Anaemia prevalence and risk factors in pregnant women in Oman: a retrospective case-control study

Abstract

Background/Aims **Anaemia is a multifactorial condition and understanding its prevalence and associated factors is crucial for effective healthcare planning and interventions. The aim of this study was to explore the prevalence of anaemia during pregnancy and its potential risk factors in Oman.**

Methods **A retrospective approach was used to identify anaemia cases by examining medical records taken from 9321 women who gave birth at the hospital over 3 years. Chi-squared tests were used to establish differences in risk factors using a case-control design, with a 1:2 ratio.**

Results **The crude prevalence of anaemia was 31.2%, dropping to 4.9% after excluding women with chronic and/or acute diseases. Significant differences were found in nationality (χ^2=4.738, *P*=0.030), body mass index (χ^2=6.392, *P*=0.041) and gestational age (χ^2=4.329, *P*=0.037) for women with anaemia compared to those without.**

Conclusions **These findings underscore the significance of assessing and managing anaemia in pregnancy, while considering the interaction of demographic and clinical variables in formulating anaemia prevention strategies.**

Keywords

Case-control | Determinants | Pregnancy-induced anaemia | Prevalence

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Anaemia during pregnancy is a global public health concern with significant implications for maternal and fetal health (Means, 2020). It is a multifactorial condition, and understanding its prevalence and associated factors is crucial for effective healthcare planning and interventions. Anaemia is defined as a condition characterised by a deficiency of red blood cells or haemoglobin in the blood, leading to reduced oxygen-carrying capacity (Ogunbode and Ogunbode, 2021). During pregnancy, anaemia is a common issue, and its prevalence varies globally from 5.2% to 65.7% (Stevens et al, 2013; Costa and Ayres-Silva, 2019; Karami et al, 2022). Oman has a unique sociodemographic profile and healthcare system (Farzah and Husin, 2022). Approximately 24% of the total Omani population are women of reproductive age (15–49 years), the total fertility rate was 3.9 children per woman in 2019, and Oman has a well-developed, universal healthcare system that provides free health services to all citizens (World Health Organization, 2021). In this context, it is essential to examine the prevalence of anaemia in pregnancy to implement effective strategies for its prevention and management.

The prevalence of anaemia in pregnancy in Oman has not been recently explored; the authors found only one study by Garzon et al (2020), which provided valuable insight into the extent of the issue among Omani women, reporting a prevalence of 41.7%. A comprehensive analysis of the literature shows reports of varying prevalences (Karami et al, 2022) and potential contributing factors (Bansal et al, 2020). In 2019, the prevalence of anaemia (defined as Hb<110g/L) in pregnant Omani women was reported as 30.2% (WorldBank, 2024). Limited sample studies of anaemia in pregnancy reported prevalences of anaemia as secondary findings, ranging from 29.3% (Petry et al, 2020) to 41.7% (Seshan et al, 2018).

Several factors have been reported to contribute to the prevalence of anaemia in pregnancy among Omani women, including parity and socioeconomic status (Seshan et al, 2018). The Omani diet can provide

an inadequate iron intake, contributing to anaemia (Nasreddine et al, 2018). Cultural practices and beliefs surrounding food choices during pregnancy also play a role in anaemia prevalence (Kilshaw et al, 2016; Halabi, 2018). Socioeconomic disparities in Oman (Islam and Al-Hadhrami, 2022) can lead to variations in anaemia rates.

Access to prenatal care is essential for early detection and management of anaemia. Women who receive early and regular prenatal care are more likely to have anaemia addressed, preventing complications for both mother and child (Beckert et al, 2019). The Ministry of Health (2016) in Oman follows the WHO recommendations for antenatal care, and has clear guidelines for nurses, midwives and medical practitioners that recommend six antenatal and two postnatal care visits. The guidelines also recommend screening for anaemia at antenatal care booking, continuous monitoring of anaemia and other risk factors throughout the pregnancy and routine iron supplementation at gestational week 13, regardless of a woman's Hb status (standard dose of 150mg of ferrous sulphate and 400mcg folic acid daily till the end of pregnancy).

