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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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Complete List of Authors:	<p>Harada, Yuriko; Tokyo Women's Medical University, Kishk, Nada; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Headquarters Amman</p> <p>Hajat, Shakoor; London School of Hygiene & Tropical Medicine, Department of Social and Environmental Health Research</p> <p>Akita, Mio; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Health Department, Headquarters Amman</p> <p>Horino, Masako; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Headquarters Amman</p> <p>Albaik, Shatha; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Health Department, Headquarters Amman</p> <p>Naqera, Khalil ; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Jordan Field Office</p> <p>Hababeh, Majed; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Health Department, Headquarters Amman</p> <p>Habash, Rami ; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Headquarters Amman</p> <p>Seita, Akihiro; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Headquarters Amman</p>
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1 **Adherence to UNRWA's anemia treatment guidelines**

2 **in the Jerash Camp Health Center, Jordan: a retrospective observational study**

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4 Yuriko Harada¹, Nada Abu Kishk², Shakoor Hajat³, Mio Akita², Masako Horino²,
5 Shatha Albaik², Khalil Abu Naqera⁴, Majed Hababeh², Rami Habash², Akihiro Seita²

6
7 1. International Affairs and Tropical Medicine, Tokyo Women's Medical University,
8 162-8666, 8-1 Kawada-chou, Shinjuku-ku, Tokyo, Japan

9 2. Department of Health, United Nations Relief and Works Agency for Palestine
10 Refugees in the Near East, Headquarters Amman, 140157, Amman 11814, Jordan

11 3. London School of Hygiene and Tropical Medicine, Keppel Street, London, WC1E
12 7HT, United Kingdom

13 4. Department of Health, United Nations Relief and Works Agency for Palestine
14 Refugees in the Near East, Jordan Field Office, 143464, Amman, 11814, Jordan

15 16 **Contributors**

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6 17 Study was designed by YH, NH, SH and MA. Data was analyzed by YH. Results were
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9 18 interpreted by YH and NH. YH drafted the paper and it was revised by all authors. All
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12 19 authors have seen and approved the final version of the paper.
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18 **Email address of authors:**

19
20
21 22 Yuriko Harada: yurikoharada22@gmail.com

23 24 Nada Abu Kishk: nada_abukishk@hms.harvard.edu

25
26
27 28 Shakoor Hajat: shakoor.hajat@lshtm.ac.uk

29
30 31 Mio Akita: mioakitabga@gmail.com

32
33 34 Masako Horino: M.HORINO@unrwa.org

35
36 37 Shatha Albaik: S.ALBAIK@unrwa.org

38
39 40 Khalil Abu Naqera: K.AbuNaqera@unrwa.org

41
42 43 Majed Hababeh: M.HABABEH@unrwa.org

44
45 46 Rami Habash: R.HABASH@unrwa.org

47
48 49 Akihiro Seita: A.SEITA@unrwa.org

50
51 52

53
54 55

56
57 58 **Corresponding Author:** Yuriko Harada
59
60

1
2
3
4
5
6 35 Postal address: International Affairs and Tropical Medicine, Tokyo Women's Medical
7

8
9 36 University, 162-8666, 8-1 Kawada-chou, Shinjuku-ku, Tokyo, Japan
10
11

12 37 Email: yurikoharada22@gmail.com
13
14

15 38 Phone: +81 80 7898 0738
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For peer review only

40 **Abstract**

41 **Objective**

42 The United Nations Relief and Works Agency for Palestine Refugees in the Near East

43 (UNRWA) provides primary health care to 2.2 million Palestinian refugees in Jordan.

44 This study aimed to measure patient and doctor adherence to the UNRWA guidelines for

45 the prevention and treatment of iron deficiency anemia in moderate to severe anemia

46 children, defined as hemoglobin (Hb) level <10.0 g/dL.

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48 **Design, Setting, and Participants**

49 A retrospective observational study was conducted by analyzing the electronic health

50 records of 800 (398 boys and 402 girls) children aged 12-months old in 2018 in the Jerash

51 Camp Health Center, Jordan.

52

53 **Outcome**

54 Patient adherence to the UNRWA guidelines was calculated by the proportion of health

55 center visits and doctor adherence by the proportions of Hb tests and iron supplementation

56 among moderate to severe anemia children at screening, 1st, 2nd, and 3rd follow-up visits,

57 respectively.

58 **Results**

59 The prevalence of moderate to severe anemia was 15.6% among 12-month-old children.
60 After one-month of iron supplementation, 83.7% of anemic children improved their Hb
61 status: mean \pm SD from 9.1 ± 0.6 g/dL to 10.1 ± 1.0 g/dL. Patient and doctor adherence
62 to the UNRWA guidelines was above 80% at the screening visit but progressively
63 decreased at follow-up visits, especially patient adherence at the 3rd follow-up visit of
64 34.4%. The analysis revealed unnecessary health center visits and iron supplementation
65 being given to mildly anemic children (Hb level=10.0 g/dL–10.9 g/dL). Additionally,
66 children visited the health center at an age significantly later compared to that
67 recommended by the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits
68 (p-value<0.05).

69

70 **Conclusion**

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

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10 77 **Strengths and limitations of this study**
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12 78 • This was the first study analyzed the patient and doctor adherence to the
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15 79 UNRWA's guideline on the prevention and treatment of childhood anemia.
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18 80 • We included all children aged 12-months old, registered in the Jerash Health Center
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21 81 operated by the United Nations Relief and Works Agency for Palestine Refugees
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24 82 in the Near East (UNRWA).
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26
27 83 • Potential confounding factors could not be analyzed due to the lack of information
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30 84 in electronic health records.
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37 86 **Keywords**
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40 87 UNRWA; Palestinian Refugees; Anemia; Hemoglobin; Adherence
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88 **Background**

89 Anemia is caused by a decreased quantity of red blood cells, diminished hemoglobin level,
90 or altered morphology of red blood cells.¹ It has been estimated that 2 billion people (25%
91 of the world's population) had anemia globally in 2016, and developing countries
92 accounted for more than 89% of the burden.^{2,3} The most common cause of anemia is iron
93 deficiency anemia, affecting 1.2 billion (15% of the world population).^{1,2} It happens when
94 there are no mobilizable iron stores because of a prolonged negative iron balance,⁴ and
95 young children and women are at high risk.³ High burden of anemia and iron deficiency
96 anemia among children in Jordan were reported. In 2016, World Health Organization
97 (WHO) estimated that prevalence of anemia, defined as Hb level<11.0 g/dL, was 31.1%
98 among children below 5 years old in Jordan.⁵ Additionally, a study conducted among
99 children aged 12–23 months old in Jordan reported that prevalence of anemia, defined as
100 Hb level<11.0 g/dL, was 34.4% in 2002.⁶ This study further investigated that the
101 prevalence of iron deficiency anemia, defined as Hb level<11.0 g/dL and serum ferritin
102 level<12.0 µg/L, was 21.3% among children aged 12–23 months old. ⁶ There is evidence
103 that children below 2 years old with iron deficiency anemia are more susceptible to poorer
104 cognitive, motor, social-emotional, and neurophysiologic development.^{7,8} Additionally,
105 children with iron deficiency anemia have a higher risk of mortality and infectious

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6 106 diseases.^{9,10} Because anemia caused by depletion of iron status may be irreversible in
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9 107 young children⁴, it is crucial to prevent and treat iron deficiency anemia as early as
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12 108 possible before it becomes severe or chronic to maintain normal growth and
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15 109 development.¹¹

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18 110 Mandated by the United Nations General Assembly, the United Nations Relief and Works
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21 111 Agency for Palestine Refugees in the Near East (UNRWA) began its operation in 1950
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24 112 to protect and promote the livelihoods of Palestinian refugees in Jordan, Lebanon, Syria,
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26
27 113 the West Bank, and the Gaza Strip. UNRWA serves more than 5 million Palestinian
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30 114 refugee to achieve their potential in human development in health, education, and social
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33 115 relief.¹² In Jordan, UNRWA provides serves in 10 refugee camps for 2.2 million
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36 116 Palestinian refugees, which is the largest population among five UNRWA regions.¹²
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39 117 Moreover, UNRWA is the main primary health care provider for Palestinian refugees,
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42 118 and it provides health services free of charge.¹² In 2019, UNRWA reported a high burden
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45 119 of anemia among Palestinian refugee children in Jordan; the overall prevalence of anemia,
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48 120 defined as Hb level<11.0 g/dL, was 39% among 12-month-old children, which could be
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51 121 attributed to continuous food insecurity, low iron intake, and poor dietary habits.^{13,14}

