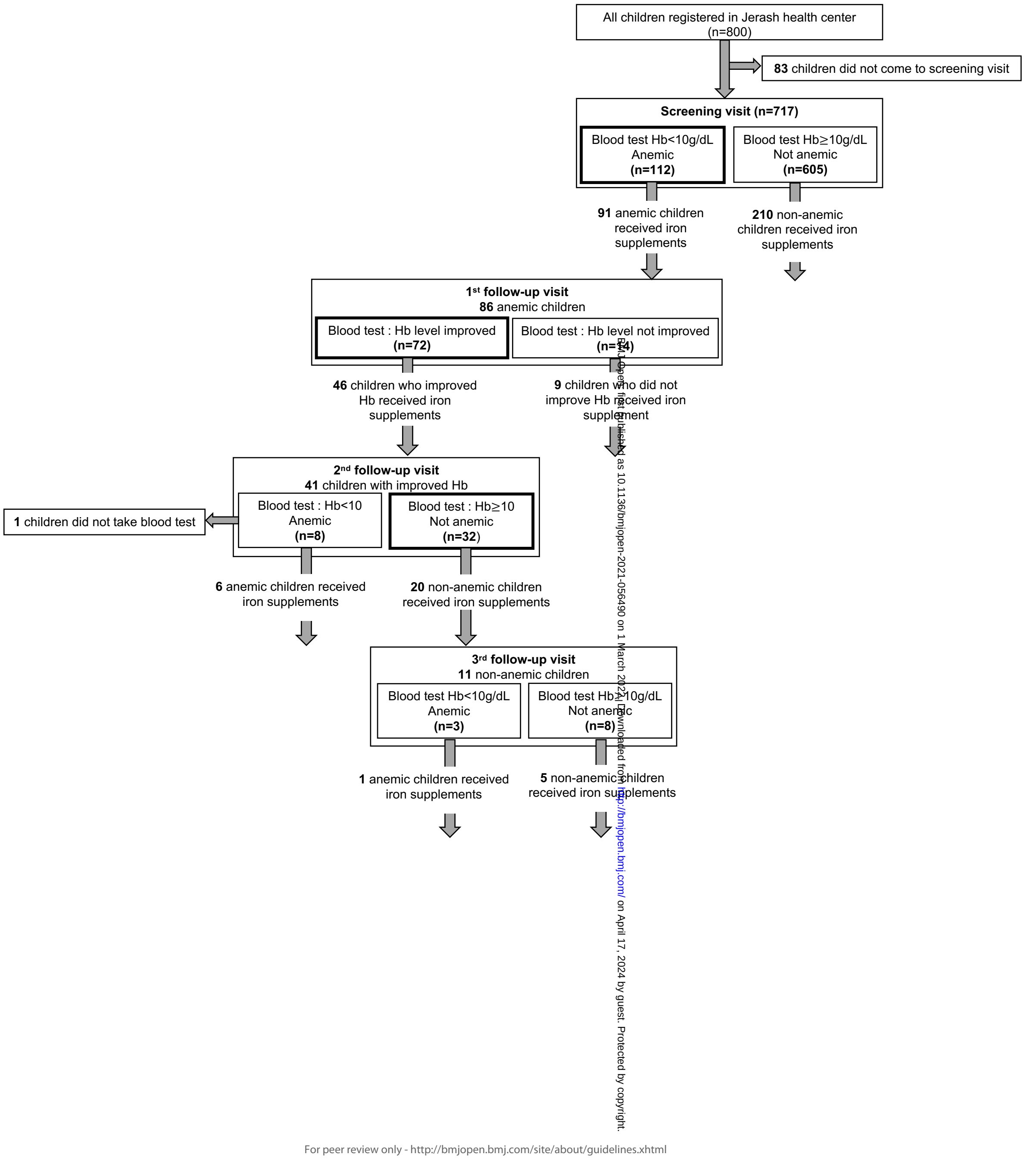
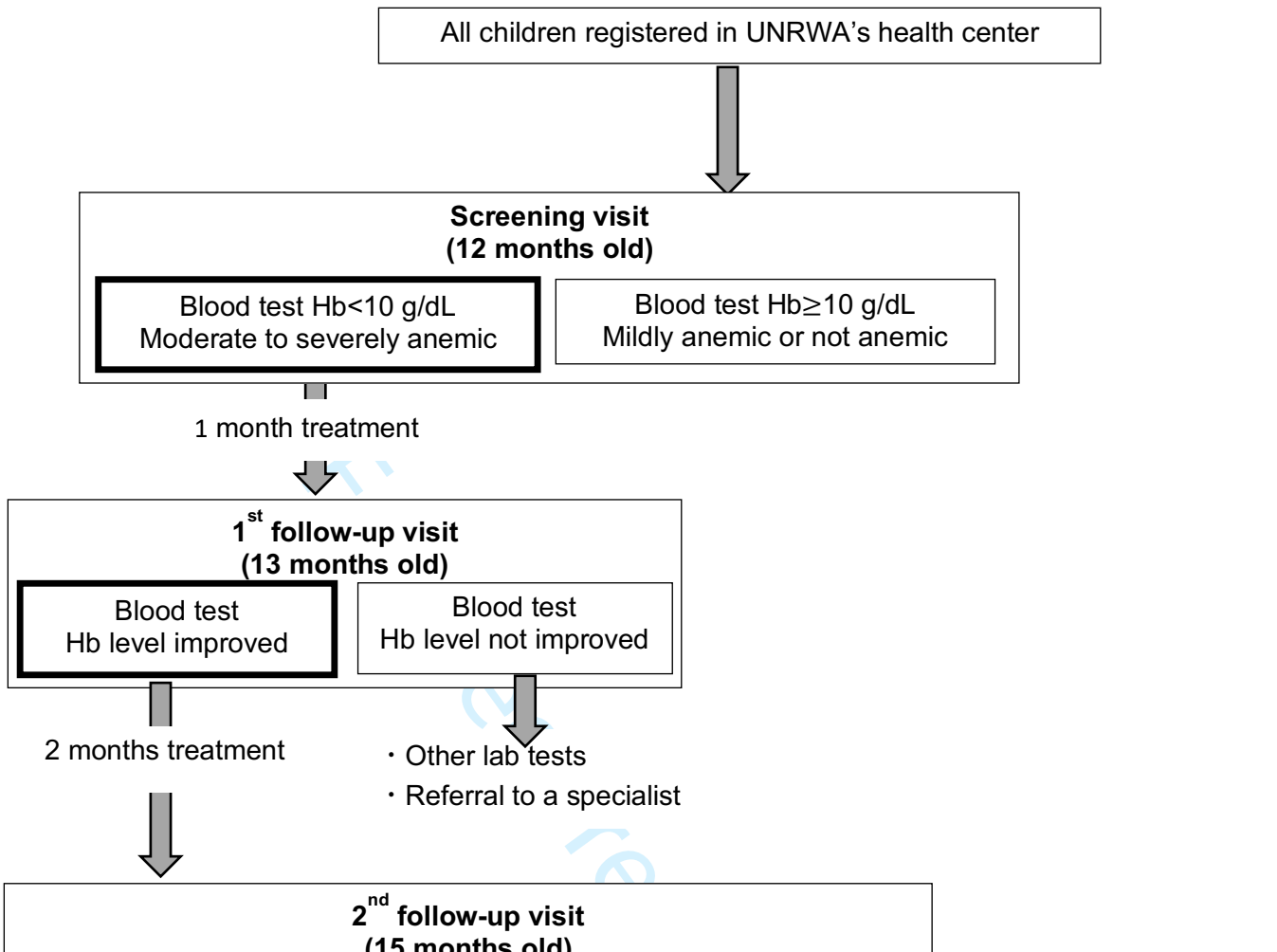
Figure 1. Children's flow in Jerash Camp Health Center