Despite considerable global research on the prevalence of anaemia in pregnancy, there is a significant gap in the understanding of the prevalence and specific factors contributing to anaemia among pregnant women in the Omani context. While some studies have assessed anaemia prevalence as a secondary finding, few have explored the involved sociodemographic determinants unique to Oman. This knowledge gap hampers the development of targeted interventions and healthcare policies necessary to effectively address anaemia in pregnancy among Omani women (Mo'ness, 2008), potentially jeopardising maternal and fetal health outcomes in the region. To bridge this gap, the present study aimed to explore the nuanced factors associated with anaemia in pregnancy among Omani women to inform evidence-based strategies for the prevention and management of this preventable, yet common, health condition.

Methods

The study used a retrospective design to identify pregnant women with anaemia by examining medical records from the Department of Obstetrics and Gynecology at the Sultan Qaboos University Hospital in the Sultanate of Oman. Risk factors were explored using a case-control design, with a 1:2 ratio for cases and controls, respectively.

Sample

The sampling frame encompassed all births over 3 years, from 1 January 2020 to 31 December 2022, a total of 9321 births. The World Health Organization's definition of anaemia was used (Eweis et al, 2021), with women with Hb levels <11.0g/dL during the third trimester considered anaemic and included as cases. Women with Hb levels ≥11.0g/dL were non-anaemic, regardless of their use of iron supplements, and included as controls.

For both cases and controls, the inclusion criteria were women with singleton pregnancies and a recorded third trimester haemoglobin level. Women were excluded if they had chronic or acute illnesses that could affect Hb levels (eg chronic kidney disease, sickle cell anaemia, infection, thalassemia, haemoglobinopathies, chronic inflammatory diseases) or if they had received a blood transfusion in the 3 months before the Hb results were reported. Women who visited the hospital for the first time to give birth were excluded, because of an expected lack of prenatal care and follow up.

The sample size was calculated for risk factors only and computed using Epi Info statistical software (version 7.2.5.0), with a confidence level of 95% and a statistical power of 80%. The ratio of pregnant women with anaemia to those without anaemia was established at 1:2. Based on an estimated exposure rate of 43.5% for women with anaemia from a similar study (Sun et al, 2021) and accounting for a potential 10% rate of incomplete data entry in the system, the minimum required sample size was determined to be 111 women with anaemia (cases) and 222 women without anaemia (controls). This yielded a minimum sample size of 333 pregnant women. However, to enhance the robustness of the findings and maximise the study's statistical power, it was decided to retrospectively screen all women for the prevalence of anaemia over the 3 years.

Data collection

The midwife in charge of the delivery ward at the hospital was responsible for the storage of delivery registers and was contacted to gain access to the medical records for women who gave birth at the hospital over the study period. The researcher responsible for data collection reviewed all medical files of pregnant women within the study frame to identify those who met the study's inclusion and exclusion criteria. In total, 454 cases and 890 controls were included in the study.

To facilitate the data collection process, a standardised data collection sheet was devised. The sheet consisted of two sections: the first captured demographics such as age, place of residence, education and nationality. The second captured information related to risk factors, including parity, gravidity, body mass index, gestational age at birth and number of antenatal visits. The data sheet was created using comprehensive literature reviews of previously published studies to ensure its accuracy and relevance.

Table 1. Participants' characteristics

Variable		With anaemia, *n*=454 (%)	Without anaemia, *n*=890 (%)
Nationality	Omani	437 (96.3)	824 (92.6)
	Non-Omani	17 (3.7)	66 (7.4)
Residence	Muscat city	213 (46.9)	457 (51.3)
	Outside city	241 (53.1)	433 (48.7)
Age (years)	19–34	321 (70.7)	589 (66.2)
	35–47	133 (29.3)	301 (33.8)
Education	School	85 (18.7)	218 (24.5)
	University	326 (71.8)	615 (69.1)
	Postgraduate	43 (9.5)	57 (6.3)
Body mass index	<18.4	19 (4.2)	17 (1.9)
	18.5–24.9	181 (39.9)	301 (33.8)
	>24.9	254 (55.9)	572 (64.3)
Gestation (weeks)	<37	32 (7.0)	30 (3.3)
	≥37	422 (93.0)	860 (96.7)
Gravidity	<1	81 (17.8)	179 (20.1)
	2–4	272 (59.9)	519 (58.4)
	>5	101 (22.2)	192 (21.6)
Parity	<1	100 (22.0)	225 (25.3)
	2–4	300 (66.1)	559 (62.8)
	>5	54 (11.9)	106 (11.9)
Antenatal visits	<4	18 (4.0)	27 (3.0)
	4–6	149 (32.8)	291 (32.7)
	>6	287 (63.2)	572 (64.3)