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54 122 UNRWA provides guidelines for the prevention and treatment of iron deficiency
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57 123 anemia for 12-month-old Palestinian refugee children, which consist of mandatory
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6 124 anemia screening and subsequent treatment instructions⁴ based on recommendations by
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9 125 the WHO.¹⁵ According to UNRWA prevention and treatment guideline for micronutrient
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12 126 deficiency (UNRWA guidelines), all children registered in UNRWA health centers
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15 127 should complete anemia screening at the age of 12 months. The UNRWA guidelines
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18 128 define the threshold for diagnosing childhood anemia is Hb level <11 g/dL. The severity
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21 129 of childhood anemia was classified with child Hb status as mild (10.0 g/dL–10.9 g/dL),
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24 130 moderate (7.0 g/dL–9.9 g/dL), and severe (<7.0 g/dL) anemia. If the child is diagnosed
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27 131 as moderate to severely anemic, defined as a Hb level <10 g/dL, they receive iron
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30 132 treatment at a dose of 25 mg elemental iron every day for three months. During the three
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33 133 months of treatment, children need to have repeated Hb tests after one month at the age
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36 134 of 13 months old. If the Hb concentration improves compared to the Hb level at the
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39 135 screening visit, each child continues the iron supplementation for two more months until
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42 136 the age of 15 months, along with dietary counseling by trained nursing staff. Six months
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45 137 after completing the treatment, at the age of 21 months old, a reassessment of Hb level is
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48 138 recommended. By contrast, if the Hb concentration does not improve despite patient and
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51 139 doctor adherence with the iron treatment and the absence of any acute illness, further
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54 140 laboratory tests including Complete Blood Cell Count (CBC), Mean Corpuscular Volume
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57 141 (MCV), Mean Corpuscular Hemoglobin (MCH), and Red Cell Distribution (RDW)
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6 142 and/or referral to a specialist is recommended.⁴ The flowchart in Additional file 1
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9 143 summarizes the UNRWA guidelines and procedure for iron deficiency anemia detection
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12 144 and treatment.
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15 145 No previous study has been conducted to investigate adherence to the UNRWA
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18 146 guidelines in Jerash Palestinian refugee camp, which is the poorest camp in Jordan.¹⁶ The
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21 147 main aim of this study was to investigate adherence to the UNRWA guidelines among
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24 148 patients and doctors in the Jerash Camp Health Center, Jordan.
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150 **Methods**

151 **Study design**

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

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156 **Study setting**

157 Jerash camp was established as an emergency camp in Jordan for Palestinian refugees
158 who fled from the Gaza Strip in 1968 as a consequence of the 1967 Arab–Israeli war. The
159 camp covers an area of 0.75 km² for 29,000 Palestinian refugees.¹⁷ In 2013, Jerash camp
160 was reported to be the poorest among 10 Palestinian refugee camps in Jordan, with 52.7%
161 of the population having incomes below the national poverty line of 814 Jordanian Dinars
162 per capita per year.^{16,17} Additionally, it was estimated that 88% of refugees in Jerash camp
163 did not have health insurance for secondary or tertiary care by governorate, which was
164 the highest proportion across the 10 refugee camps in Jordan.^{16,17}

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166 **Inclusion and exclusion criteria**

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6 167 The inclusion criteria were Palestinian refugee children who were aged 12 months old in
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9 168 2018 (i.e. born between 1st January and 31st December 2017) and registered in the Jerash
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12 169 Camp Health Center. Our exclusion criteria were non-Palestinian refugee children born
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15 170 in Jerash.
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20 21 172 **Sampling and data collection**

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24 173 There were 800 children registered in the Jerash Camp Health Center who were born in
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27 174 2017, and all of them were included in the analysis. Because we included the whole study
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30 175 population who met the inclusion criteria in the analysis, we did not conduct a sample
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33 176 size calculation. By accessing the electronic health records from the Jerash Camp Health
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36 177 Center, we collected seven categories of data for each child as shown in Additional file
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39 178 2. At screening and the 1st, 2nd, and 3rd follow-up visits, the following information was
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42 179 collected: the number of children who visited the health center, age in months at health
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45 180 center visits, the number of children who took the Hb test, their Hb levels, and whether
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48 181 they were prescribed iron supplements. Lastly, for the 1st, 2nd, and 3rd follow-up visits,
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51 182 information on the number of children who took other laboratory tests was also collected.
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54 183 The sex of each child was also recorded from the electronic health records.
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185 **Statistical analysis**

186 Relevant electronic health records were extracted from the main UNRWA database and
187 imported into a statistical computing package. Data were summarized using mean and
188 standard deviation (SD) for the continuous variables of child age and child Hb level at
189 each health center visit. For categorical variables, the frequencies and percentages of
190 children who visited the health center, received the Hb test, were diagnosed as anemic,
191 and received iron supplements were calculated. Additionally, for the 1st follow-up visit,
192 the frequencies and percentages of children who improved their Hb status compared to
193 the screening visit were calculated. One-sample t-tests were conducted to investigate
194 whether the mean age at each health center visit was significantly different from the age
195 defined in the UNRWA guidelines, with resulting p-values deemed statistically
196 significant at the 5% level. Based on UNRWA guidelines⁴, patient adherence was
197 calculated by the proportion of the health center visits, and doctor adherence was
198 calculated by the proportions of Hb tests and iron supplementation among moderate to
199 severe anemia children at screening, 1st, 2nd, and 3rd follow-up visits, respectively. The
200 definition of patient and doctor adherence is shown in Additional file 3. STATA version
201 14 was used to conduct the statistical analyses.

202

203 **Results**

204 **Children's flow in Jerash Camp Health Center**

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

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

211 ***Screening visit***

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

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

221 ***1st follow-up visit***

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6 222 Table 2 shows the results of the 1st follow-up visit. Out of 112 children diagnosed as
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9 223 moderate to severely anemic at the screening visit, 86 children came to the 1st follow-up
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12 224 visit and their mean \pm SD age at the visit was 16.0 ± 3.1 months old. Their mean \pm SD
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15 225 Hb level was to 10.1 ± 1.0 g/dL. And 72 (83.7%) children improved their Hb level,
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18 226 compared to their screening visit. Out of 72 children who improved their Hb level, 46
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21 227 children continued to receive iron supplements at the 1st follow-up visit. On the contrary,
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24 228 out of 14 children who did not improve their Hb level, 9 children also received iron
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27 229 supplements. Moreover, out of 247 children diagnosed as mildly at the screening visit,
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30 230 171 children came to the 1st follow-up visit, respectively.

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33 231 (Table 2. Results of electronic health record survey for the 1st follow-up visit)
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36 37 38 233 ***2nd follow-up visit***

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41 234 Table 3 shows the results of the 2nd follow-up visit. Out of 72 anemic children who
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44 235 improved their Hb status at the 1st follow-up visit, 41 children came to the 2nd follow-up
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47 236 visit. Their mean \pm SD age at the visit was 20.1 ± 4.9 months old, and the mean \pm SD
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50 237 Hb level was further increased to 10.5 ± 1.0 g/dL. There were 8 (20.0%) children who
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53 238 were diagnosed as moderate to severely anemic at the 2nd follow-up visit, and 6 children
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56 239 received iron supplements. Moreover, out of 18 children who were diagnosed as mildly
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59 240 anemic at the 2nd follow-up visit, 17 children received iron supplements.
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6 241 (Table 3. Results of electronic health record survey for the 2nd follow-up visit)
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12 243 ***3rd follow-up visit***
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15 244 Table 4 shows the results of the 3rd follow-up visit. Out of 32 children who were
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18 245 diagnosed as mildly anemic or non-anemic at the 2nd follow-up visit, 11 children came to
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21 246 the 3rd follow-up visit, and their mean \pm SD age at the visit was 21.6 ± 3.9 months old.
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24 247 Their mean \pm SD Hb level was 10.2 ± 0.9 g/dL, and 3 children (27.2%) were diagnosed
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27 248 as moderate to severely anemic at the 3rd follow-up visit. There were 6 children who
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30 249 received iron supplement at the 3rd follow-up visit.
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33 250 (Table 4. Results of electronic health record survey for the 3rd follow-up visit)
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36 251 Overall, we found that children visited the health center at an age significantly later
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39 252 compared to that recommended by the UNRWA guidelines for the screening, 1st, and 2nd
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42 253 follow-up visits (p-value<0.05). However, we did not find a significant delay for the 3rd
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45 254 follow-up visit, compared to the age defined in the UNRWA guidelines (p=0.64).
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51 256 **Adherence to the UNRWA guidelines**
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54 257 Table 5 shows the patient and doctor adherence to the UNRWA guidelines. For the
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57 258 screening visit, patient adherence was 89.6% (95% CI=87.3–91.7). Doctor adherence was
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6 259 100% for Hb tests and 81.3% (95% CI=72.8–88.0) for iron supplementation. For the 1st
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9 260 follow-up visit, patient adherence was decreased to 76.8% (95% CI=67.9–84.2). Doctor
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12 261 adherence was still 100% for Hb tests; however, iron supplementation was decreased to
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15 262 63.9% (95% CI=51.7–74.9). For the 2nd follow-up visit, patient adherence was further
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18 263 decreased to 56.9% (95% CI=44.7–68.6). Doctor adherence to Hb tests was slightly
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21 264 decreased to 97.6% (95% CI=87.1–99.9). For the 3rd follow-up visit, patient adherence
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24 265 was further decreased to 34.4% (95% CI=18.6–53.2). Doctor adherence to Hb tests was
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27 266 increased back to 100%.
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30 267 (Table 5. Adherence to UNRWA guidelines)
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268 **Discussion**