Additional file 1. Flow chart of the UNRWA guidelines



Additional file 2. Data collected for each child from the electronic health records

	Collected data	Stage of information
1	Children aged 12 months old in 2018	Screening visit
2	Children who visited the health center	Screening visits, 1st, 2nd, 3rd follow-up visit
3	Age in months of health center visits	Screening visits, 1st, 2nd, 3rd follow-up visit
4	Children who took the Hb test	Screening visits, 1st, 2nd, 3rd follow-up visit
5	Children's Hb level	Screening visits, 1st, 2nd, 3rd follow-up visit
6	Children who took other laboratory tests	1st, 2nd, 3rd follow-up visit
7	Children who were prescribed the iron supplements	Screening visits, 1st, 2nd, 3rd follow-up visit

Additional file 3. Case definition of electronic health record

1. Patient adherence by health center visits (%)

$$\text{Screening visit} = \frac{\text{Number of children at the screening visit}}{\text{Number of children aged 12 months old}} \times 100$$

$$1^{st} \text{ follow-up visit} = \frac{\text{Number of children at the 1st follow-up visit}}{\text{Number of moderate to severely anemic children at the screening visit}} \times 100$$

$$2^{nd} \text{ follow-up visit} = \frac{\text{Number of children at the 2nd follow-up visit}}{\text{Number of children who improved their Hb level}} \times 100$$

$$3^{rd} \text{ follow-up visit} = \frac{\text{Number of children at the 3rd follow-up visit}}{\text{Number of mildly anemic or non-anemic children at the 2nd follow-up visit}} \times 100$$

2. Doctor adherence by Hb tests (%)

$$\text{Screening visit} = \frac{\text{Number of children receiving Hb tests at the screening visit}}{\text{Number of children at the screening visit}} \times 100$$

$$1^{st} \text{ follow-up visit} = \frac{\text{Number of children receiving Hb tests at the 1st follow-up visit}}{\text{Number of children at the 1st follow-up visit}} \times 100$$

$$2^{nd} \text{ follow-up visit} = \frac{\text{Number of children receiving Hb tests at the 2nd follow-up visit}}{\text{Number of children at the 2nd follow-up visit}} \times 100$$

$$3^{nd} \text{ follow-up visit} = \frac{\text{Number of children receiving Hb tests at the 3rd follow-up visit}}{\text{Number of children at the 3rd follow-up visit}} \times 100$$

3. Doctor adherence by iron supplementation (%)

$$\text{Screening visit} = \frac{\text{Number of children receiving iron supplements at the screening visit}}{\text{Number of moderate to severely anemic children at the screening visit}} \times 100$$

$$1^{st} \text{ follow-up visit} = \frac{\text{Number of children receiving iron supplements at the 1st follow-up visit}}{\text{Number of children with increased Hb level at the 1st follow-up visit}} \times 100$$

Doctor adherence to iron supplementation for the 2nd and 3rd follow-up visits was not defined because children should not receive iron supplements at the 2nd and 3rd follow-ups visits, as defined in the UNRWA guidelines.

The RECORD statement – checklist of items, extended from the STROBE statement, that should be reported in observational studies using routinely collected health data.

	Item No.	STROBE items	Location in manuscript where items are reported	RECORD items	Location in manuscript where items are reported
Title and abstract					
	1	(a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found	Title (P1) Abstract (P2)	RECORD 1.1: The type of data used should be specified in the title or abstract. When possible, the name of the databases used should be included. RECORD 1.2: If applicable, the geographic region and timeframe within which the study took place should be reported in the title or abstract. RECORD 1.3: If linkage between databases was conducted for the study, this should be clearly stated in the title or abstract.	1.1 Title (P1), Abstract (P2) 1.2 Abstract (P2) 1.3 N/A
Introduction					
Background rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction (P7-10)		
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction (P10)		
Methods					
Study Design	4	Present key elements of study design early in the paper	Method (P11)		
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Method (P11-12)		

