Factors Influencing the Attitude and Practice Towards Anaemia Among Pregnant Women Attending Primary Healthcare Clinics in the Kuala Langat District (FAP-PW), Malaysia: A Cross-Sectional Study

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ABSTRACT

Introduction: Clinical observation has shown suboptimal knowledge, attitude and practice (KAP) among pregnant women attending primary healthcare clinics in the Kuala Langat district. This study aims to determine the KAP of anaemia management among pregnant women in late pregnancy and the associated factors with poor attitudes and practices among pregnant women.

Methods: A cross-sectional study was carried out among 395 pregnant women from May to August 2023. We included pregnant women aged 18 years and above at 34 to 38 weeks of gestation and excluded those who were illiterate in the Bahasa Melayu language or had poor cognition. The KAP was assessed using a 49-item validated questionnaire: 19 questions (knowledge), 17 questions (attitude) and 13 questions (practice) related to anaemia during pregnancy, its common cause, signs, symptoms, treatment and prevention.

Results: The majority (83.1%) attained good knowledge scores. 92.8% had poor attitude scores and 31.0% had poor practice scores. Using multivariate logistic regression analysis, two factors: (1) complications during pregnancy (OR=0.26, 95% CI 0.07, 0.97, p<0.046), (2) late bookers (OR=1.30, 95% CI 1.04, 1.62, p<0.022) were significantly associated with the poor attitude. Three factors: (1) spacing (OR=1.97, 95% CI 1.20, 3.25, p<0.008), (2) pre-pregnancy iron supplements (OR=0.62, 95% CI 0.39, 1.00, p<0.049) (3) good knowledge (OR=0.21, 95% CI 0.06, 0.74, p<0.015) were significantly associated with the poor practice.

Conclusion: This study indicated poor attitudes among pregnant women. Primary care providers play a pivotal role in counselling and strengthening health literacy among pregnant women.

Keywords: attitude, practice, anaemia, pregnancy, primary care

INTRODUCTION

Anemia in pregnancy is defined as a hemoglobin (Hb) level of < 11.0 g/dl while its severity is classified as severe (Hb<7 g/dl), moderate (Hb 7.0-9.9 g/dl), to mild anemia (Hb 10.0-10.9 g/dl).(1,2) The problem of anemia affects half a billion women of reproductive age globally and remains a critical challenge mainly in Low and Middle-Income Countries such as Malaysia.(3)

In Malaysia, anaemia in pregnancy remains a challenging health problem with its prevalence of 30% among reproductive age and 19.3 to 57.4% in pregnant women.(2,4) It was also shown that 80-90% of the pregnant women in Malaysia have low iron stores while 38-42% develop anemia as pregnancy advances due to IDA.(2,5)

Currently, the Ministry of Health Malaysia has integrated strategies under maternal and child healthcare programs whereby the management of IDA in pregnancy is standardized according to the Malaysian Perinatal Care Manual and iron supplementation is readily made available to all pregnant women in primary care health clinics.(6) Nevertheless, despite efforts to mitigate the problem of anemia in the district, clinical audits have shown suboptimal health literacy and treatment compliance among pregnant women. To date, there is also a scarcity of existing local studies pertaining to the root cause of IDA in pregnancy and indeed an exigency to implement strategies to alleviate this problem.(4)

Moving on, the risk factors of anemia in pregnancy in Malaysia were found to be higher in the rural compared to urban and associated with the following antenatal characteristics; late antenatal booking, extremes of reproductive age, non-compliance to iron supplements, being in second or third trimester while the sociodemographic characteristics were; Indian ethnicity, low maternal educational level, low family income, and unemployment.(4) In addition, IDA in pregnancy leads to major adverse effects in both maternal and fetal outcomes if not adequately managed such as postpartum hemorhage leading to twice the risk of maternal death and heart failure.(4,7) Whereas in the fetal outcome, it could lead to neonatal IDA, risk of adult hypertension, low birth weight, prematurity, and adverse effects on cognitive function and behaviour.(4,7)

Clinical observation has shown suboptimal KAP among pregnant women attending government primary healthcare clinics in the Kuala Langat district. Looking into the Kuala Langat district health department Selangor data, the prevalence of pregnant women at 36 weeks of gestation with Hb level of <11.0g/dl remains high (>5%) over the consecutive years. Presently, there are no studies done in the district to determine the cause of the high

prevalence of anaemia among pregnant women at 36 weeks of gestation. Hence this study aimed to determine KAP levels regarding anaemia among pregnant women in the district and to identify its association with the socio-demographic and antenatal characteristics. With this, early identification of the root cause of anaemia among pregnant women in the district could facilitate early intervention and preventive measures in the local community.