269 This study illustrates that patient and doctor adherence to treatment guidelines was above
270 80% during the screening visit; however, this progressively decreased at follow-up visits,
271 especially patient adherence at the 3rd follow-up visit of 34.4%. Furthermore, the analysis
272 identifies unnecessary health center visits and iron supplement prescriptions to mildly
273 anemic children at the screening and 1st follow-up visit, and children visited the health
274 center at an age significantly later compared to that recommended by the UNRWA
275 guidelines for the screening, 1st, and 2nd follow-up visits (p-value<0.05).

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

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6 286 crucial to avoid a delay to health center visits and treatment for anemia because anemia
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9 287 status interferes with normal growth and development¹¹, otherwise, these impairments
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12 288 may become irreversible⁴. Although patient and doctor adherence to the UNRWA's
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15 289 guidelines should be improved, our study found that the 83.7% of moderate to severely
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18 290 anemic children improved their status through iron supplementation. Therefore, Hb
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21 291 improvement rates via iron supplementation could be increased further if these issues are
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24 292 addressed in the Jerash Camp Health Center.

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27 293 Our analysis identified unnecessary health center visits and iron supplementation
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30 294 in mildly anemic children. For example, out of 247 children who were diagnosed as
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33 295 mildly anemic at the screening visit, 191 children received iron supplements and 171
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36 296 children came to the 1st follow-up visit. It has been pointed out that UNRWA's health
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39 297 center tends to be overcrowded, and this may negatively affect the quality of care
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42 298 provided.¹⁸ Furthermore, UNRWA has faced a financial crisis since 2018 by donors
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45 299 ceasing their financial support, and this has negatively affected UNRWA's operation.¹⁹
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48 300 Thus, it is very important to avoid unnecessary health center visits and iron
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51 301 supplementation to utilize the available resources efficiently.

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54 302 This study found that the burden of childhood anemia was higher in Jerash Camp
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57 303 Health Center, compared to non-refugee Jordanian children and Palestinian refugee
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6 304 children in other Jordan's refugee camps. The mean \pm SD Hb level at the 12-month-old
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9 305 screening in Jerash Camp Health Center was 10.7 ± 0.9 g/dL, which was lower than the
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12 306 mean \pm SD Hb level among non-refugee children aged 12–23 months old in Jordan of
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15 307 11.2 ± 0.16 g/dL as reported in 2002.⁶ Additionally, we found that half of 12-month-old
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18 308 children had an Hb level <11.0 g/dL in Jerash Camp Health Center, which was higher than
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21 309 12-month-old Palestinian children registered by UNRWA in Jordan of 39.0% as reported
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24 310 in 2019.¹³ Palestinian refugees face poor intake of iron source food due to food
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27 311 insecurity¹³, and Jerash camp in particular has a higher poverty rate¹⁶, which increases
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30 312 the risk of anemia. UNRWA recommends 6-month exclusive breastfeeding because
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33 313 breast milk contains highly bioavailable iron that helps to restore iron and protect children
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36 314 from infectious diseases⁴. In 2005, a survey conducted by UNRWA reported that only
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39 315 25% of Palestinian children had exclusive breastfeeding up to 4 months in Jordan which
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42 316 was the lowest proportion among five UNRWA regions.²⁰ Additionally, a study
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45 317 conducted in Jerash camp reported that mothers could not afford iron rich foods and
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48 318 diverse food to feed their children due to economic hardship.²¹ Some mother gave tea to
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51 319 their infants, which is known as an inhibitor of iron absorption.^{21,4} This was because
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54 320 mothers faced lactation failure due to their own undernutrition but could not afford to buy
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57 321 formula milk.²¹
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6 322 This study has important implications for Jerash Camp Health Center; efforts
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9 323 should be made to improve adherence to the UNRWA guidelines, avoid a delay of health
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12 324 center visits, and decrease unnecessary health center visits and iron supplementation.
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15 325 Further studies are needed to understand the reason why adherence was decreased at the
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18 326 follow-up visits, whether mothers were informed about when their children should visit
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21 327 the health center for anemia screening and treatment, and whether doctors correctly
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24 328 understood UNRWA guidelines on when to prescribe iron supplements, especially
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27 329 regarding treatment thresholds between mild anemia and moderate to severe anemia.

30 330 This study had several limitations. First, our analysis did not consider potential
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33 331 confounding factors such as socioeconomic status²²⁻²⁴, food security¹⁰, child
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36 332 anthropometric status²⁴, and parent's smoking status²³ because there was no such
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39 333 information available in electronic health record, which may be associated with patients
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42 334 adherence to UNRWA's guidelines. Second, the analysis of electronic health records
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45 335 included all children born in 2017 and registered in Jerash Camp Health Center, assuming
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48 336 all of them continued to live in Jerash until 2018 due to lack of data availability. Therefore,
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51 337 the study population (n=800) could be smaller in reality, which would lead to
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54 338 underestimation of adherence to health center visits for the screening visit. Lastly, this
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57 339 study was conducted in Jerash Camp Health Center only, and so findings may not be
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6 340 readily generalizable to other UNRWA health centers in Jordan or other regions due to
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9 341 the poor economic condition among Palestinian refugees, especially in Jerash camp.
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12 342 Nevertheless, our results provide sufficient stimulus for the need for public health
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15 343 intervention to improve adherence to UNRWA guidelines at follow-up visit and to
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18 344 minimize any unnecessary health center visits and iron supplementation.
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345 **Conclusion**

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

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362 completing the study in Jerash Camp Health Center.

363

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365 The authors received no financial support for this research study.

366

367 **Competing interests**

368 The authors declare that they have no competing interests.

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370 **Patient consent for publication**

371 No patient involved.

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373 **Ethics approval**

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

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6 376 research review board of UNRWA Headquarters in Amman. There was no potential harm
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9 377 expected in the study. There was no reference number for the ethics approval because
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12 378 UNRWA did not have a system to give identification numbers when this study was
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15 379 approved by the research review board.
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20 21 381 **Data availability statement**

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24 382 All data relevant to the study are included in the article or as supplementary information.
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27 383 Some restrictions will apply for the availability of data.
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32 33 385 **Word count**

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455 **Figures**

456 Figure 1. Children’s flow in Jerash Camp Health Center

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Tables

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

	Children registered in Jerash Camp Health Center (n=800)		
	Non-anemia (Hb \geq 11.0g/dL)	Mild anemia (Hb=10.0–10.9 g/dL)	Moderate to severe anemia (Hb<10.0 g/ dL)
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)	
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

460 **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

461 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 1 st follow-up visit (n=72)		
	Non-anemia (Hb \geq 10.0g/dL)	Mild anemia (Hb=10.0–10.9 g/dL)	Moderate to severe anemia (Hb<10.0 g/ dL)
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)	
Anemia status at the 2 nd 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 \geq 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

466 **Table 5. Adherence to UNRWA guidelines**

	Screening visit	1 st follow-up visit	2 nd follow-up visit	3 rd 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

