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ORIGINAL PAPER

Red Cells and Iron

Greater prevalence of anaemia and heavy menstrual bleeding reported in women of reproductive age in the United Kingdom compared to Australia

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Summary

Heavy periods are a common cause of anaemia in women of reproductive age. We compare the prevalence of anaemia and heavy menstrual bleeding (HMB) among women in the United Kingdom and Australia. Women aged 15–50 years were recruited through screening events conducted in the United Kingdom and Australia from 2016 to 2024. In these cross-sectional studies, self-report questionnaires screened for HMB and finger prick haemoglobin concentration (Hb) identified anaemia (Hb < 120 g/L). Of 1937 women (United Kingdom = 333, Australia = 1604), the mean age was 28.5 ± 9.2 years and 33.7% reported HMB. In the United Kingdom, the mean Hb was 129.2 ± 12.0 g/L and 19.2% were anaemic, of which 59.4% had HMB. In Australia, the mean Hb was higher (134.4 ± 12.2 g/L; $p < 0.001$), with fewer women being anaemic (9.7%; $p < 0.001$), and fewer anaemic women had HMB (30.3%; $p < 0.001$). Logistic regression analysis found that women in the United Kingdom were at a greater risk of being anaemic (AOR: 2.144; 95%CI:1.545, 2.946; $p < 0.001$). HMB was more common in the United Kingdom (45.9% vs. 31.2%; $p < 0.001$). In Australia, 24.7% (299/1211) reported receiving intravenous iron; while those with prior intravenous iron treatment were less likely to be anaemic (AOR: 0.616; 95%CI: 0.372, 0.982; $p = 0.0496$). Women in the United Kingdom are more likely to have anaemia and HMB than women in Australia, with HMB presenting a greater risk for anaemia development in the United Kingdom.

KEYWORDS

anaemia, haemoglobin, heavy menstrual bleeding, iron deficiency, menstruation

INTRODUCTION

Anaemia is common, affecting a quarter of the world population and disproportionately affecting non-pregnant women (38%).[1] The most common cause of anaemia is iron deficiency (ID)[2] which, regardless of anaemia status, is known to cause non-specific symptoms such as fatigue, pallor, shortness of breath, headache, hair loss and restless legs.[3] Women are at an increased risk of ID during pregnancy due to increased iron demand.[4] However, a common and often overlooked risk for iron deficiency is regular blood loss via menstruation.[5] Around one in three women of reproductive age suffer from heavy menstrual bleeding (HMB), which occurs when there is >80 mL of blood lost each menstrual cycle, which consequently increases the risk of developing ID.[6]

The impact of HMB and ID is well documented but under-recognized despite the impact on a woman's physical, emotional and social well-being; mental and physical health and vitality; and overall impact on a woman's quality of life.[7] Frequently normalized, HMB is often overlooked as a cause of ID,[8] which in turn presents difficulties in differentiating

symptoms from ID. Currently, screening for HMB and ID is not routinely performed for women of reproductive age.[9]

A state of 'medical misogyny' was recently raised by the UK parliament, whereby the lack of awareness and education regarding menstrual health and female reproductive health conditions was flagged as problematic.[10,11] In light of this, we have collated data gathered over the last decade of known risk factors for developing ID in reproductive-aged women; where we have undertaken screening events in the community, at sporting events and Universities across both the United Kingdom and Australia.[12–14]

Oral iron is the first-line treatment for ID. It is affordable, effective and a readily available therapeutic option; however, gastrointestinal side effects are common and can result in a lack of therapeutic adherence in as many as half of women.[15] This may explain the often long burden of iron deficiency, with many women suffering from iron deficiency for an average of 2 years.[16,17] Due to a different mechanism of absorption, IV iron can be administered in a single, large dose, resulting in a quicker response time compared to oral iron therapy.[18]

