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Evaluating Malaysian Government Primary Healthcare Workers Knowledge, Attitude and Practice in Managing Iron Deficiency Anaemia during Pregnancy

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Authors' contributions

This work was carried out in collaboration among all authors. Authors BJNL and MA were involved in the study conceptualization. All authors drafted the manuscript, involved with data collection, manuscript editing, and revisions. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Management of iron deficiency anaemia (IDA) in pregnancy remains suboptimal. This study aimed to develop a tool and determine the knowledge, attitude, and practice (KAP) of primary healthcare providers and its associated factors using a newly developed validated questionnaire.
Methodology: A validation study was conducted among 159 Perak government primary healthcare doctors and nurses. Cronbach's alpha, factor analysis, face validation and test-retest were performed. Subsequently, a cross-sectional study was conducted among 435 doctors and nurses in Selangor, Johor, and Terengganu from October to December 2023. Association between socio-demographics, clinical experience, organizational support, and attitude with the knowledge and practices were analyzed using logistic regression.
Results: The final Health Care Providers Knowledge, Attitude and Practice- Iron Deficiency Anaemia (HCPKAP-IDA) questionnaires had 28 items. A good internal consistency was observed; Cronbach's alpha (0.781-0.859), factor loading; attitude (0.490-0.811), and practice (0.444-0.841). Using HCPKAP-IDA, poor knowledge (38.9%), attitude (46.9%), and practice (43%) scores were shown. The significant factors associated with the poor practice were female (OR=0.39, 95% CI 0.15- 0.99, p=0.049), had IDA (OR=0.74, 95% CI 1.34- 1.58, p=0.043), experienced Anaemic symptoms (OR=0.71, 95% CI 1.36- 1.40, p=0.032), took iron supplement (OR=0.62, 95% CI 1.70-2.87, p=0.033), received training (OR=0.29, 95% CI 0.11- 0.74, p=0.010), availability of parenteral iron (OR=0.74, 95% CI 1.03- 1.28, p=0.027) and good attitude (OR=0.40, 95% CI 2.62- 6.01, p=0.001). The significant factors associated with poor knowledge were community nurses (OR=15.49, 95% CI 6.46- 37.11, p<0.001), staff nurses (OR=7.74, 95% CI 3.45- 17.39, p<0.001), and availability of guidelines (OR=0.18, 95% CI 0.05- 0.69, p=0.012).
Conclusion: Improving the knowledge of primary healthcare providers through training and the availability of parenteral iron in all primary care clinics nationwide should be advocated. A national guideline that incorporates quick algorithms and checklists should be considered.

Keywords: Knowledge; attitude; practice; anaemia; pregnancy; primary healthcare.

1. INTRODUCTION

Anaemia is a major public health problem. In 2019, the prevalence of anaemia in pregnancy worldwide was reported as 37% (32 million) while in Southeast Asia, the prevalence was 48% mainly attributed to low- and middle-income countries' status [1,2]. The most common cause of anaemia in pregnancy in low and middle income countries was iron deficiency anaemia [3]. Anaemia in pregnancy leads to maternal morbidity, impaired quality of life, needing blood transfusions, post-partum haemorrhage, and maternal mortality [3]. Anaemia also poses adverse fetal outcomes such as preterm birth, small for gestational age, and perinatal death [3].

World Health Organization (WHO) defines anaemia in pregnancy as the haemoglobin (Hb) concentration of less than 11 g/dl [2]. A low transferrin saturation (<16%) is indicative of iron deficiency and can be used in the diagnosis of iron deficiency in conditions where iron deficiency is suspected, with normal serum ferritin levels [4] However in conditions where serum ferritin is low (<30 ng/mL), no other laboratory testing may be necessary to diagnose IDA [5].

In Malaysia, the management of iron deficiency anaemia in pregnancy is based on the National Perinatal Care Manual with individualized management plan based on the severity of anaemia [6]. Severity of iron deficiency anaemia is subdivided ranging from severe (Haemoglobin <7 g/dl), moderate (Haemoglobin 7.0-9.9 g/dl), to mild anaemia (Haemoglobin 10.0-10.9 g/dl) [6] Guidelines recommend intermittent or daily iron and folic acid supplementation as a primary prevention to improve iron status and reduce the risk of anaemia in women of reproductive age, depending on pregnancy and postpartum status, menstruation, population-level prevalence, and the diagnosis of chronic disease or infection [6] The first-line treatment is oral iron with doses of oral elemental iron of 100–200 mg daily for the management of established IDA in pregnancy [5]. For patients with iron deficiency anaemia who cannot tolerate, cannot absorb, or do not respond to oral iron, parenteral iron therapy is preferred in the third trimester and sometimes as early as the second trimester [7]. It serves as a valuable second-line therapy in correcting

anaemia and replenishing iron stores [7]. It provides more rapid Hb correction and reduces the need for blood transfusions in late pregnancy and peripartum [7]. Parenteral iron therapy may provide a safer alternative to blood transfusion in treating anaemia [8].