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468 **Additional Files**

469 Additional file 1. Flow chart of the UNRWA guidelines

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

472 Additional file 3. Case definition of electronic health record

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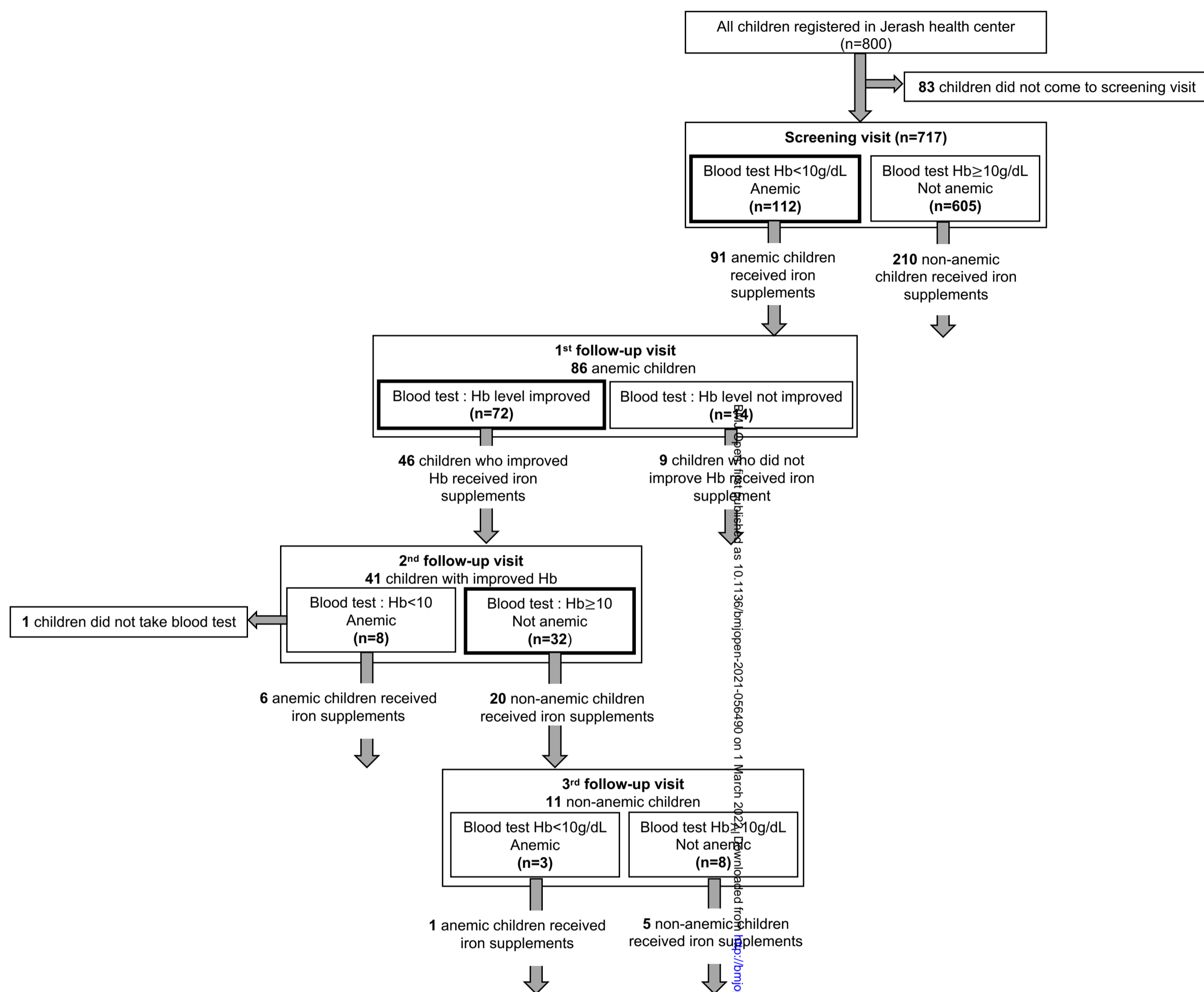
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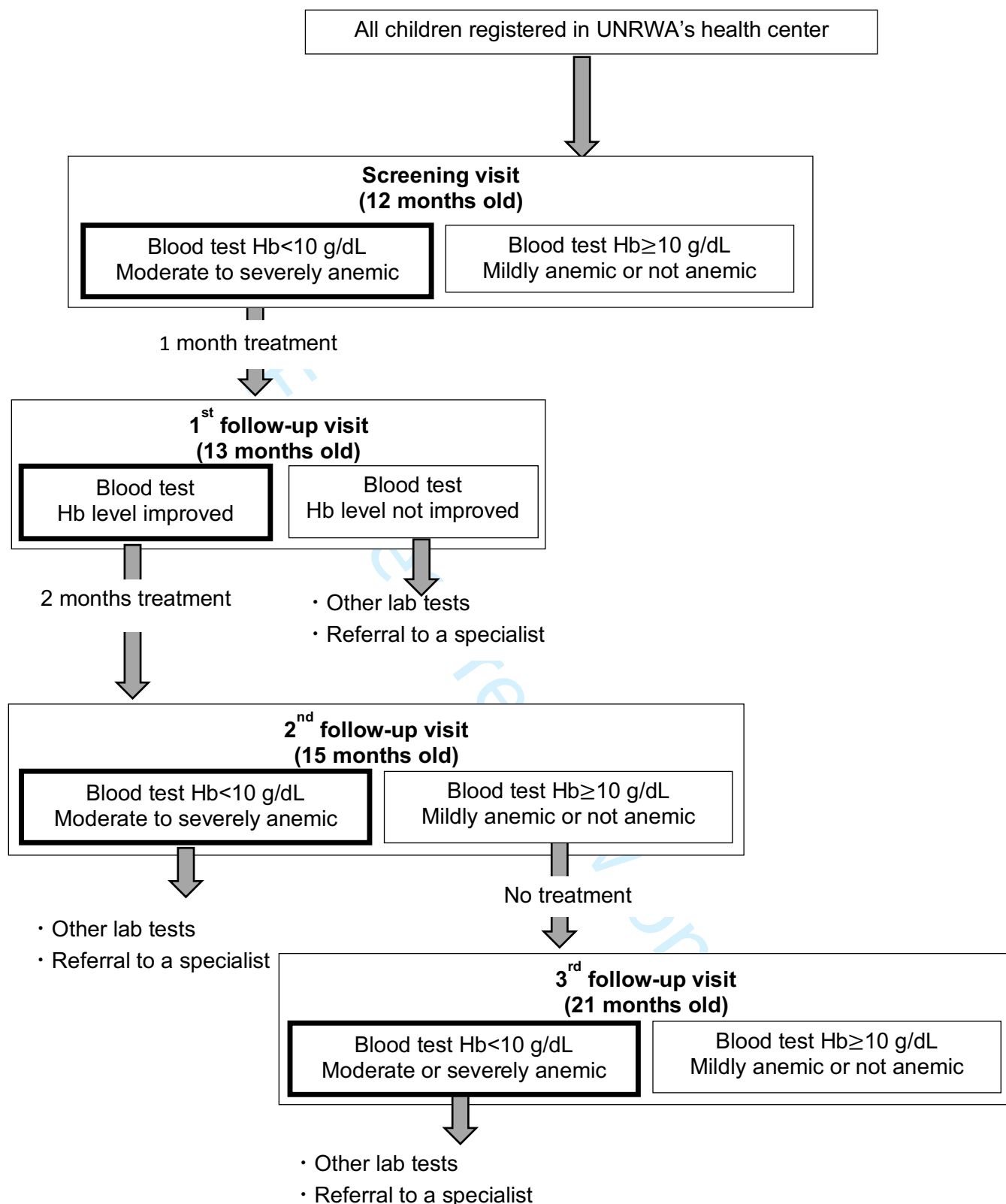
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Figure 1. Children's flow in Jerash Camp Health Center



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

Additional file 3. Case definition of electronic health record

1. Patient adherence by health center visits (%)

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

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

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

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

2. Doctor adherence by Hb tests (%)

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

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

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

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

3. Doctor adherence by iron supplementation (%)

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

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

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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.