Table 2. Association between anaemia in pregnancy and risk factors

Variable	Chi-squared value	*P* value
Nationality	4.738	0.030
Residence	1.300	0.254
Age	1.624	0.203
Education	4.924	0.085
Body mass index	6.392	0.041
Gestation	4.329	0.037
Gravidity	0.551	0.758
Parity	1.045	0.593
Antenatal visits	1.100	0.777

Data analysis

The Statistical Package for Social Sciences (version 23) was used for analysis. To ensure data accuracy and precision, a meticulous examination was carried out to identify any missing information, errors or outliers. Descriptive statistics, including frequency, percentage, mean and standard deviation, were applied to offer a comprehensive overview of the characteristics of the sample. A Chi-squared test was used to evaluate the relationship between anaemia and associated risk factors. A significance level of $P \leq 0.05$ was used for statistical analysis.

Ethical considerations

Ethical approval was granted by both the ethics committee of Sultan Qaboos University's College of Nursing (reference: CON/MAS/2022/6) and the Medical Research Ethics Committee of the College of Medicine (reference: SQU-EC/ 176/2022, MREC #2888). Subsequently, permission to commence data collection was sought from the Director General of the hospital (reference: ADM/HDG/1122/22).

In consideration of the retrospective study design, consent forms for individual participants, which had been provided as part of women's admission papers and authorised use of their data for research purposes, were anonymised. Data drawn from birth records and electronic medical archives excluded any identifying information and used unique codes for each woman. Stringent confidentiality measures were maintained, with hard copies of data sheets stored securely in a locked cupboard. All data were entered and stored in a password and fingerprint-protected program, accessible exclusively to the research team. After 2 years, all data will be appropriately discarded to maintain privacy and confidentiality.

Results

A total of 9321 women were admitted to the hospital for birth in the study period. Of these, 2906 had anaemia, giving a prevalence of 31.2%. However, when women with chronic and/or acute diseases that could contribute to anaemia were excluded, per the study's selection criteria, the total number of women with anaemia dropped to 454, giving an overall prevalence of 4.9%. *Table 1* outlines women's sociodemographic characteristics across both groups.

The mean age for women with anaemia was 29 years (±3.1 years), with the majority (70.7%) aged 19–34 years. Most women with anaemia were Omani nationals (96.3%) and just over half (53.1%) lived outside Muscat city. Most had been educated to university level (71.8%), gave birth at more than 37 weeks' gestation (93.0%) and had both a gravidity

and parity of 2–4 (59.9% and 66.1% respectively). The majority of women had attended more than six antenatal appointments (63.2%).

Women without anaemia showed similar characteristics, with 66.2% aged 19–34 years, 92.6% being Omani nationals and 48.7% living outside Muscat city. The majority had university education (69.1%), a body mass index over 25.0 (64.3%), 2–4 pregnancies (58.4%), 2–4 children (62.8%), and had more than six antenatal visits (64.3%).

Anaemia risk factors

To explore risk factors, each pregnant woman with anaemia was compared with two randomly selected women without anaemia. The Chi-squared test showed statistically significant differences in nationality (χ^2=4.738, P=0.030), body mass index (χ^2=6.392, P=0.041) and gestation at birth (χ^2=4.329, P=0.037). A smaller number of non-Omani women, those with a higher body mass index and those at ≥37 weeks' gestation were anaemic. No other statistically significant differences were observed (*Table 2*).

Discussion

This study explored the prevalence of anaemia during pregnancy and its potential risk factors in a university hospital in the Sultanate of Oman. The study initially identified an overall prevalence of 31.2%. Other studies have reported prevalence rates among pregnant women ranging from 7.9% in Ethiopia (Berhe et al, 2019) to 50.8% in Ghana (Wemakor, 2019), depending on the population and criteria used for diagnosis. Although there are no current comparative rates from Oman, the most recently reported rate was 29.3% in 2017 (Ministry of Health, 2017). Findings in neighboring countries show similar prevalences of 31.2% in Kuwait, 33.2% in the United Arab Emirates and 33.4% in Qatar (Al-Jawaldeh et al, 2021).