The National Health and Morbidity Survey (NHMS) 2019, showed a prevalence of anaemia among women of the reproductive age group aged 15 to 49 years old in Malaysia was 29.9% whilst moderate and severe anaemia comprised 14.0% [8]. In terms of ethnicity, Malaysian Indian pregnany women were at higher risk of iron deficiency anaemia [9]. A systematic review in 2022 of literatures of studies done in Malaysia on anaemia that the overall prevalence of anaemia in pregnancy ranged from 19.3% to 57.4%, while the prevalence of iron deficiency anaemia among pregnant women ranged from 25.9% to 34.6% [9-11]. This high prevalence of iron deficiency anaemia among pregnant women renders a need to further scrutinize contributory factors from both the patient and healthcare workers' aspects with contribute to the prevalence of anaemia [9-11]. Existing data mainly focus on the factors from the patient's perspective and there is a dearth of evidence from the healthcare workers' aspect [9-11].

Currently, there is no validated and unified questionnaire to assess the knowledge, attitude and practices (KAP) of primary healthcare doctors and nurses on the management of iron deficiency anaemia among pregnant women attending government primary healthcare clinics in Malaysia. A KAP measured through a structured, standardized questionnaire, would be able to identify the gaps and assist in intervention [5]. Therefore, the present study was done to evaluate the knowledge, attitude and practices among doctors and nurses in management of IDA among pregnant mother in routine clinical practice at government healthcare clinic reflecting a real-life scenario in Malaysia.

2. METHODS

A cross-sectional study was conducted from October to December 2023 in 28 public primary healthcare clinics providing antenatal care services in the districts of Kuala Langat, Gombak and Klang in the state of Selangor, districts of Johor Bahru, Pontian and Batu Pahat in the state of Johor and district of Setiu in the state of Terengganu. All public primary care doctors and nurses were included in the study. Those working in administration, on long leave of more than a month, less than a month of service and housemen were excluded.

Participants were given an online self-administered anonymous questionnaire to ensure confidentiality and mitigate response bias. There were five sections in the questionnaire, i) section one examined the socio-demographic characteristics of the participants: age, gender, years of service, occupation, ii) section two examined the personal experience of participants with IDA, having haemoglobin checked, ferritin checked, diagnosed with IDA, experienced anaemic symptoms, took the iron supplement or received parenteral iron. iii) the third section examined the clinical experience of the participants: cases of IDA seen in a week, performed clinical audits, and confidence in managing IDA. iv) section four examined the organizational support: training, availability of guidelines and parenteral iron at individual clinics. iv) the fifth and last section examined the knowledge, attitude and practices on the management of IDA in pregnancy.

A validated questionnaire to assess the knowledge attitude and practice among primary care providers on the management of iron deficiency anaemia in pregnant women (HCPKAP-IDA) was made available in English and Bahasa Melayu language. (Refer Appendix) The Bahasa Melayu option was made available as it is the official national language in Malaysia and to facilitate administration among nursing staff who are usually more fluent in Bahasa Melayu. There was a total of 28 items: 13 items in the knowledge domain, 9 items in the attitude domain, and 6 items in the practice domain. In the knowledge domain by the single-based answer, a score is given for the correct option and a score for the incorrect option. In the attitude domain, the scores were measured using a five-point Linkert scale with responses ranging from "1=strongly disagree", "2=disagree", "3=neutral", "4=agree", and "5=strongly agree" while in the practice domain: "1=never practised", "2=rarely practised", "3=occasionally practised", "4=frequently practised", and "5=very frequently practised". The factor analysis in the attitude and practice domains had a high value of Kaiser-Meyer-Olkin measure of sampling adequacy (0.877) and highly significant Bartlett's Test of Sphericity (< 0.001). In the attitude domain, the factor loading value ranged from 0.490-0.811 and Cronbach's alpha was 0.722 while in the practice domain, the factor loading value ranged

from 0.444-0.841 and Cronbach's alpha was 0.845.

2.1 Data Analysis

The data was collected using the IBM SPSS statistic version 26.0. There were two outcomes in this study: the level of knowledge and practice of primary healthcare doctors and nurses on the management of IDA among pregnant women attending government primary healthcare clinics. The median score of these outcome variables was reported as the data was not normally distributed. The knowledge, attitude and practice were reclassified into two groups, the good group for those who scored equal to or higher than the median score and the poor group for those who scored less than the median score.