A notable difference between these two countries is the availability of intravenous (IV) iron as a treatment strategy for ID. In Australia, IV iron is available to women in the community and is most often prescribed by a general practitioner.[19] Australia has seen a rapid increase in the dispensing of IV iron, with there being a steady (20%) increase in the dispensing claim for IV iron in women of reproductive age from 2013 to 2017.[19] In comparison, IV iron in the United Kingdom has minimal availability as a therapeutic option outside of the hospital setting and is not currently listed as a treatment option by the National Institute for Healthcare and Excellence (NICE) unless there is significant intolerance to oral iron.[20,21]

We wished to observe whether there was a difference in anaemia prevalence in women of reproductive age in the United Kingdom when compared to women in Australia.

METHODS

Data were collated from five different cross-sectional screening studies, three conducted in Australia and two in the United Kingdom (Table 1).[12,22,23] Women ($n = 1937$) that provided informed written consent, had complete datasets according to each individual study protocol and met the inclusion criteria were included in this analysis. The inclusion criteria for all studies required women to be aged between 18 and 50 years old and non-pregnant. One study in the United Kingdom and one in Australia included a minimum level of physical activity in the recruitment criteria, whereas the remaining studies did not include further parameters of inclusion criteria, though they did differ by recruitment location as detailed in Table 1. Participants completed a self-report female health Questionnaire (FHQ), which has been developed across a multitude of previous studies and specifically tailored for each cohort to explore risk factors commonly associated with iron deficiency in women during the reproductive years.[12–14,23] Women either approached the research team at the screening event venue or the team approached women passing by to advertise recruitment to the study, verbally ensuring women met the study inclusion criteria prior to commencing recruitment.

Anaemia was categorized as a finger prick (Haemocue BioRad 801) haemoglobin concentration (Hb) <120 g/L, in accordance with the World Health Organisation guidelines.[24]

For each screening study, the FHQ was tailored to risk factors within the specific population studied. In general, the FHQ captured a history of iron deficiency diagnosis, treatment, diet, previous blood donation, history of pregnancy and HMB. HMB was assessed using the four-item questionnaire developed by Fraser et al.[25] women who had two or more HMB symptoms were categorized as having HMB. The HMB questions were:

1. Needing frequent changes of sanitary towels or tampons (meaning changes every 2 h or less);
2. Passing large clots;
3. Needing double sanitary protection (tampons and towels);
4. Flooding through clothes or bedding.

Statistical analysis

From all the data available, outcomes assessed were age (categorized as those between 18 and 34 years compared with 35–50 years), Hb, HMB status, anaemia status and, where available, IV iron replacement history, history of pregnancy, diet and blood donor status. Analysis was conducted using R v4.4.2. Data were analysed by location (United Kingdom vs. Australia), with subgroup analysis for those with HMB and those who had received IV iron treatment. For age and Hb levels (continuous data), F tests were conducted to determine variance, with normally distributed data analysed by two-tailed *t*-tests and skewed data analysed by Mann–Whitney *U*-test. Categorical data were reported as prevalence (percentage) and analysed utilizing chi-squared testing. The alpha level was set at 0.05. Logistic regression analysis was conducted to determine which factors (HMB, age, location, history of IV iron, history of pregnancy, diet and blood donor status) influence the development of anaemia. Logistic regression analysis is reported as adjusted coefficient estimate ±standard error (SE) and adjusted odds ratio (AOR) with 95% confidence intervals (CI).

RESULTS

Across the combined dataset ($n = 1937$), average age was 28.5 ± 9.2 years and mean Hb was 133.5 ± 12.3 g/L. Anaemia (Hb < 120 g/L) was present in 219 women (11.3%) and 653 women (33.7%) reported HMB. Age, Hb level and prevalence of anaemia and HMB for UK and Australian populations are displayed in Table 2.

In the United Kingdom, mean Hb was 129.2 ± 12.0 g/L, with 19.2% (64/333) of women being anaemic, of which

TABLE 1 Summary of data for UK and Australia cohorts.