However, the crude prevalence included women with underlying chronic or acute conditions that could independently contribute to the development of anaemia. When these cases were excluded, the prevalence dropped to 4.9% , indicating the importance of accurately assessing anaemia during pregnancy. A substantial proportion of initial cases was attributable to other health conditions. The significant drop in prevalence highlights the need for a thorough evaluation of anaemia in pregnant women (Dorsamy et al, 2022). Identifying the primary causes of anaemia can help healthcare providers develop targeted interventions and treatment strategies (Williams et al, 2020). This study underscores the importance of distinguishing between anaemia that is directly related to pregnancy and anaemia that arises from other pre-existing health conditions.

Significant factors

The study's analyses revealed a statistically significant difference in nationality between groups, with a smaller proportion of non-Omani women being anaemic. This suggests that nationality may play a role in the risk of anaemia among pregnant women in this population. Although the exact reasons behind this disparity were not explored in the present study, they may involve cultural or genetic factors, access to healthcare, eating habits or socioeconomic differences (Frayne and Pinchon, 2019; Yadav et al, 2021; Quezada-Pinedo et al, 2022). More research is needed to explore these factors and develop interventions to address anaemia in non-Omani women.

The majority of women in the control group had a body mass index ≥25.0, indicating that a higher body mass index may be a protective factor against anaemia. However, this contradicts existing evidence suggesting that pregnant women who are obese or overweight are at increased risk of developing an iron deficiency or iron deficiency anaemia (Wawer et al, 2021). Pregnant women who are overweight may experience anaemia as a result of suboptimal dietary choices or metabolic differences that affect iron status (Charnley and Abayomi, 2016; Wawer et al, 2021). This should be studied further in future research.

Other factors

In the control group, just over half of pregnant women who were not anaemic lived in Muscat city, compared to less than half of women with anaemia. This urban concentration may indicate a potential link between urban living and a lower prevalence of anaemia (Ayensu et al, 2020), possibly as a result of better access to healthcare services, improved socioeconomic status or dietary differences. However, this difference was not found to be statistically significant.

The majority of women in both the case and control groups were 19–34 years old and no significant differences were found between the groups in terms of age, highlighting that anaemia does not appear to be limited to a specific age group among pregnant women (Ampiah et al, 2019). However, there was a wide range of ages grouped together for this study, so any conclusions should be considered carefully. In terms of education, the broader understanding is that higher education often correlates with better health awareness and access to healthcare, leading to improved nutritional status (Tugut et al, 2021). However, the present study's results showed a higher proportion of women with higher education were seen in the anaemia group, although it should be noted that there were no significant differences in anaemia prevalence among women with different levels of education.

In both case and control groups, most women had had 2–4 pregnancies and 2–4 children. Other studies in Japan (Imai, 2020) and Pakistan (Shah et al, 2020) have identified significantly higher risk of anaemia among multiparous women compared to nulliparous women. However, the present study did not find a significant difference between groups in terms of parity or gravidity, which may be a result of differing used from those in previous studies. Differences in the study's sample population and demographics (World Health Organization, 2021), criteria for anaemia diagnosis and timing of blood sampling (WorldBank, 2024), control of confounding factors and statistical power may have contributed to these divergent findings.

The majority of women in both the anaemia and control groups had attended more than six antenatal appointments, and there was no significant difference in anaemia prevalence between the groups. This suggests that the frequency of antenatal care attendance was not associated with the risk of anaemia during pregnancy, although this may have been related to the generally high attendance in this population. A study reported that 73% of Omani mothers attend the recommended eight or more antenatal care visits (Islam and Al-Balushi, 2021). Adequate antenatal care is essential for monitoring and addressing maternal health issues, including anaemia (Ny et al, 2023). The influence of antenatal care attendance may vary depending on individual circumstances, such as the spacing between pregnancies and the mother's nutritional status. Future studies should further investigate the influence of these factors.