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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 time frame 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)		

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<p>1 Participants</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p> <p>7</p> <p>8</p> <p>9</p> <p>10</p> <p>11</p> <p>12</p> <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> <p>23</p> <p>24</p> <p>25</p> <p>26</p> <p>27</p>	<p>6</p>	<p>(a) <i>Cohort study</i> - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up</p> <p><i>Case-control study</i> - 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</p> <p><i>Cross-sectional study</i> - Give the eligibility criteria, and the sources and methods of selection of participants</p> <p>(b) <i>Cohort study</i> - For matched studies, give matching criteria and number of exposed and unexposed</p> <p><i>Case-control study</i> - For matched studies, give matching criteria and the number of controls per case</p>	<p>Method (P11-12)</p>	<p>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.</p> <p>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.</p> <p>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.</p>	<p>6.1 Method (P12)</p> <p>6.2 N/A</p> <p>6.3 N/A</p>
<p>28 Variables</p> <p>29</p> <p>30</p> <p>31</p> <p>32</p> <p>33</p> <p>34</p>	<p>7</p>	<p>Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.</p>	<p>Method (P12)</p>	<p>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.</p>	<p>Method (P12)</p> <p>Additional file 3</p>
<p>35 Data sources/ measurement</p> <p>36</p> <p>37</p> <p>38</p> <p>39</p> <p>40</p> <p>41</p> <p>42</p> <p>43</p> <p>44</p> <p>45</p> <p>46</p> <p>47</p>	<p>8</p>	<p>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</p>	<p>Method (P12)</p>		

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) <i>Cohort study</i> - If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> - If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> - 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)

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				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 (<i>e.g.</i> , 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>i.e.</i> , 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) Figure 1
Descriptive data	14	(a) Give characteristics of study participants (<i>e.g.</i> , 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) <i>Cohort study</i> - summarise follow-up time (<i>e.g.</i> , average and total amount)	Result (P14-16)		
Outcome data	15	<i>Cohort study</i> - Report numbers of outcome events or summary measures over time <i>Case-control study</i> - Report numbers in each exposure	Result (P14-16)		

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		category, or summary measures of exposure <i>Cross-sectional study</i> - 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, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langen 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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BMJ Open

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

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Complete List of Authors:	<p>Harada, Yuriko; Tokyo Women's Medical University, Kishk, Nada; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Headquarters Amman</p> <p>Hajat, Shakoor; London School of Hygiene & Tropical Medicine, Department of Social and Environmental Health Research</p> <p>Akita, Mio; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Health Department, Headquarters Amman</p> <p>Horino, Masako; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Headquarters Amman</p> <p>Albaik, Shatha; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Health Department, Headquarters Amman</p> <p>Naqera, Khalil ; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Jordan Field Office</p> <p>Hababeh, Majed; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Health Department, Headquarters Amman</p> <p>Habash, Rami ; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Headquarters Amman</p> <p>Seita, Akihiro; United Nations Relief and Works Agency for Palestine Refugees in the Near East Jordan, Department of Health, Headquarters Amman</p>
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Secondary Subject Heading:	Global health, Health informatics, Public health
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7 **1 Adherence to UNRWA's anemia treatment guidelines**
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9 **2 in the Jerash Camp Health Center, Jordan: a retrospective observational study**
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15 **4** Yuriko Harada¹, Nada Abu Kishk², Shakoor Hajat³, Mio Akita², Masako Horino²,
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18 **5** Shatha Albaik², Khalil Abu Naqera⁴, Majed Hababeh², Rami Habash², Akihiro Seita²
19
20
21
22 **6**

23
24 **7** 1. International Affairs and Tropical Medicine, Tokyo Women's Medical University,
25
26
27 **8** 162-8666, 8-1 Kawada-chou, Shinjuku-ku, Tokyo, Japan
28
29

30
31 **9** 2. Department of Health, United Nations Relief and Works Agency for Palestine
32
33
34 **10** Refugees in the Near East, Headquarters Amman, 140157, Amman 11814, Jordan
35

36
37 **11** 3. London School of Hygiene and Tropical Medicine, Keppel Street, London, WC1E
38
39
40 **12** 7HT, United Kingdom
41

42
43 **13** 4. Department of Health, United Nations Relief and Works Agency for Palestine
44
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46 **14** Refugees in the Near East, Jordan Field Office, 143464, Amman, 11814, Jordan
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16 Contributors

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6 17 YH, NK, SH, MA and MH designed the study. YH analyzed data. YH and NK
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9 18 interpreted results. YH drafted the paper and NK, SH, MA, MH, SA, KN, MH, RH, and
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12 19 AS have seen and approved the final version of the paper.
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18 **Email address of authors:**
19

20
21
22 22 Yuriko Harada: yurikoharada22@gmail.com

23 23 Nada Abu Kishk: nada_abukishk@hms.harvard.edu

24 24 Shakoor Hajat: shakoor.hajat@lshtm.ac.uk

25 25 Mio Akita: mioakitabga@gmail.com

26 26 Masako Horino: M.HORINO@unrwa.org

27 27 Shatha Albaik: S.ALBAIK@unrwa.org

28 28 Khalil Abu Naqera: K.AbuNaqera@unrwa.org

29 29 Majed Hababeh: M.HABABEH@unrwa.org

30 30 Rami Habash: R.HABASH@unrwa.org

31 31 Akihiro Seita: A.SEITA@unrwa.org

32

33

34 **Corresponding Author:** Yuriko Harada
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- 35 Postal address: International Affairs and Tropical Medicine, Tokyo Women's Medical
- 36 University, 162-8666, 8-1 Kawada-chou, Shinjuku-ku, Tokyo, Japan
- 37 Email: yurikoharada22@gmail.com
- 38 Phone: +81 80 7898 0738
- 39

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40 **Abstract**

41 **Objective**

42 The United Nations Relief and Works Agency for Palestine Refugees in the Near East

43 (UNRWA) provides primary health care to 2.2 million Palestinian refugees in Jordan.

44 This study aimed to measure patient and doctor adherence to the UNRWA guidelines for

45 the prevention and treatment of iron deficiency anemia in moderate to severe anemia

46 children, defined as hemoglobin (Hb) level <10.0 g/dL.

47

48 **Design, Setting, and Participants**

49 A retrospective observational study was conducted by analyzing the electronic health

50 records of 717 children (353 boys and 364 girls) children aged 12-months old in 2018 in

51 the Jerash Camp Health Center, Jordan.

52

53 **Outcome**

54 Patient adherence to the UNRWA guidelines was calculated by the proportion of health

55 center visits and doctor adherence by the proportions of Hb tests and iron supplementation

56 among moderate to severe anemia children at screening, 1st, 2nd, and 3rd follow-up visits,

57 respectively using STATA.

58 **Results**

59 The prevalence of moderate to severe anemia was 15.6% among 12-month-old children.
60 After one-month of iron supplementation, 83.7% of anemic children improved their Hb
61 status: mean \pm SD from 9.1 ± 0.6 g/dL to 10.1 ± 1.0 g/dL. Patient and doctor adherence
62 to the UNRWA guidelines was above 80% at the screening visit but progressively
63 decreased at follow-up visits, especially patient adherence at the 3rd follow-up visit of
64 34.4%. The analysis revealed unnecessary health center visits and iron supplementation
65 being given to mildly anemic children (Hb level=10.0 g/dL–10.9 g/dL). Additionally,
66 children visited the health center at an age significantly later compared to that
67 recommended by the UNRWA guidelines for the screening, 1st, and 2nd follow-up visits
68 (p-value<0.05).

69

70 **Conclusion**

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

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77 **Strengths and limitations of this study**

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

86 **Keywords**

87 UNRWA; Palestinian Refugees; Anemia; Hemoglobin; Adherence

88 **Background**

89 Anemia is caused by a decreased quantity of red blood cells, diminished hemoglobin level,
90 or altered morphology of red blood cells.¹ It has been estimated that 2 billion people (25%
91 of the world's population) had anemia globally in 2016, and developing countries
92 accounted for more than 89% of the burden.^{2,3} The most common cause of anemia is iron
93 deficiency anemia, affecting 1.2 billion (15% of the world population).^{1,2} It happens when
94 there are no mobilizable iron stores because of a prolonged negative iron balance,⁴ and
95 young children and women are at high risk.³ High burden of anemia and iron deficiency
96 anemia among children in Jordan were reported. In 2016, World Health Organization
97 (WHO) estimated that prevalence of anemia, defined as Hb level<11.0 g/dL, was 31.1%
98 among children below 5 years old in Jordan.⁵ Additionally, a study conducted among
99 children aged 12–23 months old in Jordan reported that prevalence of anemia, defined as
100 Hb level<11.0 g/dL, was 34.4% in 2002.⁶ This study further investigated that the
101 prevalence of iron deficiency anemia, defined as Hb level<11.0 g/dL and serum ferritin
102 level<12.0 µg/L, was 21.3% among children aged 12–23 months old. ⁶ There is evidence
103 that children below 2 years old with iron deficiency anemia are more susceptible to poorer
104 cognitive, motor, social-emotional, and neurophysiologic development.^{7,8} Additionally,
105 children with iron deficiency anemia have a higher risk of mortality and infectious

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6 106 diseases.^{9,10} Because anemia caused by depletion of iron status may be irreversible in
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9 107 young children⁴, it is crucial to prevent and treat iron deficiency anemia as early as
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12 108 possible before it becomes severe or chronic to maintain normal growth and
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15 109 development.^{11,12}

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18 110 In Jordan, the United Nations Relief and Works Agency for Palestine Refugees in the
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21 111 Near East (UNRWA) provides services in 10 refugee camps for 2.2 million Palestinian
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24 112 refugees.¹³ UNRWA is the main primary health care provider for Palestinian refugees,
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27 113 and it provides health services free of charge.¹³ In 2019, UNRWA reported a high burden
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30 114 of anemia among Palestinian refugee children in Jordan; the overall prevalence of anemia,
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33 115 defined as Hb level <11.0 g/dL, was 39% among 12-month-old children, which could be
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36 116 attributed to continuous food insecurity, low iron intake, and poor dietary habits.^{14,15}