METHODS

A cross-sectional study was conducted from May to August 2023 in ten government primary healthcare clinics providing antenatal services in Kuala Langat Selangor. All pregnant women aged 18 years and above at 34 to 38 weeks of gestation were invited to participate in the study. The selection of the 34 to 38 weeks range of gestation in this study corresponds to the Malaysian national key performance index target haemoglobin level of more than 11g/dl at 36 weeks of gestation for all pregnant women. Those who were illiterate in the Bahasa Melayu language or had poor cognition were excluded. The sampling method was conducted by systematic random sampling whereby every third pregnant woman who fulfilled the inclusion criteria was recruited in the study. The study sample size was determined with single and two-sample proportion formulas.(8) The two sample proportions formulas were used to calculate associated factors with the assumption that the two populations have the same variance, the assumption of homogeneity of variance, the populations are normally distributed, and each value is independent.(8) The largest sample size value calculated among all the variables were taken as the sample size in this study.(8) The sample size calculated was 395 pregnant women with a 20% drop-out rate.

The self-administered questionnaire was made available in the Bahasa Melayu language as the majority (80%) of the pregnant women in the district are of Malay ethnicity. Anonymous of the participants of the study was carried out to ensure confidentiality and mitigate response bias. This could encourage participants to answer the questionnaire honestly reflecting their attitudes and practices. There were five sections in the questionnaire whereby the first section

76 examined the socio-demographic characteristics (age, ethnicity, education level, occupation,
77 income, marital status). The second section examined the antenatal characteristics (BMI,
78 booking gestation, booking and current haemoglobin level, parity, spacing, the presence of
79 haematological disease (thalassemia and/or sickle cell anaemia), complication during
80 pregnancy, miscarriage, pre-pregnancy iron supplement intake, diet). The third section
81 examined the knowledge, attitude and practices (KAP) using a locally validated
82 questionnaire.(7)

83 This validated questionnaire on KAP of anaemia management consisted of a total of 49 items:
84 19 (knowledge), 17 (attitude) and 13 (practice) related to anaemia, its common cause, signs
85 and symptoms, treatment and prevention.(7) Frequency analysis was calculated for each
86 question for the KAP domains using percentages of correct versus incorrect answers in the
87 knowledge domain (true/false), positively versus negatively answered questions in the attitude
88 (agree/disagree) and practice domains (yes/no).(7) In the knowledge domain, a score of 1 was
89 given for the correct answer and 0 if incorrect, while in the attitude domain, good responses
90 were scored as 1 and poor responses were scored as 0.(7) Positive answers were scored as
91 1 and negative answers were scored as 0 for the practice domain.(7) The overall KAP domains
92 were assessed using sum score outcome, which was classified into two categories: good and
93 poor. A score of below 70% was rated as poor while 70% and above was rated as a good
94 level. The items in the knowledge and attitude domains had an acceptable internal consistency
95 of Cronbach alpha at 0.82 and 0.72, respectively.(7) The items in the practice domain had
96 acceptable reliability of Kuder-Richardson Formula 20 (KR20) at 0.80.(7)

97 The study has two outcomes: The poor attitude and poor practices of anaemia among
98 pregnant women. The independent variables undertaken were as follows: sociodemographic
99 characteristics (age, ethnicity, education level, occupation, income, marital status), antenatal
100 characteristics (body mass index, booking gestation, booking haemoglobin level, current
101 haemoglobin level, parity, spacing, haematological disease, complications during pregnancy,

102 history of previous pregnancy miscarriages, pre-pregnancy iron supplement, diet) and
103 knowledge.

104 **DATA ANALYSIS**
105
106 The data was undertaken using the IBM SPSS statistic version 26.0. There were two outcomes
107 in this study: the attitude and practice of anaemia management among pregnant women
108 attending primary healthcare clinics. The median score of these outcome variables was
109 reported as the data was not normally distributed. To examine the associated factors with
110 attitude and practice of anaemia management among pregnant women attending primary
111 healthcare clinics, the Pearson Chi-Square/Fisher exact test was used for bivariate analysis
112 and multiple logistic regression was used for multivariate analysis.