Study number	Country	*n*	Age (years)	Hb (g/L)	Anaemia (%)	HMB (%)	Study summary
1	UK	276	30.3 (±6.46)	131.5 (±11.4)	36 (13.0)	122 (44.2)	Pre-menopausal women aged 18–50 years at a fitness exhibition in England who routinely exercise
2	United Kingdom	57	36.5 (±9.5)	118.4 (±9.0)	28 (49.1)	31 (54.4)	Women aged 18–50 attending a nursing conference in England
3	Australia	831	27.7 (±9.2)	131.9 (±12)	85 (10.2)	265 (31.9)	Women aged between 18 and 50 years recruited from University events and local sporting clubs whom undertake ≥3 h of exercise per week
4	Australia	393	23.8 (±8.2)	134.3 (±12.0)	26 (6.6)	127 (32.2)	Women aged 18–50 years recruited from University and local sporting clubs
5	Australia	380	32.8 (±8.8)	132.2 (±12.1)	44 (11.6)	108 (28.4)	Women aged 18–50 years recruited in a shopping centre in Western Australia

Note: Continuous data are reported as mean ± SD. Published study details available for study 1 (12), study 3 (22) and study 5 (23).

TABLE 2 Overview of combined Australia and UK datasets.

	Australia	United Kingdom	Total	*p*-value
$n^{1,2,3,4,5}$	1604	333	1937	~
Age (years)	27.9 (±9.4)	31.2 (±7.3)	28.5 (±9.2)	<0.001
Finger prick Hb (g/L)	134.4 (±12.2)	129.2 (±12.0)	133.5 (±12.3)	<0.001
Anaemic	155 (9.7%)	64 (19.2%)	85 (13.0%)	<0.001
HMB	500 (31.2%)	153 (45.9%)	653 (33.7%)	<0.001
$n^{1,2,3,5}$	1211	333	1544	~
Vegetarian/meat free	178 (14.7%)	79 (23.7%)	257 (16.6%)	<0.001
Blood donor	141 (11.6%)	65 (19.5%)	206 (13.3%)	<0.001
$n^{3,5}$	1211	NA	1211	~
History of pregnancy	328 (27.1%)	NA	328 (27.1%)	~
History of IV iron	299 (24.7%)	NA	299 (24.7%)	~

Note: ~ signifies significance testing is not appropriate. NA signifies no data available. Anaemia = Hb < 120 g/L. n^x numbers in subscript correspond to the study numbers included in each section. The table above displays the number of participants included from screening events in Australia and the United Kingdom. Mean age and finger prick Hb are reported as mean ± SD and analysed by *t*-test. Categorical data, HMB and anaemia status, are reported as number of responders and % of they comprise of their group, data between the Australia and United Kingdom are compared by chi-squared testing. All studies report participant age, Hb and prevalence of anaemia and HMB. Study numbers 1, 2, 3 and 5 report the prevalence of vegetarians and blood donors[12,22,23] and study numbers 3 and 5 report a history of pregnancy and prevalence of IV iron recipients.[22,23]

59.4% had HMB (38/64). In Australia, mean Hb was higher at 134.4 ± 12.2 g/L ($p < 0.001$, Table 2), with a lower prevalence of 9.6% of anaemia (155/1604, $p < 0.001$, Table 2). Of those with anaemia in Australia, 30.3% had HMB (47/155, $p < 0.001$). Overall, there was a greater prevalence of HMB in the United Kingdom compared to Australia (45.9% vs. 31.2%, $p < 0.001$, Table 2).

In terms of risk factors for iron deficiency, there was a greater prevalence of women reporting vegetarian/meat-free diets in the United Kingdom (23.7% vs. 14.7%, $p < 0.001$, Table 2). Similarly, more women in the United Kingdom were blood donors (19.5% vs. 11.6%, $p < 0.001$, Table 2). A history of pregnancy was only captured in studies 3 and 5 in Australia, reporting 27.1% of women had a history of pregnancy.