To examine the associated factors with the knowledge and practice of primary healthcare doctors and nurses on the management of IDA among pregnant women attending government primary healthcare clinics, the Pearson Chi-Square/Fisher exact test was used for bivariate analysis and multiple logistic regression was used for multivariate analysis. From the bivariate analysis, factors with p-values equal to or less than 0.25 were included in the multiple logistic regression.

Testing for multicollinearity and assumption was also carried out before multiple logistic regression analysis. Testing for multicollinearity of the independent variables was carried out by examining the variance inflation factor (VIF). There was no multicollinearity detected and the VIF ranged from 1.00 to 2.29. The tolerance level of 0.1 (=VIF 10) was used. The statistical significance in the final model was accepted at p-values equal to or less than 0.05. The model fitness was assessed using the Goodness-of-fit and Hosmer-Lemeshow goodness-of-fit tests. The analysis with the Hosmer-Lemeshow test showed a p-value of more than 0.05, indicating an adequate model fit.

3. RESULTS AND DISCUSSION

3.1 Results

The response rate was 96.7% (435/450). Most of the participants (37.3%) were aged more than 40 years, (94.3%) were female, (47.1%) had more than 10 years of service and (38.9%) were community nurses. The majority (97.7%) had self haemoglobin checked. However, more than half (66.4%) did not have their serum ferritin checked, (84.4%) did not have IDA, (81.1%) never experienced anaemic symptoms, (76.3%) did not take iron supplements and (97.7%) did not receive parenteral iron. Looking into their clinical experience, most of the participants (54.5%) reported seeing less than 5 cases of IDA in a week, (70.3%) performed clinical audits and (64.8%) were fairly confident in managing IDA in pregnancy. The majority (93.6%) received training, (54.5%) of training was by continuous medical education, (96.6%) reported availability of guidelines and (82.1%) parenteral iron. (Refer Table 1).

Table 1. Sociodemographic characteristics, clinical experience and availability of organisational support in the management of IDA in pregnancy of primary healthcare providers

	N (435)	%
Sociodemographic characteristics:		
Age		
< 30 years	122	28.0
30-40 years	151	34.7
> 40 years	162	37.3
Gender		
Male	25	5.7
Female	410	94.3
Years of service		
< 5 years	84	19.3
5-10 years	146	33.6
>10 years	205	47.1
Occupation		
Community nurse	169	38.9

	N (435)	%
Sociodemographic characteristics:		
Age		
Staff nurse	126	29.0
Doctors	140	32.1
Self-reported		
Had self-Haemoglobin level checked		
No	10	2.3
Yes	425	97.7
Had self-serum ferritin checked		
No	289	66.4
Yes	146	33.6
Had iron deficiency anaemia		
No	367	84.4
Yes	68	15.6
Experienced anaemic symptoms		
No	353	81.1
Yes	82	18.9
Took iron supplement		
No	332	76.3
Yes	103	23.7
Received parenteral iron		
No	425	97.7
Yes	10	2.3
Clinical experience:		
Number of anaemia in pregnancy cases seen in a week		
< 5 cases	237	54.5
5-10 cases	131	30.1
>10 cases	67	15.4
Performed clinical audit		
No	129	29.7
Yes	306	70.3
Confidence in managing IDA in pregnancy		
Not	7	1.6
Slightly	22	5.1
Somewhat	62	14.3
Fairly	282	64.8
Completely	62	14.2
Organisational support:		
Received training		
No	28	6.4
Yes	407	93.6
Training received		
Medical or nursing school	30	6.9
Post-basic training	15	3.4
Continuous medical education	237	54.5
Workshop or course	128	29.4
Others	25	5.8
Availability of guidelines		
No	15	3.4
Yes	420	96.6
Availability of parenteral iron		
No	78	17.9
Yes	357	82.1

The median score for knowledge was 54, attitude was 96 and practice was 93 respectively. More than a quarter (38.9%) of the participants had poor knowledge scores. Almost half (46.9%) of the participants had poor attitudes and (43%) had poor practice scores (Refer Table 2).