113 Testing for multicollinearity and assumptions was also carried out before multiple logistic
114 regression analysis. Testing for multicollinearity of the independent variables was carried out
115 by examining the variance inflation factor (VIF). There was no multicollinearity detected and
116 the VIF ranged from 1.06 to 1.14. The tolerance level of 0.1 (=VIF 10) was used because a
117 tolerance of less than 0.20 is cause for concern; a tolerance of less than 0.10 almost certainly
118 indicates a serious collinearity problem and a tolerance value of 0.10 corresponds to the "rule
119 of 10" with respect to the VIF.(9) The statistical significance in the final model was accepted at
120 p-values equal to or less than 0.05. The model fitness was assessed using the Hosmer-
121 Lemeshow goodness of fit test. The analysis with the Hosmer-Lemeshow test showed a p-
122 value of more than 0.05 (attitude domain: p=1.00, practice domain: p=0.55), indicating an
123 adequate model fit.

124
125 **RESULTS AND DISCUSSION**
126
127 **RESULTS**
128
129 The response rate was 91.4% (361/395). Most of the respondents (76.3%) were aged more
130 than 35 years. The median age was 30 years and gestation was 36 weeks. The majority

131 (76.7%) were Malay ethnicity and married (98.1%). Meanwhile, more than half (52.4%) of the
132 respondents had secondary and below education level, were unemployed (52.6%) and had a
133 household income of less than RM5000 a month (57.3%).

134 The antenatal characteristics showed that 37.6% of the respondents have a BMI of 25.5 to
135 29.9 kg/m^2. The majority (67.8%) were early bookers, less than 5 parity (96.1%), close spacing
136 (71.5%) and had a baseline (88.1%) and current (85.6%) haemoglobin of more than 11.0g/dl
137 respectively. While most (83.8%) had no haematological disease, complications during
138 pregnancy (95.0%), history of miscarriage in the previous pregnancy (85.6%) and pre-
139 pregnancy iron supplementation (54.6%), almost all (93.6%) were non-vegetarians. (Refer
140 Table 1)

141 **Table 1: Demographic and antenatal characteristics of pregnant women attending**
142 **primary healthcare clinic in the Kuala Langat district (N=361)**

Characteristics	Frequency	Percentage
Demographic		
Age		
≤ 35 years	85	23.7
> 35 years	276	76.3
Ethnicity		
Others	84	23.3
Malay	277	76.7
Education level		
Secondary and below	190	52.4
Diploma and above	171	47.6
Occupation		
Unemployed	190	52.6
Employed	171	47.4
Income		
≤ RM3000	207	57.3
> RM3000	154	42.7
Marital status		
Single	7	1.9
Married	354	98.1
Antenatal characteristics		
Gestation (weeks)		
34	88	24
35	61	17
36	95	26
37	54	15
38	63	18
BMI (kg/m2)		
< 18.5	15	4.2

18.5-24.9	117	32.4
25-29.9	136	37.6
≥30.0	93	25.8
Booking gestation		
Early booker	245	67.8
Late booker	116	32.2
Booking haemoglobin (g/dl)		
<11.0	43	11.9
≥11.0	318	88.1
Current haemoglobin (g/dl)		
<11.0	52	14.4
≥11.0	309	85.6
Parity		
< 5	347	96.1
≥ 5	14	3.9
Spacing		
< 2 years	258	71.5
≥ 2 years	103	28.5
Underlying haematological disease (thalassemia, sickle cell anaemia)		
No	303	83.8
Yes	58	16.2
Complication during pregnancy		
No	343	95.0
Yes	18	5.0
History of miscarriage in the previous pregnancy		
No	309	85.6
Yes	52	14.4
Pre-pregnancy iron supplement		
No	197	54.6
Yes	164	45.4
Diet		
Vegetarian	23	6.4
Non-vegetarian	338	93.6

143

144 The median score for the knowledge domain was 83.4%, the attitude domain was 35.0% and
145 the practice domain was 76.4% respectively. The majority (83.1%) of the respondents attained
146 a good knowledge score of more than 70%. However, the majority of 92.8% (n=335) of the
147 respondents with a poor attitude score of below 70% while a quarter of 31.0% (n=112) of the
148 respondents attained poor practice scores of below 70%. (Refer Table 2)

149

150 **Table 2: The level of knowledge, attitude and practice of anaemia management among**
151 **pregnant women attending primary healthcare clinics in the Kuala Langat district**

