Magna Scientia Advanced Research and Reviews

eISSN: 2582-9394

Cross Ref DOI: 10.30574/msarr

Journal homepage: https://magnascientiapub.com/journals/msarr/

(RESEARCH ARTICLE)

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Anemia among pregnant and lactating women in Baghdad, Iraq: Prevalence, severity, and independent predictors in a comparative cross-sectional study

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Magna Scientia Advanced Research and Reviews, 2026, 17(02), 232–240

Publication history: Received on 22 May 2026; revised on 22 July 2026; accepted on 25 July 2026

Article DOI: https://doi.org/10.30574/msarr.2026.17.2.0148

Abstract

Background: Anemia in women of reproductive age remains a major public health problem, with the highest risk during pregnancy and lactation. Baghdad's two health directorates, Al-Rusafa and Al-Karkh, are rarely compared with each other.

Objectives: To compare the prevalence and severity of anemia among pregnant and lactating women attending primary health care centers (PHCs) in the two directorates, and to identify its independent determinants.

Methods: A comparative cross-sectional study included 600 pregnant and lactating women attending PHCs in Baghdad, 300 per directorate. A structured interview covered sociodemographic, obstetric and dietary variables; dietary diversity was assessed with the Minimum Dietary Diversity for Women (MDD-W) indicator. Hemoglobin was measured in all participants and anemia defined by WHO cut-offs. Directorates were compared using chi-square and t-tests, and variables significant at the bivariate level entered a multivariable logistic regression model.

Results: Overall anemia prevalence was 41.3% (248/600), significantly higher in Al-Rusafa than Al-Karkh (47.3% versus 35.3%, P = 0.003), with correspondingly lower mean hemoglobin (10.8 ± 1.6 versus 11.4 ± 1.3 g/dL, P < 0.001). Anemia was mostly mild (21.3%) or moderate (16.3%); 3.7% was severe. Seven variables were independently associated with anemia: no iron supplementation (adjusted OR [AOR] 2.86, 95% CI 1.81–4.52), fewer than four antenatal care visits (AOR 2.41, 1.54–3.76), low dietary diversity (AOR 2.11, 1.34–3.31), tea immediately after meals (AOR 1.89, 1.22–2.93), birth spacing under 24 months (AOR 1.76, 1.11–2.78), Al-Rusafa residence (AOR 1.68, 1.07–2.64) and age under 25 years (AOR 1.54, 1.01–2.36).

Conclusions: Anemia affected about four in ten pregnant and lactating women attending PHCs in Baghdad, with an uneven burden between directorates. Because the strongest predictors were service-related and dietary, they are largely modifiable. Securing supplement supply and adherence, improving antenatal attendance, and counselling on dietary diversity and tea timing are practical priorities, beginning in Al-Rusafa.

Keywords: Anemia; Pregnancy; Lactation; Dietary Diversity; Iron Supplementation; Primary Health Care; Iraq.

1. Introduction

Anemia is one of the most common nutritional disorders in the world. It is defined as a hemoglobin (Hb) concentration below the value expected for a person's age, sex and physiological state, and it reduces the capacity of the blood to carry oxygen (1). Women of reproductive age carry a disproportionate share of the global burden: recent estimates indicate

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that anemia still affected about 30.7% of women aged 15–49 years in 2023, compared with 27.6% in 2012 (2). Because progress has effectively stalled, World Health Organization (WHO) Member States extended the global anemia reduction target from 2025 to 2030 (2,3).

The situation during pregnancy is more serious. Anemia in pregnancy affects roughly 32 million women each year and contributes to more than 115,000 maternal and about 591,000 perinatal deaths worldwide; in low- and middle-income countries close to half of all pregnant women are affected, and global prevalence remains more than twice the 15% target (1). It is associated with preterm birth, low birth weight, increased need for transfusion and postpartum hemorrhage (1). Lactation is often overlooked, although iron reserves are further depleted by blood loss at delivery and by continued nutrient transfer through breast milk, so anemia frequently persists after birth (4, 5).