Participants	6	*(a) Cohort study* - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study* - Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study* - Give the eligibility criteria, and the sources and methods of selection of participants *(b) Cohort study* - For matched studies, give matching criteria and number of exposed and unexposed *Case-control study* - For matched studies, give matching criteria and the number of controls per case	Method (P11-12)	RECORD 6.1: The methods of study population selection (such as codes or algorithms used to identify subjects) should be listed in detail. If this is not possible, an explanation should be provided. RECORD 6.2: Any validation studies of the codes or algorithms used to select the population should be referenced. If validation was conducted for this study and not published elsewhere, detailed methods and results should be provided. RECORD 6.3: If the study involved linkage of databases, consider use of a flow diagram or other graphical display to demonstrate the data linkage process, including the number of individuals with linked data at each stage.	6.1 Method (P12) 6.2 N/A 6.3 N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.	Method (P12)	RECORD 7.1: A complete list of codes and algorithms used to classify exposures, outcomes, confounders, and effect modifiers should be provided. If these cannot be reported, an explanation should be provided.	Method (P12) Additional file 3
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	Method (P12)		

Bias	9	Describe any efforts to address potential sources of bias	N/A		
Study size	10	Explain how the study size was arrived at	Method (P12)		
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen, and why	Method (P13) Additional file 3		
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) *Cohort study* - If applicable, explain how loss to follow-up was addressed *Case-control study* - If applicable, explain how matching of cases and controls was addressed *Cross-sectional study* - If applicable, describe analytical methods taking account of sampling strategy (e) Describe any sensitivity analyses	Method (P13)		
Data access and cleaning methods		..		RECORD 12.1: Authors should describe the extent to which the investigators had access to the database population used to create the study population.	12.1Method (P12)

				RECORD 12.2: Authors should provide information on the data cleaning methods used in the study.	12.2Method (P13)
Linkage		..		RECORD 12.3: State whether the study included person-level, institutional-level, or other data linkage across two or more databases. The methods of linkage and methods of linkage quality evaluation should be provided.	N/A
Results					
Participants	13	(a) Report the numbers of individuals at each stage of the study (*e.g.*, numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed) (b) Give reasons for non-participation at each stage. (c) Consider use of a flow diagram	Result (P14-16)	RECORD 13.1: Describe in detail the selection of the persons included in the study (*i.e.,* study population selection) including filtering based on data quality, data availability and linkage. The selection of included persons can be described in the text and/or by means of the study flow diagram.	Result (P14-16) Figure1
Descriptive data	14	(a) Give characteristics of study participants (*e.g.*, demographic, clinical, social) and information on exposures and potential confounders (b) Indicate the number of participants with missing data for each variable of interest (c) *Cohort study* - summarise follow-up time (*e.g.*, average and total amount)	Result (P14-16)		
Outcome data	15	*Cohort study* - Report numbers of outcome events or summary measures over time *Case-control study* - Report numbers in each exposure	Result (P14-16)		

		category, or summary measures of exposure *Cross-sectional study* - Report numbers of outcome events or summary measures			
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Result (P16)		
Other analyses	17	Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses	N/A		
Discussion					
Key results	18	Summarise key results with reference to study objectives	Discussion (P18)		
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	Discussion (P21)	RECORD 19.1: Discuss the implications of using data that were not created or collected to answer the specific research question(s). Include discussion of misclassification bias, unmeasured confounding, missing data, and changing eligibility over time, as they pertain to the study being reported.	Discussion (P21)
Interpretation	20	Give a cautious overall interpretation of results considering objectives,	Discussion (P21)		

		limitations, multiplicity of analyses, results from similar studies, and other relevant evidence			
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion (P21)		
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	P21		
Accessibility of protocol, raw data, and programming code		..		RECORD 22.1: Authors should provide information on how to access any supplemental information such as the study protocol, raw data, or programming code.	P25

*Reference: Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langan SM, the RECORD Working Committee. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. *PLoS Medicine* 2015; in press.