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39 117 UNRWA provides guidelines for the prevention and treatment of iron deficiency
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42 118 anemia for 12-month-old Palestinian refugee children, which consist of mandatory
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45 119 anemia screening and subsequent treatment instructions⁴ based on recommendations by
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48 120 the WHO.¹⁶ According to UNRWA prevention and treatment guideline for micronutrient
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51 121 deficiency (UNRWA guidelines), all children registered in UNRWA health centers
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54 122 should complete anemia screening at the age of 12 months. The UNRWA guidelines
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57 123 define the threshold for diagnosing childhood anemia is Hb level <11 g/dL. The severity
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6 124 of childhood anemia was classified with child Hb status as mild (10.0 g/dL–10.9 g/dL),
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9 125 moderate (7.0 g/dL–9.9 g/dL), and severe (<7.0 g/dL) anemia. If the child is diagnosed
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12 126 as moderate to severely anemic, defined as a Hb level<10 g/dL, they receive iron
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15 127 treatment at a dose of 25 mg elemental iron every day for three months. During the three
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18 128 months of treatment, children need to have repeated Hb tests after one month at the age
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21 129 of 13 months old. If the Hb concentration improves compared to the Hb level at the
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24 130 screening visit, each child continues the iron supplementation for two more months until
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27 131 the age of 15 months, along with dietary counseling by trained nursing staff. Six months
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30 132 after completing the treatment, at the age of 21 months old, a reassessment of Hb level is
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33 133 recommended. By contrast, if the Hb concentration does not improve despite patient and
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36 134 doctor adherence with the iron treatment and the absence of any acute illness, further
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39 135 laboratory tests including Complete Blood Cell Count (CBC), Mean Corpuscular Volume
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42 136 (MCV), Mean Corpuscular Hemoglobin (MCH), and Red Cell Distribution (RDW)
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45 137 and/or referral to a specialist is recommended.⁴ The flowchart in Additional file 1
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48 138 summarizes the UNRWA guidelines and procedure for iron deficiency anemia detection
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51 139 and treatment.

54 140 No previous study has been conducted to investigate adherence to the UNRWA
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57 141 guidelines in Jerash Palestinian refugee camp, which is the poorest camp in Jordan.¹⁷ The
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6 142 main aim of this study was to investigate adherence to the UNRWA guidelines among
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9 143 patients and doctors in the Jerash Camp Health Center, Jordan.
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145 **Methods**

146 **Study design**

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

150

151 **Study setting**

152 Jerash camp was established as an emergency camp in Jordan for Palestinian refugees
153 who fled from the Gaza Strip in 1968 as a consequence of the 1967 Arab–Israeli war. The
154 camp covers an area of 0.75 km² for 29,000 Palestinian refugees.¹⁸ In 2013, Jerash camp
155 was reported to be the poorest among 10 Palestinian refugee camps in Jordan, with 52.7%
156 of the population having incomes below the national poverty line of 814 Jordanian Dinars
157 per capita per year.^{17,18} Additionally, it was estimated that 88% of refugees in Jerash camp
158 did not have health insurance for secondary or tertiary care by governorate, and 42% of
159 the population were reported to experience catastrophic health expenditure.^{17–19}

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161 **Eligibility criteria and sampling**

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6 162 The inclusion criteria were Palestinian refugee children who were aged 12 months old in
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9 163 2018 (i.e. born between 1st January and 31st December 2017) and registered in the Jerash
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12 164 Camp Health Center. Our exclusion criteria were non-Palestinian refugee children born
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15 165 in Jerash. There were 800 children registered in the Jerash Camp Health Center who were
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18 166 born in 2017, and all of them were included in the analysis. Because we included the
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21 167 whole study population who met the inclusion criteria in the analysis, we did not conduct
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24 168 a sample size calculation. By accessing the electronic health records from the Jerash
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27 169 Camp Health Center, we collected seven categories of data for each child as shown in
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30 170 Additional file 2. At screening and the 1st, 2nd, and 3rd follow-up visits, the following
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33 171 information was collected: the number of children who visited the health center, age in
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36 172 months at health center visits, the number of children who took the Hb test, their Hb levels,
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39 173 and whether they were prescribed iron supplements. Lastly, for the 1st, 2nd, and 3rd follow-
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42 174 up visits, information on the number of children who took other laboratory tests was also
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45 175 collected. The sex of each child was also recorded from the electronic health records.
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177 **Statistical analysis**

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

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6 180 standard deviation (SD) for the continuous variables of child age and child Hb level at
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9 181 each health center visit. For categorical variables, the frequencies and percentages of
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12 182 children who visited the health center, received the Hb test, were diagnosed as anemic,
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15 183 and received iron supplements were calculated. Additionally, for the 1st follow-up visit,
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18 184 the frequencies and percentages of children who improved their Hb status compared to
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21 185 the screening visit were calculated. One-sample t-tests were conducted to investigate
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24 186 whether the mean age at each health center visit was significantly different from the age
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27 187 defined in the UNRWA guidelines, with resulting p-values deemed statistically
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30 188 significant at the 5% level. Based on UNRWA guidelines⁴, patient adherence was
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33 189 calculated by the proportion of the health center visits, and doctor adherence was
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36 190 calculated by the proportions of Hb tests and iron supplementation among moderate to
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39 191 severe anemia children at screening, 1st, 2nd, and 3rd follow-up visits, respectively. The
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42 192 definition of patient and doctor adherence is shown in Additional file 3. STATA version
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45 193 14 was used to conduct the statistical analyses.
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195 **Patient and Public Involvement**

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

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198 **Results**

199 **Children's flow in Jerash Camp Health Center**

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

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

206 **Screening visit**

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

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

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217 ***1st follow-up visit***

218 Table 2 shows the results of the 1st follow-up visit. Out of 112 children diagnosed as
219 moderate to severely anemic at the screening visit, 86 children came to the 1st follow-up
220 visit and their mean \pm SD age at the visit was 16.0 \pm 3.1 months old. Their mean \pm SD
221 Hb level was to 10.1 \pm 1.0g/dL. And 72 (83.7%) children improved their Hb level,
222 compared to their screening visit. Out of 72 children who improved their Hb level, 46
223 children continued to receive iron supplements at the 1st follow-up visit. On the contrary,
224 out of 14 children who did not improve their Hb level, 9 children also received iron
225 supplements. Moreover, out of 247 children diagnosed as mildly at the screening visit,
226 171 children came to the 1st follow-up visit, respectively.

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

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229 ***2nd follow-up visit***

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

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6 235 received iron supplements. Moreover, out of 18 children who were diagnosed as mildly
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9 236 anemic at the 2nd follow-up visit, 17 children received iron supplements.

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12 237 (Table 3. Results of electronic health record survey for the 2nd follow-up visit)
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17 18 239 ***3rd follow-up visit***

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21 240 Table 4 shows the results of the 3rd follow-up visit. Out of 32 children who were
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24 241 diagnosed as mildly anemic or non-anemic at the 2nd follow-up visit, 11 children came to
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27 242 the 3rd follow-up visit, and their mean \pm SD age at the visit was 21.6 ± 3.9 months old.

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30 243 Their mean \pm SD Hb level was 10.2 ± 0.9 g/dL, and 3 children (27.2%) were diagnosed
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33 244 as moderate to severely anemic at the 3rd follow-up visit. There were 6 children who
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36 245 received iron supplement at the 3rd follow-up visit.

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39 246 (Table 4. Results of electronic health record survey for the 3rd follow-up visit)
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42 247 Overall, we found that children visited the health center at an age significantly later
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45 248 compared to that recommended by the UNRWA guidelines for the screening, 1st, and 2nd
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48 249 follow-up visits (p-value<0.05). However, we did not find a significant delay for the 3rd
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51 250 follow-up visit, compared to the age defined in the UNRWA guidelines (p=0.64).