Seven factors: (1) female gender (2) had IDA (3) experienced anaemic symptoms (4) took iron supplements (5) training (6) availability of parenteral iron (7) attitude were statistically associated with the poor practice in the management of IDA in pregnancy. (Refer Table 3). Female gender was 61% less likely to have poor practice (OR=0.39, 95% CI 0.15- 0.99, p=0.049) compared to male. Those who had IDA were 26% less likely to have poor practice (OR=0.74, 95% CI 1.34- 1.58, p=0.043) compared to those who did not have IDA while those who experienced anaemic symptoms were 29% less likely to have poor practice (OR=0.71, 95% CI 1.36- 1.40, p=0.032) compared to those who did not experience anaemic symptoms. Those who took iron supplements were 38% less likely to have poor practice (OR=0.62, 95% CI 1.70- 2.87, p=0.033) compared to those who were not on supplements. Doctors and nurses who received training were 71% less likely to have poor practice (OR=0.29, 95% CI 0.11- 0.74, p=0.010) compared to those who did not receive training while those who reported availability of parenteral iron were 26% less likely to have poor practice (OR=0.74, 95% CI 1.03- 1.28, p=0.027) compared to those without the availability of parenteral iron. Doctors and nurses with good attitude scores were 60% less likely to have poor practice (OR=0.40, 95% CI 2.62- 6.01, p=0.001) compared to those with poor attitude scores.

Table 2. Descriptive statistics of primary healthcare providers knowledge (K), attitude (A) and practice (P) in the management of IDA in pregnancy

Variables	Median	Min	Max	N (435)	%
Knowledge score					
Overall	54	38	69		
Poor (<54)				169	38.9
Good (≥54)				266	61.1
Attitude score					
Overall	96	89	100		
Poor (<96)				204	46.9
Good (≥96)				231	53.1
Practice score					
Overall	93	87	100		
Poor (<93)				187	43.0
Good (≥93)				248	57.0

Table 3. Binary logistic regression: Independent factors influencing the poor practice (P) in the management of IDA in pregnancy among primary healthcare providers

	Preliminary model				Final model			
	Simple Logistic Regression				Multiple Logistic Regression			
	*COR	95% CI		¶p-value	*AOR	95% CI		¶p-value
		Lower	Upper			Lower	Upper	
Sociodemographic characteristics: Age								
< 30 years	1.00							
30-40 years	0.98	0.61	1.58	0.948				
> 40 years	0.92	0.59	1.44	0.707				
Gender								
Male	1.00				1.00			
Female	0.57	0.25	1.29	0.181	0.39	0.15	0.99	0.049
Years of service								
< 5 years	1.00				1.00			

	Preliminary model				Final model			
	Simple Logistic Regression				Multiple Logistic Regression			
	*COR	95% CI		¶p-value	*AOR	95% CI		¶p-value
		Lower	Upper			Lower	Upper	
5-10 years	0.67	0.39	1.16	0.150	0.64	0.34	1.20	0.163
>10 years	0.81	0.48	1.34	0.805	0.87	0.42	1.77	0.695
Occupation								
Doctors	1.00				1.00			
Staff nurse	1.50	0.92	2.44	0.102	1.75	0.93	3.29	0.085
Community nurse	1.01	0.64	1.60	0.966	1.24	0.63	2.45	0.534
Self-reported Had self Haemoglobin level checked								
No	1.00							
Yes	0.75	0.65	0.75	0.640				
Had self-serum ferritin checked								
No	1.00				1.00			
Yes	0.93	0.62	0.89	0.030	0.90	0.56	1.45	0.066
Had iron deficiency anaemia								
No	1.00				1.00			
Yes	0.85	1.05	1.44	0.014	0.74	1.34	1.58	0.043
Experienced anaemic symptoms								
No	1.00				1.00			
Yes	0.93	1.07	1.51	0.013	0.71	1.36	1.40	0.032
Took iron supplement								
No	1.00				1.00			
Yes	0.75	1.02	1.62	0.009	0.62	1.70	2.87	0.033
Received parenteral iron								
No	1.00				1.00			
Yes	0.75	1.38	4.68	0.033	1.33	0.31	5.82	0.070
Clinical experience: Number of anaemia in pregnancy cases seen in a week								
< 5 cases	1.00							
5-10 cases	0.93	0.60	1.43	0.725				
>10 cases	0.92	0.53	1.59	0.761				
Performed clinical audit								
No	1.00							
Yes	0.89	0.59	1.35	0.590				
Confidence in managing IDA in pregnancy								
Not	1.00				1.00			
Slightly	3.38	0.53	21.42	0.197	3.86	0.49	30.21	0.198
Somewhat	0.62	0.13	2.99	0.550	0.70	0.12	4.16	0.693
Fairly	0.50	0.11	2.28	0.372	0.62	0.11	3.52	0.593
Completely	0.47	0.47	2.30	0.355	0.76	0.13	4.55	0.757