Variable (Total score %)	Frequency	Percentage
Knowledge		
Poor (0-69)	61	16.9
Good (70-100)	300	83.1
Attitude		
Poor (0-69)	335	92.8
Good (70-100)	26	7.2
Practice		
Poor (0-69)	112	31.0
Good (70-100)	249	69.0

152

153 In the preliminary model, five factors: (1) age of more than 35 years, (2) education level of
154 diploma and above, (3) household income of more than RM3000 (4) late bookers (5)
155 complications during pregnancy were significantly associated with the poor attitude towards
156 anaemia management. Three factors: (1) spacing, (2) pre-pregnancy iron supplement (3) good
157 knowledge were significantly associated with the poor practice towards anaemia
158 management. (Refer Table 3)

159 **Table 3: Univariate analysis of the Factors associated with the poor attitude and**
160 **practice of iron deficiency anaemia management among pregnant women attending**
161 **primary healthcare clinics in the Kuala Langat district**

	Preliminary model (SLR)							
	Attitude domain				**Practice domain**			
	COR	**95% CI**		**¶p-value**	**COR**	**95% CI**		**¶p-value**
		Lower	**Upper**			**Lower**	**Upper**	
Demographic								
Age								
≤ 35 years	1.00				1.00			
> 35 years	0.38	0.16	0.89	**0.026**	0.57	0.32	1.00	0.050
Ethnicity								
Others	1.00				1.00			
Malay	0.67	0.27	1.69	0.397	1.23	0.73	2.07	0.429
Education level								
Secondary and below	1.00				1.00			
Diploma and above	3.77	1.26	11.34	**0.018**	1.09	0.69	1.70	0.718
Occupation								
Unemployed	1.00				1.00			
Employed	1.47	0.63	3.46	0.372	1.11	0.71	1.74	0.640
Income								
≤ RM3000	1.00				1.00			
> RM3000	4.15	1.59	10.79	**0.048**	1.14	0.73	1.80	0.567
Marital status								

Single	1.00				1.00			
Married	<0.01	<0.01	<0.01	0.999	1.12	0.20	6.23	0.894
Antenatal characteristics BMI (kg/m2)								
< 18.5	1.00				1.00			
18.5-24.9	1.95	0.60	6.33	0.265	0.65	0.36	1.18	0.156
25-29.9	1.20	0.33	4.39	0.783	0.75	0.41	1.39	0.358
≥30.0	3.39	0.56	20.36	0.183	0.50	0.16	1.56	0.232
Booking gestation								
Early booker	1.00				1.00			
Late booker	1.37	0.58	3.26	**0.047**	0.79	0.49	1.27	0.329
Booking haemoglobin (g/dl)								
<11.0	1.00				1.00			
≥11.0	1.46	0.33	6.48	0.615	1.08	0.55	2.14	0.817
Current haemoglobin (g/dl)								
<11.0	1.00				1.00			
≥11.0	1.76	0.40	7.76	0.454	0.50	0.24	1.03	0.059
Parity								
< 5	1.00				1.00			
≥ 5	<0.01	<0.01	<0.01	0.999	1.68	0.46	6.14	0.433
Spacing								
< 2 years	1.00				1.00			
≥ 2 years	1.39	0.57	3.38	0.471	0.51	0.32	0.82	**0.006**
Haematological disease								
No	1.00				1.00			
Yes	1.97	0.74	5.22	0.175	1.10	0.60	2.04	0.758
Complication during pregnancy								
No	1.00				1.00			
Yes	3.44	0.91	2.96	**0.040**	1.18	0.41	3.39	0.760
History of Miscarriage in the previous pregnancy								
No	1.00				1.00			
Yes	0.88	0.29	3.06	0.835	1.26	0.65	2.34	0.490
Pre-pregnancy iron supplement								
No	1.00				1.00			
Yes	2.40	0.99	5.81	0.053	1.60	1.11	2.53	**0.043**
Diet								
Vegetarian	1.00				1.00			
Non-vegetarian	0.68	0.09	5.29	0.712	0.68	0.29	1.63	0.388
Knowledge								
Poor (0-69)	1.00				1.00			