Implications for practice

The findings of the present study emphasise the multifactorial nature of anaemia in pregnancy and the need for personalised interventions addressing specific risk factors. The high crude prevalence rate may lead to unwarranted concern and resource allocation, while a refined understanding of anaemia's true prevalence in pregnancy allows for more precise healthcare planning. Further research is required to validate these results in different populations and explore the interplay of these factors in anaemia development during pregnancy. Targeting resources and interventions to pregnant women with pregnancy-related anaemia can improve overall health outcomes for mothers and their infants.

The findings also have important implications for healthcare and public health initiatives aimed at reducing the prevalence of anaemia and its associated health risks in pregnant women, especially among non-Omani individuals and those with higher body mass index. Both evidence-based practice and practice-based evidence could be planned to explore the underlying mechanisms and potential interventions to mitigate anaemia risk in pregnant women.

These findings could also be applied more widely to other countries in the Middle East with similar demographics and socioeconomic conditions. The findings may have broader implications for improving maternal and child health globally. Although mild anaemia is the most common form, anaemia affects 36.8% of pregnant women globally (Karami et al, 2022). The present study highlights the importance of addressing risk factors such as chronic and acute diseases, nationality and gestational age, which are relevant to other countries where anaemia in pregnancy remains a significant public health concern (Lin et al, 2018).

Limitations

The data were obtained from a single hospital setting, which may not be representative of the entire population. However, the population of the capital is known to be mixed, and the majority of the study's population resided outside the capital, which may add value to the representativeness of the population of pregnant women. More research with larger and more diverse samples is needed to validate and generalise these findings.

The exclusion criteria for chronic and acute diseases may not have been exhaustive, potentially missing cases of comorbid anaemia. All pregnant women in the study took iron supplements, as they were attending antenatal clinics, and women who came only for birth were not included. This may contribute to a possible underestimated prevalence of anaemia.

Finally, using a wide age range as a single category in the study did not allow for a more detailed examination of potential age-related differences. Dividing the participants into smaller, more specific age categories would provide a better understanding of whether certain age groups are at higher risk of anaemia during pregnancy.

Conclusions

The study's results emphasise the importance of accurately assessing and addressing anaemia during pregnancy to optimise the use of healthcare resources and improve maternal and fetal outcomes. Further research and population-based studies are essential for a more comprehensive understanding of anaemia in pregnant women.

The findings provide valuable insights into the risk factors associated with anaemia in pregnant women. Nationality and body mass index were identified as statistically significant factors, with non-Omani women and overweight women being at decreased risk for anaemia. These results underscore the importance of

considering the interplay of demographic and clinical factors when developing strategies for the prevention of anaemia and its management during pregnancy.

Healthcare policies that promote awareness, improve access to prenatal care, and provide nutritional support are essential steps in addressing this public health concern and enhancing the wellbeing of Omani women and their infants. Further research is needed to better understand the dynamics of anaemia in pregnancy and the effectiveness of interventions in the Omani context. BJM

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Key points

- The current study emphasizes the importance of understanding and addressing anaemia to optimize healthcare resources and improve maternal and fetal outcomes.
- The study found a crude prevalence of anaemia of 31.2% among pregnant women, which dropped to 6.48% after excluding women with chronic and/or acute diseases.
- Significant differences were found in nationality, body mass index, and gestational week among women with anemia.
- The article highlights the need to consider the interplay of demographic and clinical factors when developing strategies for the prevention and management of anaemia during pregnancy in the Omani context.

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CPD reflective questions

- How might the sociodemographic profile and healthcare system of Oman influence the prevalence of anaemia during pregnancy, and what implications does this have for healthcare planning and intervention?
- How could the findings of this study inform the development of targeted interventions and healthcare policies to effectively address anaemia in pregnancy among Omani women, and what are the potential implications for maternal and fetal health outcomes in the region?
- How might the key demographic and clinical factors be considered when developing strategies for the prevention and management of anaemia in this population?
- How can understanding the prevalence rates of anaemia during pregnancy in Oman contribute to the global understanding of this issue?
- What are the potential implications for the development of evidence-based strategies for the prevention and management of anaemia in pregnancy on a broader scale?

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