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55 56 57 252 **Adherence to the UNRWA guidelines**

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6 253 Table 5 shows the patient and doctor adherence to the UNRWA guidelines. For the
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9 254 screening visit, patient adherence was 89.6% (95% CI=87.3–91.7). Doctor adherence was
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12 255 100% for Hb tests and 81.3% (95% CI=72.8–88.0) for iron supplementation. For the 1st
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15 256 follow-up visit, patient adherence was decreased to 76.8% (95% CI=67.9–84.2). Doctor
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18 257 adherence was still 100% for Hb tests; however, iron supplementation was decreased to
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21 258 63.9% (95% CI=51.7–74.9). For the 2nd follow-up visit, patient adherence was further
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24 259 decreased to 56.9% (95% CI=44.7–68.6). Doctor adherence to Hb tests was slightly
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27 260 decreased to 97.6% (95% CI=87.1–99.9). For the 3rd follow-up visit, patient adherence
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30 261 was further decreased to 34.4% (95% CI=18.6–53.2). Doctor adherence to Hb tests was
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33 262 increased back to 100%.
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36 263 (Table 5. Adherence to UNRWA guidelines)
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264 **Discussion**

265 This study illustrates that patient and doctor adherence to treatment guidelines was above
266 80% during the screening visit; however, this progressively decreased at follow-up visits,
267 especially patient adherence at the 3rd follow-up visit of 34.4%. Furthermore, the analysis
268 identifies unnecessary health center visits and iron supplement prescriptions to mildly
269 anemic children at the screening and 1st follow-up visit, and children visited the health
270 center at an age significantly later compared to that recommended by the UNRWA
271 guidelines for the screening, 1st, and 2nd follow-up visits (p-value<0.05).

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

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6 282 crucial to avoid a delay to health center visits and treatment for anemia because anemia
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9 283 status interferes with normal growth and development¹¹, otherwise, these impairments
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12 284 may become irreversible⁴. Although patient and doctor adherence to the UNRWA's
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15 285 guidelines should be improved, our study found that the 83.7% of moderate to severely
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18 286 anemic children improved their status through iron supplementation. Therefore, Hb
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21 287 improvement rates via iron supplementation could be increased further if these issues are
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24 288 addressed in the Jerash Camp Health Center.

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27 289 Our analysis identified unnecessary health center visits and iron supplementation
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30 290 in mildly anemic children. For example, out of 247 children who were diagnosed as
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33 291 mildly anemic at the screening visit, 191 children received iron supplements and 171
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36 292 children came to the 1st follow-up visit. It has been pointed out that UNRWA's health
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39 293 center tends to be overcrowded, and this may negatively affect the quality of care
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42 294 provided.²⁰ Furthermore, UNRWA has faced a financial crisis since 2018 by donors
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45 295 ceasing their financial support, and this has negatively affected UNRWA's operation.²¹
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48 296 Thus, it is very important to avoid unnecessary health center visits and iron
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51 297 supplementation to utilize the available resources efficiently.

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54 298 This study found that the burden of childhood anemia was higher in Jerash Camp
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57 299 Health Center, compared to non-refugee Jordanian children and Palestinian refugee
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6 300 children in other Jordan's refugee camps. The mean \pm SD Hb level at the 12-month-old
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9 301 screening in Jerash Camp Health Center was 10.7 ± 0.9 g/dL, which was lower than the
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12 302 mean \pm SD Hb level among non-refugee children aged 12–23 months old in Jordan of
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15 303 11.2 ± 0.16 g/dL as reported in 2002.⁶ Additionally, we found that half of 12-month-old
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18 304 children had an Hb level <11.0 g/dL in Jerash Camp Health Center, which was higher than
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21 305 12-month-old Palestinian children registered by UNRWA in Jordan of 39.0% and 6-12
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24 306 months children in Jerash governorate of 36.9% in 2019.^{14,22} Palestinian refugees face
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27 307 poor intake of iron source food due to food insecurity¹⁴, and Jerash camp in particular has
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30 308 a higher poverty rate¹⁷, which increases the risk of anemia. UNRWA recommends 6-
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33 309 month exclusive breastfeeding because breast milk contains highly bioavailable iron that
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36 310 helps to restore iron and protect children from infectious diseases⁴. In 2005, a survey
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39 311 conducted by UNRWA reported that only 25% of Palestinian children had exclusive
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42 312 breastfeeding up to 4 months in Jordan which was the lowest proportion among five
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45 313 UNRWA regions.²³ Additionally, a study conducted in Jerash camp reported that mothers
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48 314 could not afford iron rich foods and diverse food to feed their children due to economic
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51 315 hardship.²⁴ Some mother gave tea to their infants, which is known as an inhibitor of iron
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54 316 absorption.^{24,4} This was because mothers faced lactation failure due to their own
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57 317 undernutrition but could not afford to buy formula milk.²⁴
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6 318 This study has important implications for Jerash Camp Health Center; efforts
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9 319 should be made to improve adherence to the UNRWA guidelines, avoid a delay of health
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12 320 center visits, and decrease unnecessary health center visits and iron supplementation.
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15 321 Further studies are needed to understand the reason why adherence was decreased at the
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18 322 follow-up visits, whether mothers were informed about when their children should visit
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21 323 the health center for anemia screening and treatment, and whether doctors correctly
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24 324 understood UNRWA guidelines on when to prescribe iron supplements, especially
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27 325 regarding treatment thresholds between mild anemia and moderate to severe anemia.

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30 326 This study had several limitations. First, our analysis did not consider potential
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33 327 confounding factors such as socioeconomic status²⁵⁻²⁷, food security¹⁰, child
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36 328 anthropometric status²⁷, and parent's smoking status²⁶ because there was no such
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39 329 information available in electronic health record, which may be associated with patients
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42 330 adherence to UNRWA's guidelines. Second, the analysis of electronic health records
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45 331 included all children born in 2017 and registered in Jerash Camp Health Center, assuming
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48 332 all of them continued to live in Jerash until 2018 due to lack of data availability. Therefore,
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51 333 the study population (n=800) could be smaller in reality, which would lead to
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54 334 underestimation of adherence to health center visits for the screening visit. Lastly, this
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57 335 study was conducted in Jerash Camp Health Center only, and so findings may not be
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6 336 readily generalizable to other UNRWA health centers in Jordan or other regions due to
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9 337 the poor economic condition among Palestinian refugees, especially in Jerash camp.
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12 338 Nevertheless, our results provide sufficient stimulus for the need for public health
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15 339 intervention to improve adherence to UNRWA guidelines at follow-up visit and to
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18 340 minimize any unnecessary health center visits and iron supplementation.
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341 **Conclusion**

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

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356 dataset and provided comments about this manuscript. Additionally, we appreciate all the
357 doctors, nurses, midwives, interpreters, and mothers and children who supported in
358 completing the study in Jerash Camp Health Center.

359

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361 The authors received no financial support for this research study.

362

363 **Competing interests**

364 The authors declare that they have no competing interests.

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366 **Patient consent for publication**

367 No patient involved.

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369 **Ethics approval**

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

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6 372 research review board of UNRWA Headquarters in Amman. There was no potential harm
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9 373 expected in the study. There was no reference number for the ethics approval because
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12 374 UNRWA did not have a system to give identification numbers when this study was
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15 375 approved by the research review board.
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20 21 377 **Data availability statement**

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24 378 All data relevant to the study are included in the article or as supplementary information.
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27 379 Some restrictions will apply for the availability of data.
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458 **Figures**

459 Figure 1. Children’s flow in Jerash Camp Health Center

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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 \geq 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

463 **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

464 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 1 st follow-up visit (n=72)		
	Non-anemia (Hb \geq 10.0g/dL)	Mild anemia (Hb=10.0–10.9 g/dL)	Moderate to severe anemia (Hb<10.0 g/ dL)
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)	
Anemia status at the 2 nd 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 \geq 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

469 **Table 5. Adherence to UNRWA guidelines**

	Screening visit	1 st follow-up visit	2 nd follow-up visit	3 rd 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