Logistic regression analysis exploring the influence of age (categorized as those between 18 and 34 years compared with 35–50 years), HMB and location to predict anaemia found that those women located in Australia were less likely to be anaemic compared to women located in the United Kingdom (AOR: 2.144; 95% CI: 1.545, 2.946; $p < 0.001$, Table 3). The presence of HMB and age did not influence the prediction of anaemia in the model (AOR: 1.192; 95% CI: 0.885, 1.597; $p = 0.243$ and AOR: 1.197; 95% CI: 0.872, 1.628; $p = 0.258$).

Data were available for IV iron therapy history for 1211 women in the Australian datasets (studies 3 and 5), whereby one quarter (24.7%, $n = 299$) reported having had an IV iron infusion. Of those 299 women, 37.8% (113) showed symptoms of HMB. For those with HMB who had received IV

TABLE 3 Logistic regression model for the prediction of anaemia.

Characteristics	Adjusted coefficient (estimate ± standard error)	Adjusted odds ratio (AOR) (95% confidence interval)	*p*-value
Intercept	−2.338 (±0.109)	0.097 (0.078, 0.119)	<0.001
Age (35–50 years)	0.180 (±0.159)	1.197 (0.872, 1.628)	0.258
HMB (yes)	0.176 (±0.150)	1.192 (0.885, 1.597)	0.243
Location (UK)	0.763 (±0.164)	2.144 (1.545, 2.946)	<0.001

Note: Intercept refers to the log-odds of anaemia (Hb < 120 g/L) when all predictors are at reference value (age = 18–34 years, HMB = no and location = Australia). Data from all studies are included in this model.

TABLE 4 Logistic regression model for the prediction of anaemia.

Characteristics	Adjusted coefficient (estimate ± standard error)	Adjusted odds ratio (AOR) (95% confidence interval)	*p*-value
Intercept	−2.190 (±0.150)	0.112 (0.084, 0.149)	<0.001
Blood donor (yes)	0.284 (±0.268)	1.328 (0.765, 2.200)	0.290
HMB (yes)	0.064 (±0.204)	1.066 (0.709, 0.579)	0.754
History of IV iron (yes)	−0.484 (±0.267)	0.616 (0.372, 0.982)	0.0496
Vegetarian/meat free (yes)	0.348 (±0.244)	1.416 (0.861, 2.249)	0.154
History of pregnancy (yes)	0.175 (±0.214)	1.191 (0.776, 1.797)	0.412

Note: Intercept refers to the log-odds of anaemia (Hb < 120 g/L) when all predictors are at reference value (blood donor = no, HMB = no, history of IV iron = no, vegetarian/meat free = no, history of pregnancy = no). Data from study numbers 3 and 5 are used for this model.[22,23]

iron therapy, the prevalence of anaemia was 8.8% (10/113). In women with HMB who had not received IV iron therapy, the prevalence of anaemia was 11.5% (30/260, $p = 0.02$). Logistic regression analysis utilizing these data found that women with a history of IV iron treatment were less likely to be anaemic (AOR: 0.616; 95% CI: 0.372, 0.982; $p = 0.0496$, Table 4). Other risk factors observed in these studies (history of pregnancy, blood donor status and diet) did not influence anaemia prediction (Table 4).

DISCUSSION

We found a lower prevalence of anaemia in women in Australia compared to the United Kingdom. This difference may be due to the increased use of IV iron therapy in Australia where one in four women had received an IV iron infusion, while the results of the logistic regression analysis found that those who had previously received IV iron therapy were less likely to be anaemic. It was also notable that UK women with HMB were more likely to be anaemic compared to women with HMB in Australia, which may also suggest differing approaches to both the management of anaemia and HMB. The difference observed in HMB prevalence between the two countries may reflect variations in awareness, diagnosis and reporting of this condition, alongside the accessibility of treatment options. This aspect of our findings further supports the recent UK parliament statement on the need for healthcare systems to adapt and re-evaluate their approach to menstrual health conditions.[11]