Good (70-100)	<0.01	<0.01	<0.01	0.999	2.18	1.24	3.83	**0.007**

162 SLR: Simple logistic regression
163 95% CI: 95% confidence interval
164 COR: Crude odd ratio
165 p-value <0.05
166
167
168 In the final model, two factors: (1) complications during pregnancy, and (2) booking gestation
169 were significantly associated with the poor attitude towards anaemia management. (Refer
170 Table 4) Pregnant women who had complications during pregnancy had 74% lower odds of
171 poor attitude (AOR=0.26, 95% CI 0.07, 0.97, p<0.046) compared to those without
172 complications. Pregnant women who were late bookers had 1.3 times higher odds of poor
173 attitude (AOR=1.30, 95% CI 1.04, 1.62, p<0.022) compared to those who were early bookers.
174 Three factors: (1) spacing, (2) pre-pregnancy iron supplement, and (3) knowledge were
175 significantly associated with the poor practice towards anaemia management. (Refer Table 5)
176 Pregnant women who had 2 years and more spacing had 1.97 times higher odds of poor
177 practice in anaemia management (AOR=1.97, 95% CI 1.20, 3.25, p<0.008) compared to those
178 with poor spacing. Pregnant women who were on pre-pregnancy iron supplements had 38%
179 lower odds of poor practice (AOR=0.62, 95% CI 0.39, 1.00, p<0.049) compared to those not
180 on supplements. Pregnant women who had good knowledge scores had 79% lower odds of
181 poor practice (AOR=0.21, 95% CI 0.06, 0.74, p<0.015) compared to those with poor
182 knowledge scores.

183
184 **Table 4: Multivariate analysis of the factors associated with the poor attitude toward**
185 **anaemia management among pregnant women attending primary healthcare clinics in**
186 **the Kuala Langat district (backwards and forward method)**

	Final model (MLR)			
	AOR	**95% CI**		**¶p- value**
		Lower	**Upper**	
Complication during pregnancy				
No	1.00			
Yes	0.26	0.07	0.97	**0.046**
Booking gestation				
Early booking	1.00			
Late booking	1.30	1.04	1.62	**0.022**

187 MLR: Multiple logistic regression

188 95% CI: 95% confidence interval
189 AOR: Adjusted odd ratio
190 ¶p-value <0.05

191 **Table 5: Multivariate analysis of the factors associated with the poor practice of**
192 **anaemia management among pregnant women attending primary healthcare clinics in**
193 **the Kuala Langat district (backwards and forward method)**

	Final model (MLR)			
	AOR	**95% CI**		**¶p- value**
		Lower	**Upper**	
Spacing				
< 2 years	1.00			
≥ 2 years	1.97	1.20	3.25	**0.008**
Pre-pregnancy iron supplement				
No	1.00			
Yes	0.62	0.39	1.00	**0.049**
Knowledge				
Poor (0-69)	1.00			
Good (70-100)	0.21	0.06	0.74	**0.015**

194 MLR: Multiple logistic regression
195 95% CI: 95% confidence interval
196 AOR: Adjusted odd ratio
197 ¶p-value <0.05

198 **DISCUSSION**
199
200 Presently, there is still a scarcity pertaining studies on anemia in pregnancy among our
201 population in Malaysia. In our study, the majority (85.6%) of pregnant women had
202 haemoglobin of more than 11.0g/dl respectively. This is in contrast with a similar study
203 conducted among the rural population in India whereby the majority (45%) were reported to
204 have anaemia.(10) In our study, we also found that the proportion of pregnant women with
205 good knowledge scores was high (83.1%). This is in contrast with studies done elsewhere in
206 some parts of India, Saudi Arabia and Euthopia whereby the majority of their knowledge was
207 found to be poor.(11–14) However, consistent with local studies conducted in Terengganu,
208 Putrajaya and Perak with similar knowledge components being assessed, the majority had
209 good knowledge scores.(7,15,16) Nevertheless in some other parts of Terengganu, the
210 majority of their knowledge scores were average.(17,18) Despite the average to good
211 knowledge of anemia among most pregnant women, it is still of utmost importance to continue

212 educational intervention to further increase and improve their knowledge.(17) In addition, good
213 knowledge is crucial to ensure continuous adherence to iron therapy.(19)

214 Despite the good knowledge among the pregnant women, the majority (92.8%) had poor
215 attitude scores. However, other studies done elsewhere in Saudi Arabia, India, locally in
216 Putrajaya and some parts of Terengganu had shown their attitude scores to be average to
217 good.(7,14,16,20) Similarly, in the state of Perak, only a quarter (39%) of the pregnant women
218 had good attitude scores.(15) This discrepancy needs to be scrutinized to explain the poor
219 attitude among our pregnant women. To address the problem of anemia, primary care
220 providers play a crucial role whereby health promotion strategies that will positively impact the
221 attitude should be incorporated to succour a positive health-related behaviour during
222 pregnancy, which predominantly determines the pregnancy's outcomes.(20,21)