Iraq is one of the countries where this problem remains unresolved. National figures place anemia among pregnant women aged 15–49 years at approximately 31% (6), but facility-based Iraqi studies report a much wider range, reflecting differences in setting, sampling and laboratory methods. Awareness of iron deficiency anemia and its prevention is limited among women attending Iraqi primary health care centers (7), and inherited red-cell disorders such as beta-thalassemia minor are not rare in Iraqi obstetric populations and can be misclassified as simple iron deficiency (8). Anemia in Iraq is therefore a mixed problem in which nutritional, obstetric, service-related and genetic factors overlap.

Health services in Baghdad are organized through two large directorates: Al-Rusafa on the eastern bank of the Tigris and Al-Karkh on the western bank. Their populations differ in density, socioeconomic composition, internal migration and service load. If the burden of anemia is unequal between them, a city-wide average will conceal the difference and resources may be misallocated. Most Iraqi studies, however, have treated Baghdad as a single unit or have been conducted in tertiary hospitals, whose case mix does not represent the women who attend primary care; comparative studies of PHC attendees across the two directorates, including lactating as well as pregnant women, are scarce.

This study therefore aimed to estimate and compare the prevalence and severity of anemia among pregnant and lactating women attending PHCs in the two directorates, to compare their sociodemographic, obstetric and dietary characteristics, and to identify factors independently associated with anemia.

2. Materials and Methods

2.1. Study design and setting

A comparative cross-sectional study was conducted among pregnant and lactating women attending primary health care centers (PHCs) in Baghdad, Iraq. The PHCs were selected from the two health directorates of the city, Al-Rusafa and Al-Karkh, to enable a direct comparison between the two populations. Data were collected between June 2025 and January 2026. Using a random sampling method, five PHCs were selected from each health directorate, yielding a total of ten participating centers.

2.2. Study population and eligibility criteria

Eligible participants were women aged 15 years or older who were either pregnant at any gestational age or currently breastfeeding, who attended one of the selected centers during the study period for antenatal, postnatal, child health or general services, and who agreed to take part. Women were excluded if they had a known hematological disorder such as thalassemia major or sickle cell disease, a chronic condition known to cause anemia (for example chronic renal disease or malignancy), an active bleeding disorder, or a blood transfusion within the previous three months. These exclusions were applied to reduce the number of cases in which anemia was clearly not of nutritional origin.

2.3. Sample size and sampling

A total of 600 women were enrolled, 300 from each health directorate. The equal allocation was selected to ensure that both groups are statistically equal and to facilitate the comparison of directorates. The required number of participants was recruited in each directorate and the recruitment was continued in the participating centres consecutively.

2.4. Data collection

Data were gathered using a structured, interviewer administered questionnaire in a confidential space in the centre. There were four sections in the questionnaire. The first was on sociodemographic characteristics: age, place of residence (urban or peri-urban/rural), educational level, employment status, and the woman's own assessment that the

household's monthly income was adequate to cover basic needs. The second covered obstetric and reproductive history: current physiological state (pregnant or lactating), gravidity and parity, the number of antenatal care (ANC) visits made during the current or most recent pregnancy, the interval since the previous birth, any history of anemia in a previous pregnancy, and current use of iron or iron–folic acid supplements. The third part covered dietary practice, and the fourth recorded anthropometric and laboratory results.

2.5. Dietary and anthropometric assessment

Dietary practice was assessed by asking about habits known to influence iron status: regular consumption of breakfast, daily intake of iron-rich foods (red meat, liver, poultry, fish, eggs, legumes and dark green leafy vegetables), daily fruit consumption, and the habit of drinking tea immediately after meals rather than between them. Dietary diversity was assessed using a food-group recall over the preceding 24 hours, and participants were classified as having low dietary diversity when the number of food groups consumed fell below the accepted threshold. Weight and height were measured with standard calibrated equipment and body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared; underweight was defined as a BMI below 18.5 kg/m^2.

2.6. Hemoglobin measurement and definition of anemia

A venous or capillary blood sample was obtained from every participant and hemoglobin concentration was determined in the laboratory of the participating center. Anemia was defined according to WHO criteria: a hemoglobin concentration below 11.0 g/dL for pregnant women and below 12.0 g/dL for lactating (non-pregnant) women. Among pregnant women, severity was classified as mild (10.0–10.9 g/dL), moderate (7.0–9.9 g/dL) and severe (below 7.0 g/dL), in line with current international recommendations (1).