Despite estimates from the Global Burden of Disease highlighting the disproportionally higher rates of anaemia in women of reproductive age,[24,26] there are currently no screening programmes for anaemia or iron deficiency in women globally.[9] Lack of screening for HMB and iron deficiency perpetuates a cycle of underdiagnosis, undertreatment and sustains the high global prevalence of anaemia in women of reproductive age.[9,24] Previous studies have similarly indicated variations in iron deficiency, anaemia and HMB management across different healthcare systems, suggesting that healthcare accessibility might play a role in these disparities.[5,9,20,27]

The key strength of the current study is the ability to combine large datasets recorded over nearly a decade between two countries, providing invaluable insights into the differences in iron deficiency and anaemia risk between the different populations. Instant haematological feedback from the point of care haemoglobin concentration testing enabled the studies to be conducted by a real-world screening approach, providing population-level trends for analysis.

In terms of limitations, the cross-sectional nature of the data used in this study does not enable us to establish causative relationships, particularly between IV iron access and anaemia prevalence. Instead, we highlight these correlations as a basis for further exploratory research. We also note that there are substantial differences in cohort size between the Australia and UK populations, which could be attenuated by further screening studies conducted in the United Kingdom to increase the respective sample size and thus strengthen the statistical power. In addition, recruitment to the included studies was not based on a history of iron deficiency or anaemia; however, we acknowledge that there may be self-selection bias. Furthermore, the recruitment varied in setting and eligibility which may have influenced

the data, particularly in cohorts where iron deficiency may be more common or more recognized, such as female athletes or nurses.[28] Female athletes are at a particular risk of developing iron deficiency due to increased bodily demands, increased inflammation and increased iron loss through sweating and bleeding.[12]

Notably, we can observe differences in lifestyle factors between the populations which may have influenced the risk of iron deficiency, particularly the greater prevalence of blood donors and those with vegetarian/meat-free diets in the UK population. We acknowledge that the data do not truly capture women of reproductive age; while age limits and physical activity levels were utilized to inform the eligibility criteria, we acknowledge these inclusion criteria and recruitment settings may alter the risk of HMB, iron deficiency and anaemia.[29,30] We also appreciate that utilizing a screening questionnaire to detect HMB does not account for clinical diagnosis, cultural differences and social desirability bias which may influence questionnaire responses. Additionally, we acknowledge that data regarding ethnicity were not captured. Notably, ethnicity has been associated with the risk of developing anaemia from alternate aetiologies, such as sickle cell anaemia and thalassaemia.[24] Further to this, in the absence of iron studies, we are unable to rule out alternate causes of anaemia in the dataset.

In addition, finger prick Hb is the most feasible methodology for mass data collection[31] but, as yet, there is no validated point of care test for iron status; although ID typically accounts for the majority of anaemia cases in reproductive aged women.[24] Moreover, we acknowledge that this study does not capture causes of abnormal uterine bleeding (AUB), such as those defined by the International Federation of Gynecology and Obstetrics (FIGO): polyp, adenomyosis, leiomyoma, malignancy and hyperplasia, coagulopathy, ovulatory dysfunction, endometrial, iatrogenic and not yet classified causes (PALM-COEIN).[32] Future research may also benefit from collecting data regarding potential management of HMB through contraceptive and tranexamic acid use.

To conclude, HMB was more frequently reported, and anaemia was more prevalent in reproductive-aged women in the United Kingdom compared to Australia, suggesting the United Kingdom could benefit from exploration of differing strategies to identify and manage HMB, iron deficiency and anaemia in women of reproductive age. A review of the accessibility of IV iron in both countries and further exploration into the causality of HMB and anaemia in the United Kingdom are potential steps that could be taken to work towards addressing this health disparity.

AUTHOR CONTRIBUTIONS

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CONFLICT OF INTEREST STATEMENT

Authors have no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

Upon reasonable written request, data sharing will be considered.

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