223 Our study also demonstrated that complications during pregnancy and booking gestation were
224 significantly associated with poor attitudes among pregnant women. Presently, we could not
225 find literature which probed precisely into these components. However, in view of late bookers
226 which has been shown to be associated with anaemia in pregnancy, we postulate early
227 bookers have good attitudes in self-care.(22) Nevertheless, these components are essential
228 to be included in the assessment because a well-recognized and appropriate element of
229 attitude and self-care would prevent or delay complications and the likelihood of pregnancy-
230 related early death.(23) Looking into early antenatal booking, which is defined as before 12
231 weeks of gestation has been shown to produce favorable pregnancy outcomes and those with
232 sufficient knowledge on the importance of early antenatal booking will result in good attitudes
233 and practices among them.(24) Therefore, this is where again the primary care providers play
234 an important role in the community, as they have a better understanding of local population
235 lifestyles and beliefs which might affect a woman's knowledge and attitude towards antenatal
236 care.(24) Primary care providers are the bridge between the community and the health care
237 system while reinforcing health literacy.(24) Training should be initiated for primary care

238 providers to identify these pregnant women, counsel and tackle the problem of poor attitudes
239 among them in the community.(24)

240 We found that more than a quarter of the pregnant women (31.0%) attained poor practice
241 scores. Consistent with previous studies abroad in Saudi Arabia, Pakistan, Nigeria and some
242 parts of Ethiopia 24% to 52% had poor to moderate practices.(11,14,21,25) However locally
243 in the state Perak, 25.5% of the pregnant women had poor practices.(15) In addition we found
244 three factors to be significantly associated with the poor practices; spacing, intake of pre-
245 pregnancy iron supplement and knowledge. Previous studies abroad did not probe into the
246 factors associated with practices. However, local studies conducted in Putrajaya and Perak
247 state had shown no significant association between the intake of iron supplements and
248 knowledge of the practices.(7,15) The discrepancies in findings among various states locally
249 need to be further explored. These results also implied that there is still a need to ameliorate
250 the practices among pregnant women and this could be achieved by improving their
251 knowledge of anaemia. In a study conducted in India whereby women with no education were
252 significantly associated with anaemia while in our study, good knowledge was shown to have
253 lower odds of poor practices.(26) Therefore, we recommend similar approaches could be
254 applied in India and Malaysia whereby primary healthcare providers should share knowledge
255 on anaemia prevention in pregnant women.

256 The strength of this study includes a substantially large sample size of 395 pregnant
257 women, which enhances the reliability and generalizability of the findings. The study
258 involves the majority of clinics in the whole Kuala Langat district and these findings
259 are most relevant and applicable to the current government primary care clinic
260 settings in Malaysia. The limitation of the study includes, self-reported questionnaires,
261 which are subject to bias and participants who were not literate in Bahasa Melayu
262 were not included in the study. The resources in private primary care settings are

263 different from government primary care settings. Thus, the result cannot be applied
264 in private primary care settings.

265
266 ## CONCLUSION
267
268 In conclusion, the study underscores a significant issue. Although our pregnant population
269 generally possesses adequate knowledge about anemia, there is a notable deficiency in their
270 attitudes and practices regarding its management. Despite good awareness, there is a
271 disconnection in translating this knowledge into effective anemia management. This gap is
272 consequential, as poor attitudes are linked to pregnancy complications and delayed prenatal
273 care. Factors such as spacing pregnancies beyond two years, lack of pre-pregnancy iron
274 supplements, and even possessing good knowledge are identified in this study as contributors
275 to suboptimal practices. These findings emphasize the critical need to address these gaps in
276 managing this vital medical condition during pregnancy to reduce associated morbidity and
277 mortality. Consequently, primary healthcare providers emerge as key players in enhancing
278 and fortifying the knowledge, attitudes, and practices of pregnant women through targeted
279 health education strategies.

280

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286
287 ## COMPETING INTERESTS
288
289 The authors declare that they have no conflicts of interest
290
291 ## AUTHORS' CONTRIBUTIONS
292

BJNL was involved in the study conceptualization. All authors drafted the manuscript, involved with data collection, manuscript editing, and revisions. All authors approved the final version

ETHICAL APPROVAL

This study obtained ethical approval from the medical research ethics committee of malaysia (RSCH ID-23-00256-KOQ) and followed current regulations on the protection of personal data.