2.7. Statistical analysis

Data were entered and analyzed with SPSS version 26. Categorical variables are presented as frequencies and percentages, and continuous variables as mean ± standard deviation. Proportions were compared between the two directorates with the Pearson chi-square test, and means with the independent-samples t-test. Anemia prevalence was additionally compared between pregnant and lactating women within each directorate. The association between each candidate factor and anemia was first examined at the bivariate level, and crude odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. Variables that were significantly associated with anemia in the bivariate analysis were then entered together into a multivariable binary logistic regression model, from which adjusted odds ratios (AORs) with 95% CIs were derived. The explanatory power of the model was summarized by the Nagelkerke R^2, its calibration by the Hosmer–Lemeshow goodness-of-fit test, and its discrimination by the overall classification accuracy. A two-sided P-value below 0.05 was taken as statistically significant.

2.8. Ethical considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the relevant institutional review board, and administrative permission was granted by both health directorates before data collection began. The purpose of the study was explained to every woman in simple language, participation was voluntary, and informed consent was obtained before the interview. For participants below the legal age of consent, consent was obtained from an accompanying guardian. All data were anonymized and handled confidentially, and women who were found to be anemic were referred to the treating physician of the center for management according to national protocols.

3. Results

3.1. Sociodemographic characteristics

A total of 600 women were studied, 300 from Al-Rusafa and 300 from Al-Karkh. The mean age of the sample was 28.7 ± 5.9 years and did not differ significantly between the two directorates (P = 0.381). Most participants lived in urban areas (84.3%), had completed secondary education or less (57.3%), and were not in paid employment (73.0%). Two differences between the directorates were statistically significant. Women under 25 years of age were more common in Al-Rusafa than in Al-Karkh (37.3% versus 28.7%, P = 0.024), and a larger proportion of women in Al-Rusafa described their household income as insufficient (52.0% versus 42.0%, P = 0.014). Residence, education and employment status were comparable between the two groups (Table 1).

Table 1 Sociodemographic characteristics of the study participants by health directorate

Variable	Total (N = 600)	Al-Rusafa (n = 300)	Al-Karkh (n = 300)	P-value
Age, mean ± SD (years)	28.7 ± 5.9	28.3 ± 5.8	29.1 ± 6.1	0.381
Age < 25 years	198 (33.0)	112 (37.3)	86 (28.7)	0.024
Age 25–34 years	286 (47.7)	136 (45.3)	150 (50.0)	
Age ≥ 35 years	116 (19.3)	52 (17.4)	64 (21.3)	
Urban residence	506 (84.3)	258 (86.0)	248 (82.7)	0.267
Secondary education or less	344 (57.3)	181 (60.3)	163 (54.3)	0.138
Unemployed / housewife	438 (73.0)	225 (75.0)	213 (71.0)	0.287
Monthly income reported as insufficient	282 (47.0)	156 (52.0)	126 (42.0)	0.014

Values are n (%) unless otherwise stated. P-values are from the chi-square test for categorical variables and the independent-samples t-test for age. For variables with more than two categories the P-value applies to the whole variable.

3.2. Obstetric and reproductive characteristics

Pregnant women made up 60.0% of the sample and lactating women 40.0%, with a similar distribution in both directorates (P = 0.731). Almost three quarters of participants were multiparous (74.3%). Several indicators of reproductive risk were significantly more frequent in Al-Rusafa: fewer than four ANC visits (42.7% versus 30.0%, P = 0.001), birth spacing shorter than 24 months (34.3% versus 27.0%, P = 0.048), and a history of anemia in a previous pregnancy (43.7% versus 35.0%, P = 0.031). Current use of iron supplements was reported by 72.0% of the sample overall, with no significant difference between the directorates (P = 0.145), which means that slightly more than one quarter of the women were not taking any supplement at the time of the interview (Table 2).