	Preliminary model				Final model			
	Simple Logistic Regression				Multiple Logistic Regression			
	*COR	95% CI		¶p-value	*AOR	95% CI		¶p-value
		Lower	Upper			Lower	Upper	
Organisational support: Received training								
No	1.00				1.00			
Yes	0.23	0.10	0.55	0.001	0.29	0.11	0.74	0.010
Training received								
Medical or nursing school	1.00							
Post-basic training	0.87	0.25	3.08	0.831				
Continuous medical education	1.01	0.47	2.16	1.005				
Workshop or course	0.73	0.33	1.65	0.734				
Others	4.14	1.29	13.31	4.141				
Availability of guidelines								
No	1.00							
Yes	0.86	0.31	2.41	0.770				
Availability of parenteral iron								
No	1.00				1.00			
Yes	0.59	0.36	0.96	0.034	0.74	1.03	1.28	0.027
Knowledge score								
Poor (<54)	1.00				1.00			
Good (≥54)	0.65	0.98	2.13	0.064	0.93	0.91	2.14	0.098
Attitude score								
Poor (<96)	1.00				1.00			
Good (≥96)	0.40	2.65	5.92	<0.001	0.40	2.62	6.01	<0.001

*p-value <0.05, *COR crude odds ratio, *AOR adjusted odds ratio*

Two factors: (1) occupation (staff and community nurse) and (2) availability of guidelines were statistically associated with poor knowledge in the management of IDA in pregnancy. (Refer Table 4). Community nurses had 15.49 times higher odds of poor knowledge (OR=15.49, 95% CI 6.46- 37.11, p<0.001) while staff nurses had 7.74 times higher odds of poor knowledge (OR=7.74, 95% CI 3.45- 17.39, p<0.001) compared to doctors. Those who reported the availability of guidelines were 82% less likely to have poor knowledge (OR=0.18, 95% CI 0.05-0.69, p=0.012) compared to those without the availability of guidelines.

Table 4. Binary logistic regression: Independent factors influencing the poor knowledge (K) in the management of IDA in pregnancy among primary healthcare providers

	Preliminary model				Final model			
	Simple Logistic Regression				Multiple Logistic Regression			
	*COR	95% CI		¶p-value	*AOR	95% CI		¶p-value
		Lower	Upper			Lower	Upper	
Sociodemographic characteristics: Age								
< 30 years	1.00							
30-40 years	0.98	0.61	1.58	0.948				
> 40 years	0.92	0.59	1.44	0.707				

	Preliminary model				Final model			
	Simple Logistic Regression				Multiple Logistic Regression			
	*COR	95% CI		¶p-value	*AOR	95% CI		¶p-value
Gender								
Male	1.00				1.00			
Female	4.99	1.47	16.94	0.010	1.19	0.28	4.98	0.817
Years of service								
< 5 years	1.00				1.00			
5-10 years	1.65	0.92	2.96	0.093	1.24	0.61	2.50	0.557
>10 years	2.08	1.19	3.61	0.010	0.71	0.35	1.46	0.353
Occupation								
Doctor	1.00				1.00			
Staff nurse	6.20	3.31	11.62	<0.001	7.74	3.45	17.39	<0.001
Community nurse	10.44	5.71	19.09	<0.001	15.49	6.46	37.11	<0.001
Self-reported Had self Haemoglobin level checked								
No	1.00							
Yes	0.23	0.54	12.34	2.59				
Had self-serum ferritin checked								
No	1.00				1.00			
Yes	1.85	1.23	2.77	0.003	1.33	0.81	2.17	0.260
Had iron deficiency anaemia								
No	1.00							
Yes	0.36	0.45	1.33	0.774				
Experienced anaemic symptoms								
No	1.00							
Yes	0.89	0.54	1.46	0.64				
Took iron supplement								
No	1.00				1.00			
Yes	0.61	0.38	0.97	0.038	0.15	0.36	1.17	0.149
Received parenteral iron								
No	1.00				1.00			
Yes	2.41	0.67	8.67	0.178	1.69	0.38	7.50	0.489
Clinical experience: Number of anaemia in pregnancy cases seen in a week								
< 5 cases	1.00				1.00			
5-10 cases	0.82	0.53	1.26	0.364	1.49	0.87	2.55	0.144
>10 cases	0.45	0.25	0.83	0.010	1.79	0.79	4.02	0.162
Performed clinical audit								
No	1.00				1.00			
Yes	0.42	1.15	2.79	0.010	1.24	0.70	2.17	0.462
Confidence in managing IDA in pregnancy								
Not	1.00				1.00			
Slightly	0.35	0.06	2.00	0.238	0.29	0.04	2.17	0.229
Somewhat	0.41	0.09	2.01	0.273	0.50	0.08	3.12	0.460