CONSENT

AS PER INTERNATIONAL STANDARDS OR UNIVERSITY STANDARDS, RESPONDENTS' WRITTEN CONSENT HAS BEEN COLLECTED AND PRESERVED BY THE AUTHOR(S).

REFERENCES

1. Karami M, Chaleshgar M, Salari N, Akbari H, Mohammadi M. Global Prevalence of Anemia in Pregnant Women: A Comprehensive Systematic Review and Meta-Analysis. Matern Child Health J. 2022 Jul;26(7):1473–87.

2. Milman N. Iron Deficiency and Anaemia in Pregnant Women in Malaysia ? Still a Significant and Challenging Health Problem. J Preg Child Health [Internet]. 2015 [cited 2023 Jan 15];02(03). Available from: http://www.omicsgroup.org/journals/iron-deficiency-and-anaemia-in-pregnant-women-in-malaysia--still-a-significant-and-challenging-health-problem-2376-127X-1000168.php?aid=54257

3. Merid MW, Chilot D, Alem AZ, Aragaw FM, Asratie MH, Belay DG, et al. An unacceptably high burden of anaemia and it's predictors among young women (15–24 years) in low and middle income countries; set back to SDG progress. BMC Public Health. 2023 Jul 5;23(1):1292.

4. Abd Rahman R, Idris IB, Isa ZM, Rahman RA, Mahdy ZA. The Prevalence and Risk Factors of Iron Deficiency Anemia Among Pregnant Women in Malaysia: A Systematic Review. Front Nutr. 2022 Apr 15;9:847693.

5. Harvey T, Zkik A, Auges M, Clavel T. Assessment of iron deficiency and anemia in pregnant women: an observational French study. Womens Health (Lond). 2016 Jan;12(1):95–102.

6. Ministry of Health Malaysia. Perinatal Care Manual 4th Edition 2020 released June 2022.pdf [Internet]. [cited 2023 Sep 3]. Available from:

329 http://hsegamat.moh.gov.my/oasis/uploads/936_PERINATAL%20CARE%20MANUAL%
330 204th%20Edition%202020%20released%20June%202022.pdf

331 7. Hidayah Ad SN, Sedek R, Mohd Kasim Z. Assessment of Knowledge, Attitude and
332 Practice Levels Regarding Anaemia Among Pregnant Women in Putrajaya, Malaysia.
333 Pakistan J of Nutrition. 2018 Oct 15;17(11):578–85.

334 8. Arifin WN. Introduction to sample size calculation. EIMJ [Internet]. 2013 Jun 1 [cited
335 2024 Sep 18];5(2). Available from:
336 http://eduimed.usm.my/EIMJ20130502/EIMJ20130502_10.pdf

337 9. Marcoulides KM, Raykov T. Evaluation of Variance Inflation Factors in Regression
338 Models Using Latent Variable Modeling Methods. Educ Psychol Meas. 2019
339 Oct;79(5):874–82.

340 10. Abhishek K, Ansari M, Topno R, Madhukar M, Purakayastha D, Mahajan H, et al.
341 Prevalence of anaemia in pregnant women among rural population of Kurhani block,
342 Muzaffarpur district Bihar: A cross-sectional Primary Health Center based study. Journal
343 of Scientific Research. 2022 Jan 1;66:34–9.

344 11. Habib A, Afzal M, Parveen K, Hussain M, Gilani SA, Nursing B. Knowledge, Attitude and
345 Practices of Pregnant Women Regarding Iron Deficiency Anemia in A Rural Area of
346 Lahore. 2018; Available from:
347 https://www.researchgate.net/publication/335464620_Knowledge_Attitude_and_Practic
348 es_of_Pregnant_Women_Regarding_Iron_Deficiency_Anemia_in_A_Rural_Area_of_La
349 hore

350 12. Nivedita, Fatima Shanthini. Knowledge, attitude and practices of pregnant women
351 regarding anemia, iron rich diet and iron supplement. International Journal of
352 Reproduction, Contraception, Obstetrics and Gynecology. 2016 Dec 17;5(2):425–31.