Table 2 Obstetric and reproductive characteristics by health directorate

Variable	Total (N = 600)	Al-Rusafa (n = 300)	Al-Karkh (n = 300)	P-value
Pregnant	360 (60.0)	178 (59.3)	182 (60.7)	0.731
Lactating	240 (40.0)	122 (40.7)	118 (39.3)	
Primigravida	154 (25.7)	84 (28.0)	70 (23.3)	0.192
Multiparity (≥ 2 births)	446 (74.3)	216 (72.0)	230 (76.7)	
Fewer than 4 antenatal care visits	218 (36.3)	128 (42.7)	90 (30.0)	0.001
Birth spacing < 24 months	184 (30.7)	103 (34.3)	81 (27.0)	0.048
Anemia in a previous pregnancy	236 (39.3)	131 (43.7)	105 (35.0)	0.031
Current use of iron supplements	432 (72.0)	208 (69.3)	224 (74.7)	0.145

Values are n (%). Birth spacing and previous-pregnancy anemia were assessed among women with at least one previous birth.

3.3. Nutritional and dietary characteristics

Dietary practice differed appreciably between the two directorates, and in every case the less favorable pattern was found in Al-Rusafa. Daily consumption of iron-rich foods was reported by 39.3% of women in Al-Rusafa compared with 48.7% in Al-Karkh (P = 0.019), and daily fruit consumption by 52.7% compared with 62.7% (P = 0.013). The habit of drinking tea immediately after meals was reported by 49.3% of women in Al-Rusafa and 36.7% in Al-Karkh (P = 0.002), and a low dietary diversity score was recorded for 44.0% and 32.0% respectively (P = 0.003). Underweight (BMI below 18.5 kg/m^2) was also more frequent in Al-Rusafa (20.7% versus 14.0%, P = 0.029). Regular breakfast consumption was the only dietary variable that did not differ significantly (P = 0.084) (Table 3).

Table 3 Nutritional and dietary characteristics by health directorate

Variable	Total (N = 600)	Al-Rusafa (n = 300)	Al-Karkh (n = 300)	P-value
Regular breakfast consumption	404 (67.3)	192 (64.0)	212 (70.7)	0.084
Daily intake of iron-rich foods	264 (44.0)	118 (39.3)	146 (48.7)	0.019
Daily fruit consumption	346 (57.7)	158 (52.7)	188 (62.7)	0.013
Tea taken immediately after meals	258 (43.0)	148 (49.3)	110 (36.7)	0.002
Low dietary diversity score	228 (38.0)	132 (44.0)	96 (32.0)	0.003
Body mass index < 18.5 kg/m^2	104 (17.3)	62 (20.7)	42 (14.0)	0.029

Values are n (%). Low dietary diversity was defined according to the food-group threshold described in the Methods.

3.4. Prevalence and severity of anemia

Anemia was identified in 248 of the 600 participants, giving an overall prevalence of 41.3%. Prevalence was significantly higher in Al-Rusafa than in Al-Karkh (47.3% versus 35.3%, P = 0.003), an absolute difference of 12 percentage points. Mean hemoglobin followed the same pattern (10.8 ± 1.6 g/dL in Al-Rusafa versus 11.4 ± 1.3 g/dL in Al-Karkh, P < 0.001). Most cases were mild (21.3% of the whole sample) or moderate (16.3%), while severe anemia was found in 3.7% overall. Severe anemia was more than twice as frequent in Al-Rusafa as in Al-Karkh (5.3% versus 2.0%), so the difference between the directorates was one of severity as well as of frequency (Table 4).

Table 4 Prevalence and severity of anemia by health directorate

Variable	Total (N = 600)	Al-Rusafa (n = 300)	Al-Karkh (n = 300)	P-value
Anemia (all severities)	248 (41.3)	142 (47.3)	106 (35.3)	0.003
Non-anemic	352 (58.7)	158 (52.7)	194 (64.7)	
Mild anemia	128 (21.3)	72 (24.0)	56 (18.7)	
Moderate anemia	98 (16.3)	54 (18.0)	44 (14.7)	
Severe anemia	22 (3.7)	16 (5.3)	6 (2.0)	
Hemoglobin, mean ± SD (g/dL)	11.1 ± 1.5	10.8 ± 1.6	11.4 ± 1.3	< 0.001

Values are n (%) unless otherwise stated. Anemia was defined as hemoglobin below 11.0 g/dL in pregnant women and below 12.0 g/dL in lactating women. Severity categories: mild 10.0–10.9 g/dL, moderate 7.0–9.9 g/dL, severe below 7.0 g/dL. The P-value in the first row compares anemic with non-anemic women between directorates.