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471 **Additional Files**

472 Additional file 1. Flow chart of the UNRWA guidelines

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

475 Additional file 3. Case definition of electronic health record

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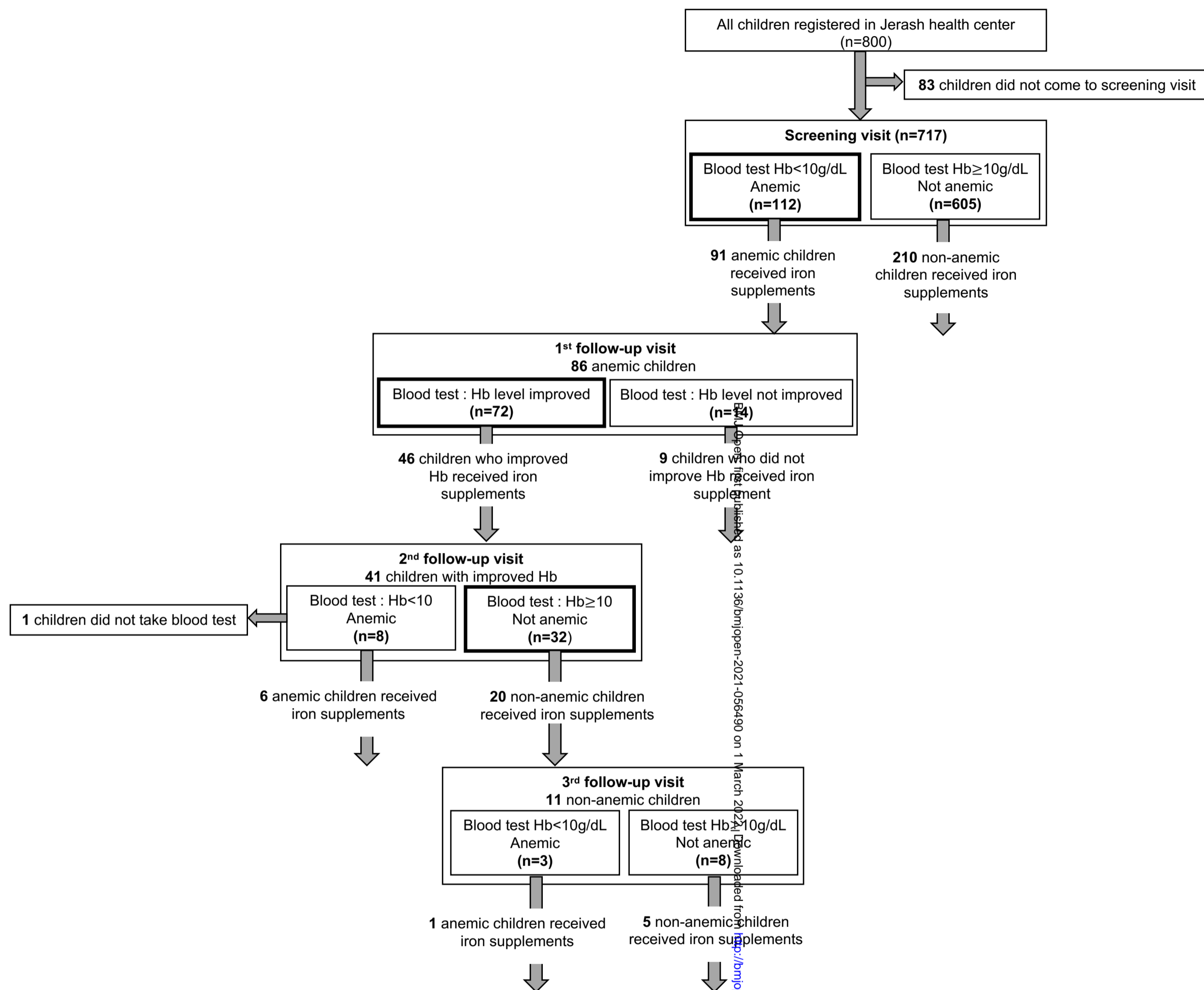
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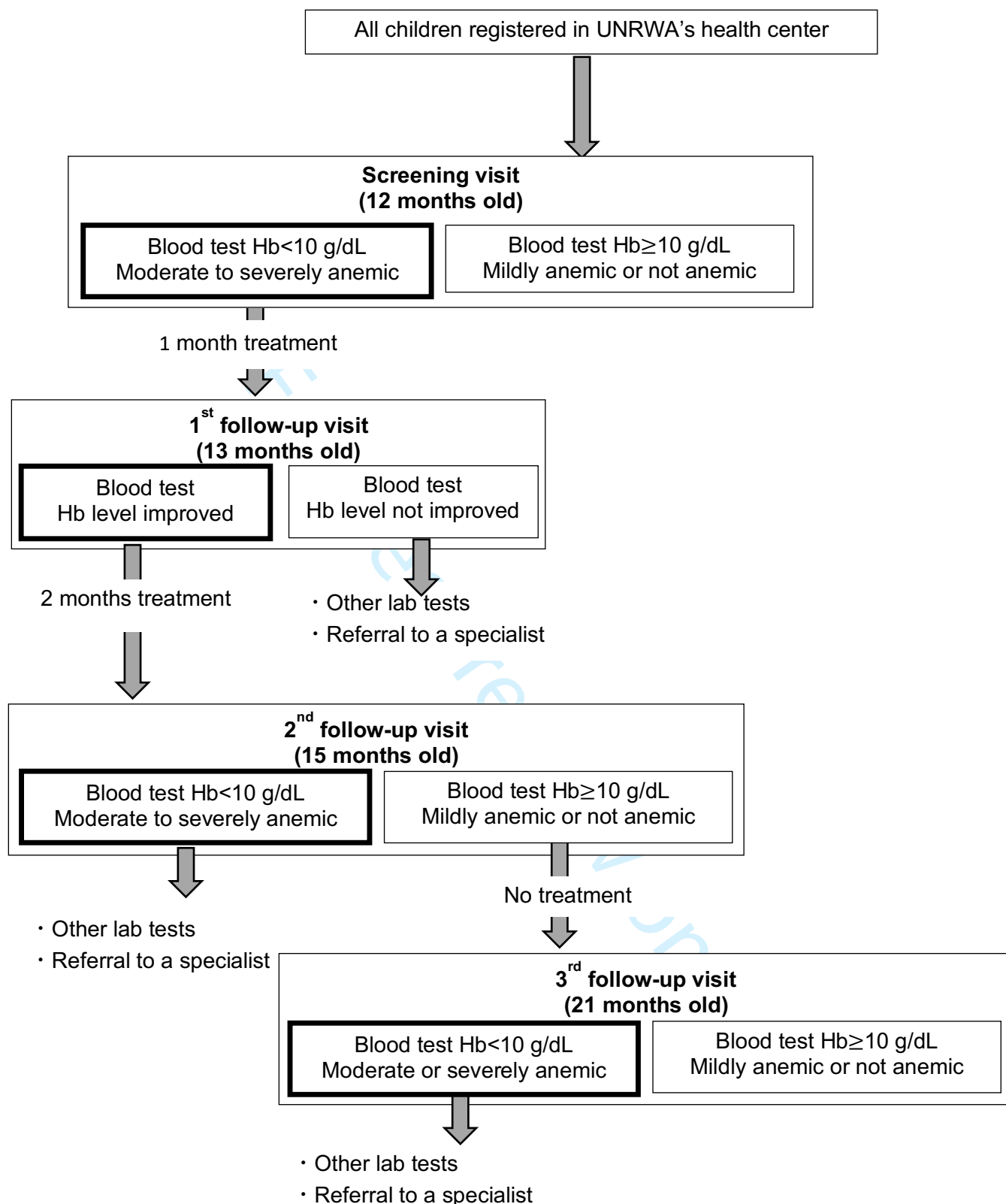
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Figure 1. Children's flow in Jerash Camp Health Center



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

Additional file 3. Case definition of electronic health record

1. Patient adherence by health center visits (%)

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

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

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

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

2. Doctor adherence by Hb tests (%)

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

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

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

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

3. Doctor adherence by iron supplementation (%)

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

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

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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.

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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 time frame 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)		

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<p>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27</p> <p>Participants</p>	<p>6</p>	<p>(a) <i>Cohort study</i> - Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> - 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 <i>Cross-sectional study</i> - Give the eligibility criteria, and the sources and methods of selection of participants</p> <p>(b) <i>Cohort study</i> - For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> - For matched studies, give matching criteria and the number of controls per case</p>	<p>Method (P11-12)</p>	<p>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.</p> <p>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.</p> <p>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.</p>	<p>6.1 Method (P12)</p> <p>6.2 N/A</p> <p>6.3 N/A</p>
<p>28 29 30 31 32 33 34</p> <p>Variables</p>	<p>7</p>	<p>Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable.</p>	<p>Method (P12)</p>	<p>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.</p>	<p>Method (P12)</p> <p>Additional file 3</p>
<p>35 36 37 38 39 40 41 42</p> <p>Data sources/ measurement</p>	<p>8</p>	<p>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</p>	<p>Method (P12)</p>		

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) <i>Cohort study</i> - If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> - If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> - 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)

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				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 (<i>e.g.</i> , 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>i.e.</i> , 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) Figure 1
Descriptive data	14	(a) Give characteristics of study participants (<i>e.g.</i> , 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) <i>Cohort study</i> - summarise follow-up time (<i>e.g.</i> , average and total amount)	Result (P14-16)		
Outcome data	15	<i>Cohort study</i> - Report numbers of outcome events or summary measures over time <i>Case-control study</i> - Report numbers in each exposure	Result (P14-16)		

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		category, or summary measures of exposure <i>Cross-sectional study</i> - 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, Guttman A, Harron K, Moher D, Petersen I, Sørensen HT, von Elm E, Langen 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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