353 13. Masresha Leta Serbesa, Maleda Tefera Iffa. Knowledge, attitude and practice on
354 prevention of iron deficiency anemia among pregnant women attending ante–natal care
355 unit at public hospitals of Harar Town, Eastern Ethiopia: institutional based cross-
356 sectional study. International Journal of Pregnancy & Child Birth [Internet]. 2019 Mar 18
357 [cited 2022 Dec 26];Volume 5(Issue 2). Available from:
358 https://medcraveonline.com/IPCB/IPCB-05-00146.pdf

359 14. Samia Abd Elhakeem H Aboud, Hanan Abd Elwahab El Sayed, Heba Abdel-Fatah
360 Ibrahim. Knowledge attitude and-practice regarding prevention of iron deficiency anemia
361 among pregnant wome [Internet]. [cited 2022 Dec 26]. Available from:
362 https://ijpras.com/storage/models/article/sOCNYToRYRctsp1PGaJS3EBGmwdQcnV5od
363 TNq70U2PAYZMQrlh6QY7etMaWp/knowledge-attitude-and-practice-regarding-
364 prevention-of-iron-deficiency-anemia-among-pregnant-wome.pdf

365 15. Fazeli NI, Khoo TH, Junaidi ANA, Dzulkafli NA, Chiew SC, Sahimi MS@, et al.
366 Knowledge, attitude and practice of pregnant women regarding anemia during antenatal
367 visit at Kampar Health Clinic. electronic - Perak Medical Journal. 2022 Oct 31;2(Supp
368 03):22–3.

369 16. Theng CE, Zakaria NS, Yusof H. Knowledge and attitude on consumption of iron
370 supplement among pregnant women in Kuala Terengganu, Terengganu. Malaysian
371 Applied Biology. 2017 Oct 1;46:105–12.

17. Zani H, Shahril MR, Rahman WNAWA, Mukhali HB, Ismail R, Yusop YM. Anaemia-Related Knowledge Amongst Pregnant Women in Kuala Terengganu, Malaysia. Asian Journal of Medicine and Biomedicine. 2020 Oct 20;4(2):1–9.

18. Bah F, Harith S, Farisni TN. Food Knowledge and Practices Related to Anemic Conditions among Pregnant Women in Kuala Terengganu, Malaysia. J-Kesmas: Jurnal Fakultas Kesehatan Masyarakat (The Indonesian Journal of Public Health). 2020 Apr 19;7(1):19–28.

19. Kadir NA, Ahmad AH, Rahim NAA. Development and Validation of a Questionnaire Assessing the Knowledge and Perception of Pregnant Women about Oral Iron Consumption. 2021; Available from: https://medic.upm.edu.my/upload/dokumen/2021062816001431_MJMHS_0912.pdf

20. Dhok A, Meshram A, Kanyal Butola L, Khare R. Knowledge, Attitude and Practice Study Among Rural Antenatal Women Regarding Anaemia, Iron Rich Diet and Iron Supplement. International Journal of Current Research and Review. 2021 Jan 1;13:27–32.

21. Gebremichael MA, Lema TB. Prevalence and Predictors of Knowledge and Attitude on Optimal Nutrition and Health Among Pregnant Women in Their First Trimester of Pregnancy. IJWH. 2023 Sep 4;15:1383–95.

22. Abd Rahman R, Idris IB, Isa ZM, Rahman RA, Mahdy ZA. The Prevalence and Risk Factors of Iron Deficiency Anemia Among Pregnant Women in Malaysia: A Systematic Review. Front Nutr. 2022 Apr 15;9:847693.

23. Nurhasanah R, Malini H, Tarawan VM. Exploring the Meaning and Practices of Self-care toward Pregnancy-related Complication: A Qualitative Study in Rural Area Indonesia. 2022; Available from: https://medic.upm.edu.my/upload/dokumen/2023010416252810_2021_1492.pdf

24. Maharaj R, Mohammadnezhad M. Perception of pregnant women towards early antenatal visit in Fiji: a qualitative study. BMC Pregnancy Childbirth. 2022 Feb 10;22:111.

25. Balcha WF, Eteffa T, Arega Tesfu A, Abeje Alemayehu B. Maternal Knowledge of Anemia and Adherence to its Prevention Strategies: A Health Facility-Based Cross-Sectional Study Design. Inquiry. 2023 Apr 19;60:00469580231167731.

26. Kuppusamy P, Prusty RK, Khan SA. Assessing the prevalence and predictors of anemia among pregnant women in India: findings from the India National Family Health Survey 2019-2021. Curr Med Res Opin. 2024 Jan;40(1):51–8.