3.5. Factors associated with anemia at the bivariate level

All six factors examined were significantly associated with anemia (Table 5). The strongest crude association was with the absence of iron supplementation (OR 3.23, 95% CI 2.17–4.81), followed by a low dietary diversity score (OR 2.68, 95% CI 1.87–3.84), fewer than four ANC visits (OR 2.58, 95% CI 1.79–3.71), tea taken immediately after meals (OR 2.28, 95% CI 1.61–3.24), age below 25 years (OR 2.08, 95% CI 1.45–2.97) and birth spacing shorter than 24 months (OR 2.02, 95% CI 1.39–2.94). Every crude odds ratio was therefore at least two, and all associations were significant at P < 0.001.

Table 5 Factors associated with anemia among pregnant and lactating women (bivariate analysis)

Variable	Anemic (n = 248)	Non-anemic (n = 352)	Crude OR (95% CI)	P-value
Age < 25 years	106 (42.7)	92 (26.1)	2.08 (1.45–2.97)	< 0.001
Fewer than 4 antenatal care visits	122 (49.2)	96 (27.3)	2.58 (1.79–3.71)	< 0.001
Low dietary diversity score	128 (51.6)	100 (28.4)	2.68 (1.87–3.84)	< 0.001

Birth spacing < 24 months	98 (39.5)	86 (24.4)	2.02 (1.39–2.94)	< 0.001
No iron supplementation	104 (41.9)	64 (18.2)	3.23 (2.17–4.81)	< 0.001
Tea taken immediately after meals	136 (54.8)	122 (34.7)	2.28 (1.61–3.24)	< 0.001

Values are n (%) within the anemic and non-anemic groups. OR, odds ratio; CI, confidence interval.

3.6. Independent predictors of anemia

When the six bivariate factors were entered together with directorate of residence into a multivariable logistic regression model, all seven variables retained statistical significance (Table 6). The absence of iron supplementation remained the strongest predictor (AOR 2.86, 95% CI 1.81–4.52), followed by fewer than four ANC visits (AOR 2.41, 95% CI 1.54–3.76), low dietary diversity (AOR 2.11, 95% CI 1.34–3.31), tea taken immediately after meals (AOR 1.89, 95% CI 1.22–2.93), birth spacing shorter than 24 months (AOR 1.76, 95% CI 1.11–2.78), residence in Al-Rusafa (AOR 1.68, 95% CI 1.07–2.64) and age below 25 years (AOR 1.54, 95% CI 1.01–2.36). The adjusted odds ratios were smaller than the crude values, which indicates that the factors were partly correlated with one another. The model explained 36% of the variance in anemia status (Nagelkerke $R^2 = 0.36$), showed acceptable calibration (Hosmer–Lemeshow P = 0.641) and classified 79.4% of participants correctly. Importantly, residence in Al-Rusafa remained an independent predictor after adjustment for age, service use and diet, which suggests that the geographical difference is not fully explained by the individual characteristics measured in this study.

Table 6 Independent predictors of anemia (multivariable binary logistic regression)

Predictor	Adjusted OR	95% CI	P-value
No iron supplementation	2.86	1.81–4.52	< 0.001
Fewer than 4 antenatal care visits	2.41	1.54–3.76	< 0.001
Low dietary diversity score	2.11	1.34–3.31	0.001
Tea taken immediately after meals	1.89	1.22–2.93	0.004
Birth spacing < 24 months	1.76	1.11–2.78	0.016
Residence in Al-Rusafa Directorate	1.68	1.07–2.64	0.024
Age < 25 years	1.54	1.01–2.36	0.047

OR, odds ratio; CI, confidence interval. All seven variables were entered simultaneously.

3.7. Model performance

The logistic regression model showed acceptable performance. It explained approximately 36% of the variance in anemia status (Nagelkerke $R^2 = 0.36$). The Hosmer–Lemeshow goodness-of-fit test was non-significant (P = 0.641), indicating that the model was well calibrated and fitted the observed data adequately, and the overall classification accuracy was 79.4%.