	Preliminary model				Final model			
	Simple Logistic Regression				Multiple Logistic Regression			
	*COR	95% CI		¶p-value	*AOR	95% CI		¶p-value
Fairly	0.54	0.12	2.46	0.425	0.55	0.09	3.21	0.506
Completely	0.31	0.06	1.51	0.146	0.39	0.06	2.56	0.330
Organisational support: Received training								
No	1.00							
Yes	0.98	0.45	2.15	0.961				
Training received								
Medical or nursing school	1.00							
Post-basic training	0.75	0.21	2.75	0.664				
Continuous medical education	1.10	0.51	2.38	0.819				
Workshop or course	0.71	0.31	1.60	0.407				
Others	1.18	0.40	3.26	0.765				
Availability of guidelines								
No	1.00				1.00			
Yes	0.41	0.14	1.17	0.097	0.18	0.05	0.69	0.012
Availability of parenteral iron								
No	1.00							
Yes	1.25	0.75	2.08	0.398				
Attitude score								
Poor (<96)	1.00				1.00			
Good (≥96)	0.41	0.95	2.07	0.085	0.50	0.81	2.08	0.281
Practice score								
Poor (<93)	1.00				1.00			
Good (≥93)	0.45	0.98	2.13	0.064	0.48	0.92	2.40	0.107

*¶p-value <0.05, *COR crude odds ratio, *AOR adjusted odds ratio*

3.2 Discussion

Our findings show healthcare providers (HCPs) managing Iron Deficiency Anaemia (IDA) in pregnancy still have suboptimal knowledge, attitude, and practice scores despite training and local guidelines. Notably, community nurses, demonstrated the lowest knowledge scores, indicating a knowledge gap. Female HCPs with personal experience of IDA, positive attitudes, training, and access to parenteral iron were associated with optimal management practices.

Adherence to oral haematinics among pregnant women is integral in preventing and treating IDA in pregnancy [1-4] Studies show that poor knowledge of IDA among pregnant women results in non-adherence to oral haematinics and highlight the importance of increasing knowledge among these groups [1-4]. Doctors and nurses play an important role not only in diagnosing and managing IDA but are also directly involved in providing health education and increasing awareness of IDA among pregnant mothers. Findings from this study show a median knowledge score of 54% highlighting that knowledge among HCPs in this study remains suboptimal which could lead to suboptimal knowledge transfer during consultation. Similar findings of suboptimal knowledge were also found among Obstetricians and gynaecologists in India and HCPs in rural India in managing pregnant women with anaemia [4-10].

Our findings show that knowledge alone does not affect HCPs' attitudes and practice in managing IDA. We found that 19% of HCPs in this study had experienced symptoms of anaemia and 31% received treatment for IDA (oral or parental). HCPs' personal experience with IDA could have contributed to the good knowledge, attitude, and practice in the management of IDA. The same findings were seen among nurses in Australia who reported personal experience of symptoms

of anaemia and showed good knowledge in identifying symptoms of anaemia among patients [8]. Future studies should explore how HCPs' personal experience influenced their management and relationship with patients with IDA and if it was a motivator to improve their knowledge, attitude, and practice.

Training of HCPs on the management of IDA plays a significant role in ensuring good knowledge attitude and practice as evidenced by our results. Most CME and workshops conducted are aimed at increasing knowledge of HCPs rather than empowering them with skills to address local barriers to diet or treatment adherence. Evidence shows that HCPs often need training to improve their consultation skills and clinical skills as well as engaging family members in antenatal care compounded with regular supervision can improve medication adherence among pregnant women with IDA [11]. The training of dedicated nurses to act as anaemia counsellors or champions should be considered. Their role would involve not only increasing community awareness about IDA during pregnancy but also providing consultations, especially in cases where non-adherence to recommended treatments poses a challenge.

Another key finding is that the availability of guidelines ensures good knowledge and practice among HCPs. Existing guidelines in Malaysia are based on recommendations made in the Perinatal care manual or management protocols developed by individual healthcare clinics or hospital [6]. The availability of a National Clinical practice guideline (CPG) or toolkit could further improve the knowledge and practices of HCPs [6]. However it is important to ensure that the newly developed CPG or toolkit be user friendly especially to nurses with clear and simplified algorithms on screening and treatment of IDA [12]. The newly developed CPG and toolkit should also provide detailed guide on screening, testing, treatment escalation and the usage of parenteral iron to reduce the prevalence of IDA in pregnancy [13]. The CPG should consider the racial, ethnical, socioeconomic factors of patients as well as resources and cost prior to implementation [14].

Our study is the first to assess the management practices of IDA in pregnancy among HCPs. HCPs play an important role in managing patients with IDA in pregnancy and identification of gaps in practices can guide further quality improvement interventions [15,16]. We also had an acceptable response rate for an online survey [17].