4. Discussion

This study compared anemia in pregnant and lactating women attending primary care in the two health directorates of Baghdad. Three findings stand out. First, anemia affected about four in every ten women, which places this population in the range that WHO classifies as a severe public health problem. Second, the burden was not distributed evenly across the city: prevalence in Al-Rusafa exceeded that in Al-Karkh by 12 percentage points, and severe anemia was more than twice as frequent there. Third, and most usefully for practice, the strongest independent predictors were not fixed characteristics but modifiable ones — supplement use, antenatal care attendance, dietary diversity, the timing of tea intake and birth spacing.

The overall figure of 41.3% is considerably higher than the national estimate of about 31% for pregnant Iraqi women (6), but this is not surprising. Our sample included lactating women, whose iron reserves are depleted by delivery and continued lactation and who are frequently excluded from national reporting (4, 5). Facility-based samples also tend to concentrate women with higher parity, closer birth spacing and greater socioeconomic vulnerability than a general population survey would capture. The result is nonetheless consistent with the wider regional and global picture, in which nearly half of pregnant women in low- and middle-income countries are anemic (1) and in which prevalence

among women of reproductive age has remained close to 30% for more than a decade (2,3). It is also comparable to the 50.6% reported among pregnant women attending antenatal care in Hargeisa, Somaliland (9), and to figures reported from other settings in the region.

The absence of iron supplementation was the strongest predictor of anemia in our model (AOR 2.86). This agrees closely with findings from Somaliland, where the absence of iron supplementation during pregnancy was independently associated with anemia (AOR 2.76) (9). Since national guidelines already recommend routine iron and folic acid during pregnancy, and international guidance reaffirms this recommendation (1), the finding that more than one quarter of the women in our sample were not taking any supplement points to a gap in implementation rather than in policy. Such gaps generally arise from interruptions in the supply chain, from gastrointestinal side effects that lead women to stop taking the tablets, and from insufficient counselling. This distinction matters, because a supply or adherence problem can be corrected within existing services.

Attending fewer than four antenatal care visits was the second strongest predictor (AOR 2.41). Antenatal care is the main channel through which supplements, screening, deworming and nutritional counselling reach pregnant women, so infrequent attendance withholds several protective interventions at once. Current international guidance recommends screening for anemia at the first contact and again at 28 weeks (1), which cannot be achieved if attendance is irregular. It is also relevant that fewer than four visits were significantly more common in Al-Rusafa, so this factor contributes directly to the geographical difference we observed.

Two dietary factors were independently associated with anemia. A low dietary diversity score increased the odds of anemia by about twofold (AOR 2.11), which is consistent with evidence from other settings: in a study of 430 pregnant women in New Delhi, the mean Minimum Dietary Diversity for Women score was substantially lower in anemic than in non-anemic women and declined progressively with increasing severity of anemia (10), and in a Ghanaian study a higher dietary diversity score was associated with better hemoglobin status (11). Drinking tea immediately after meals was also an independent predictor (AOR 1.89). The mechanism is well described: polyphenols and tannins in tea bind non-heme iron in the upper gastrointestinal tract and form insoluble complexes that cannot be absorbed. A meta-analysis of studies in pregnant women concluded that the habit of tea drinking is associated with anemia (12), although not every individual study has found a significant association (13), probably because the amount of tea, its strength and above all its timing in relation to meals vary between populations. The practical implication is not that tea should be prohibited, which would be unrealistic in Iraq, but that the interval between tea and meals should be extended — a message that is easy to deliver during routine visits and costs nothing to implement.

Birth spacing shorter than 24 months remained an independent predictor (AOR 1.76). Repeated pregnancies at short intervals do not allow iron reserves to be restored between births, and the effect accumulates when supplementation is irregular. This finding links anemia control directly to family planning services, and suggests that the two programs should be coordinated rather than run separately. Age below 25 years was also independently associated with anemia, though weaklier (AOR 1.54). Younger women are at higher risk because iron demands may coincide with their own continuing growth, because their nutritional knowledge and household decision-making power are often more limited, and because they attend antenatal care later and less regularly. A high burden of anemia among young women has been described consistently across low- and middle-income countries (14).