Our findings should be considered with some limitations. This study mainly focused on HCPs in public primary healthcare clinics, however, cases of IDA in pregnancy are also managed by private HCPs and public hospitals which were not explored in this study. Being an online survey there is the possibility that participants could have looked for the answers online, we attempted to reduce this possibility in our study design by allowing anonymous and no time restriction in the completion of the questionnaire.

Our study has important policy implications as it shows that the knowledge of nurses and community nurses still remains suboptimal despite the existence of guidelines and training. Policymakers should consider training workshops that identify areas of knowledge gap and increase the confidence of nurses in the management of IDA. A National strategy for managing IDA in pregnancy is needed encompassing strategies pre-conception, during antenatal care and post-partum care.

5. CONCLUSION

This study highlights that training, guidelines, and personal experiences contribute to optimal management practices of IDA among HCPs. The importance of tailored training for nurses, the availability of parenteral iron, and the development of a comprehensive national guidelines are crucial steps toward improving the overall care for pregnant women with IDA.

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COMPETING INTERESTS

The authors declare that they have no conflicts of interest

CONSENT

As per international standards or university standards, respondents' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

This study obtained ethical approval from the Medical Research Ethics Committee of Malaysia (RSCH ID-23-00527-9LD) and followed current regulations on the protection of personal data.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

Table 5. Exploratory factor analysis (EFA) and reliability analysis for the attitude and practice domain in the management of iron deficiency anaemia among pregnant women attending primary healthcare clinics

Items	EFA	Cronbach's alpha	Test-Retest
	Factor loading	p-value	p-value
Attitude domain			
A1. It is important to recognise and treat iron deficiency anaemia early among pregnant women to improve maternal and foetal outcome	0.497	0.722 p= <0.001	0.565 p=<0.001
A2. It is important to counsel pregnant women to increase their consumption of iron-rich food and food rich in vitamin C throughout their pregnancy.	0.706		
A3. Prescribing haematinics in pregnant women with Hb > 11g/dl is necessary in pregnancy to prevent iron deficiency anaemia	0.673		
A4. Assessing and counselling pregnant women's adherence to iron supplements during each antenatal visit will aid in improving their compliance with treatment and follow-ups	0.811		
A5. Assessing pregnant women's iron supplement tolerability profile is of comparative importance to its efficacy, as it largely determines adherence to treatment and ultimately treatment success or failure in iron deficiency anaemia	0.792		
A6.Oral iron preparations should be changed if there is no increment in haemoglobin level after assessing adherence, time and way of iron supplement intake.	0.673		
A7. Parenteral iron should be offered and given to the patient with iron deficiency anaemia who does not achieve the haemoglobin increment of ≥1.0 g/dL in 14 days after assessing adherence to the iron supplement.	0.539		
A8.Providing postnatal haematinics in pregnant women with anaemia is an important step to reduce the incidence of iron deficiency anaemia in future	0.490		
A9. Healthcare providers play an important role in the management of pregnant women with iron deficiency anaemia.	0.744		
Practice domain			
P1. I prescribe haematinics to my	0.663	0.845	0.732

Items	EFA	Cronbach's alpha	Test-Retest
	Factor loading	p-value	p-value
pregnant patients even if their Hb> 11g/dl to prevent IDA.		p= <0.001	p=<0.001
P2. During every antenatal visit, I ask for adherence and counsel my pregnant patients on iron supplementation.	0.741		
P3. During every antenatal visit, I reinforce the importance of correct dosage, frequency and timing of iron supplementation to my pregnant patients.	0.841		
P4. During every antenatal visit, I provide information and advice on the importance of increasing the amount and frequency of iron-rich and vitamin C-rich diets to my pregnant patients.	0.762		
P5. In pregnant patients with Hb < 11g/dl, I immediately order serum peripheral blood film and ferritin.	0.440		
P6. In pregnant patients with good adherence and tolerability but with no increment of Hb of more than 1.0 g/dl after 2 weeks, I discuss the cases with medical officers/family medicine specialists for treatment escalation.	0.547		
P7. I provide pregnant women with IDA 3 months of haematinics during their post-natal period	0.293		

Table 6. Components of the knowledge domain in the management of iron deficiency anaemia among pregnant women attending primary healthcare clinics

Items		Test-retest
		p= value
Knowledge domain		
K1 What is the level of haemoglobin in a pregnant mother that is defined as anaemia of moderate severity according to the Malaysian Perinatal Care Manual?	A) 10.9 – 12.0 g/dl B) 10.0 – 10.9 g/dl **C) 7.0 – 9.9 g/dl** D) 6.0 – 6.9 g/dl E) 8.0 -11.0 g/dl	0.339 p= 0.031
K2 What is the most common cause of anaemia among pregnant women?	**A) Iron deficiency anaemia** B) Anaemia of chronic disease C) Beta Thalassaemia D) Folate or/and vitamin B12 deficiency E) Alpha Thalassaemia	
K3 Which of the following are common clinical scenarios for pregnant women who are at risk of iron deficiency anaemia? 1. Gravida 4 Para 3 late booking at 15 weeks, with her last childbirth one year ago. 2. A Primigravida of the aboriginal community attending your clinic at 20 weeks pregnancy who	**A) 1, 2, 4, 5** B) 1, 2, 3, 4 C) 2, 3, 4 D) 1, 2, 3 E) 3, 4, 5	

Items		Test-retest p= value
often walks barefoot in her village. 3. Gravida 2 Para 1 with a BMI of 42, comes for booking at 9 weeks 4. Gravida 8 Para 7 with a history of low Haemoglobin is the past 4 pregnancies with no history of blood transfusion. 5. A 16-year-old Indian single unmarried girl who is seen at 18 weeks pregnancy.		
K4 The symptoms of anaemia include the following: (1) fatigue (2) weakness (3) shortness of breath (4) dizziness (5) chest pain	**A) All of the above** B) 1, 2, 3, 4 C) 2, 3, 4 D) 1, 2, 3 E) 3, 4	
K5 Which of the following clinical signs may be present in a pregnant woman with iron deficiency anaemia? (1) pallor (2) coarseness of hair (3) nail defects (4) tachycardia (5) angular stomatitis	**A) All of the above** B) 1, 2, 3, 4 C) 2, 3, 4 D) 1, 2, 3 E) 3, 4	
K6 A primigravidae at 11 weeks of gestation presented with Hb < 11.0g dl MCH 26 and MCV 70. What are the initial bloods to be ordered?	A) Peripheral blood film B) Serum ferritin C) Hb electrophoresis and peripheral blood film D) Serum ferritin and Hb electrophoresis **E) Serum ferritin and peripheral blood film**	
K7 A primigravidae at 11 weeks of gestation presented with Hb < 11.0g dl MCH 26 and MCV 70. Her initial bloods done showed serum ferritin of 28 mcg/L, and iron deficiency anaemia on peripheral blood film. She was initiated on T. Ferrous sulfate I/I OD. What is the expected level of haemoglobin increment?	A) ≥0.5 g/dL in 14 days **B) ≥1.0 g/dL in 14 days** C) ≥1.5 g/dL in 14 days D) ≥2.0 g/dL in 14 days E) ≥2.5 g/dL in 14 days	
K8 Which of the following foods is NOT recommended for an iron-rich diet?	A) Green leafy vegetable **B) Egg yolk** C) Bean curd D) Chicken thigh and breast E) Sardine	
K9 Various iron combinations and their dosage are shown in the table below, pick the correct treatment dose of elemental iron for iron deficiency anaemia. Iron preparation — Elemental iron 1. Ferrous fumarate — 30 mg 2. Ferrous gluconate — 30 mg 3. Ferrous Fumarate — 60 mg 4. Ferrous fumarate — 115 mg 5. Ferrous sulphate — 105 mg 6. Iron polymaltose — 100 mg	A)All of the above B)1,3,4,5,6 C)2,3,4,5,6 D)2,3,4,5, **E)4,5,6**	
K10 The common side effect of iron preparation includes 1) nausea and vomiting 2) blackish stool 3) constipation 4) heartburn 5) Dizziness	**A) All of the above** B) 1,2,3 C)1,2,3,4 D)2,3,4,5	

Items		Test-retest p= value
	E)2,3,4	
K11 Factors that reduce iron absorption include 1) Antacids 2) calcium supplementation 3) Milk and cheese 4) Tea 5) Lime juice	A) All of the above **B)1,2,3,4** C)1,2,3,5 D)2,3,4 E)1,2,3	
K12 Intravenous iron can be administered in the following conditions; 1) Oral iron is not tolerated 2) Not adherent to oral iron 3) <1g/dL increment of haemoglobin in 2 weeks 4) <2g/dL increment of haemoglobin in 4 weeks 5) First trimester of pregnancy	A) All of the above B) 1, 2, 3, 4 C) 2, 3, 4 **D) 1, 2, 3** E) 3, 4, 5	
K13 In the postnatal period, pregnant women with IDA should be provided the following care 1) contraception advice 2) iron supplementation for 4 weeks 3) iron supplementation for 6 weeks 4) iron supplementation for 2 months 5) iron supplementation for 3 months 6) high iron diet with no haematinics	A)1,2 B)1,3 C)1,4 **D)1,5** E)1,6	

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