It is important to emphasise the persistence of directorate of residence as an independent predictor (AOR 1.68). Even when women were adjusted for age, service use and dietary practice, those who lived in Al-Rusafa had approximately 68% greater chance of being anemic. This residual difference may reflect: differences in the density and staffing of health centres; variations in the supply of food supplements between the two directorates; the distribution of IDPs and low-income households; and food availability and prices. There was also a higher prevalence of underweight in Al-Rusafa (20.7% compared to 14.0%) and reflects a general nutritional disadvantage rather than a simple iron issue, given the complex relationship between body composition and iron status in women of reproductive age (6,15). Whatever the cause, the result has an obvious practical implication: a uniform city-wide programme will leave the more affected population under-served and intervention should be stepped up immediately in Al-Rusafa.

Strengths and limitations

The major strengths of this study are the balanced comparative design (equal numbers of women from both directorates), the inclusion of lactating as well as pregnant women, the primary care sampling frame as opposed to a tertiary care sampling frame, and the inclusion of all the sociodemographic, obstetric, and dietary variables in a single multivariable model. There are a number of caveats that need to be noted. First, the cross sectional design is an association rather than a causation; for instance, women who feel unwell due to anemia may attend antenatal services

differently, meaning that the relationship of service use with the women's feeling of being unwell is not definable. Second, dietary practice and the use of supplements were self-reported and may be subject to social desirability or recall bias that is likely to underestimate the poor dietary practices. Third, anemia was defined on hemoglobin alone. Without ferritin, transferrin saturation, C-reactive protein or hemoglobin electrophoresis, iron deficiency cannot be separated from anemia of inflammation or from inherited red-cell disorders. This is a particularly relevant caveat in Iraq, where undiagnosed beta-thalassemia minor has been documented in obstetric populations and can be mistaken for iron deficiency (6). Fourth, participants were recruited at health facilities, so women who do not use primary care are not represented and the prevalence reported here should not be read as a population estimate for Baghdad. Fifth, gestational age, trimester, dietary intake of inhibitors and enhancers other than tea, parasitic infection and household food insecurity were not analyzed, and their omission may have left part of the difference between directorates unexplained.

Implications for practice and policy

Because six of the seven independent predictors are modifiable, the findings translate readily into action at the primary care level. Four measures follow directly from the data. (i) Iron and folic acid supply should be secured at center level and adherence supported actively, with side effects addressed rather than ignored, since the absence of supplementation carried the highest adjusted risk. (ii) Antenatal care attendance should be strengthened, with hemoglobin measured at the first contact and repeated later in pregnancy as recommended internationally (3), and with defaulter follow-up for women who miss visits. (iii) Brief, practical nutrition counselling should be standard, covering the range of food groups eaten in a day and the simple advice that tea be taken between meals rather than with or immediately after them. (iv) Anemia control and postpartum family planning should be linked, given the independent contribution of short birth spacing. Finally, monitoring should be disaggregated by directorate, so that a difference of the size found here is visible to planners rather than hidden inside a city-wide average, and lactating women should be included in routine screening rather than considered only during pregnancy.

5. Conclusion

Anemia affected 41.3% of pregnant and lactating women attending primary health care centers in Baghdad, and the burden was significantly higher in Al-Rusafa than in Al-Karkh (47.3% versus 35.3%), both in frequency and in severity. The independent predictors were the absence of iron supplementation, fewer than four antenatal care visits, low dietary diversity, tea taken immediately after meals, birth spacing shorter than 24 months, residence in Al-Rusafa and age below 25 years. Since almost all of these factors can be changed through routine primary care, anemia in this population should be regarded as largely preventable. Interventions that combine reliable supplementation, better antenatal attendance, simple dietary counselling and birth spacing support are likely to have the greatest effect, and should be introduced first in the directorate with the higher burden. Prospective studies that include iron and inflammatory markers, and that separate nutritional anemia from inherited causes, are needed to refine this picture.

Compliance with ethical standards

Acknowledgments

The authors thank the staff of the participating primary health care centers and the women who agreed to take part.

Disclosure of conflict of interest

The authors declare that they have no competing interests.

Statement of ethical approval

The study was approved by the relevant institutional review board and by both health directorates.

Statement of informed consent

Informed consent was obtained from every participant.

Availability of data and materials

The dataset analyzed during this study is available from the corresponding author on reasonable request.

Funding

This research received no specific grant from any funding agency.

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