ORIGINAL ARTICLE

The effectiveness of theory-based intervention to improve haemoglobin levels among women with anaemia in pregnancy

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ABSTRACT

Background: Anaemia in pregnancy is considered a public health problem throughout the world. The effects of the existing intervention in ensuring compliance to the subscribed regimen and the impact of nutrition education in enhancing dietary modification during pregnancy in Malaysia have been minimal. This study aims to develop, implement and evaluate the effects of the Health Belief Model educational intervention on haemoglobin level among anaemic pregnant women.

Methods: This is a quasi-experimental research with pre-post test design with control group involving 81 participants per group from two health clinics in Sepang. The primary outcome was a change in the haemoglobin levels following educational intervention. Secondary outcomes include knowledge on anaemia, Health Belief Model (HBM) constructs, dietary iron intake and compliance towards iron supplementation. The intervention group received a HBM-based education intervention programme.

Results: The response rate in the intervention and control group were 83.9% and 82.7% respectively. Generalised estimating equations analysis showed that the intervention was effective in improving the mean haemoglobin level (β=0.75, 95%CI=0.52, 0.99, p<0.001), the knowledge score (β=1.42, 95%CI=0.36, 2.49, p=0.009), perceived severity score (β=2.2, 95%CI= 1.02, 3.39, p<0.001) and increased proportion of high compliance level (AOR=4.59, 95%CI=1.58, 13.35, p=0.005).

Conclusion: HBM-based health education programme has proven to be effective in improving the haemoglobin levels, knowledge scores, perceived severity scores and compliance level of participants. The study results emphasized on the effectiveness of such an approach, therefore it is recommended that future educational interventions which aim at increasing preventive healthy behaviours in pregnant women may benefit from the application of this model in primary health care settings.

KEYWORDS:
Anaemia, Pregnancy, Hemoglobin levels, Health Belief Model, Health education intervention, Compliance

INTRODUCTION

Anaemia in pregnancy is a serious global public health issue and poses a significant health problem among pregnant women.[1] The prevalence of anaemia in pregnant women was 38.2% across the world and 48.7% within countries located in the South East Asian region.[2-3] In Malaysia, the prevalence of anaemia in pregnancy was reported as 27.0% in 2011, and has slightly increased to 29.3% in 2016,[4] which constitute as a significantly moderate public health problem. Anaemia in pregnancy is defined as haemoglobin levels of less than 11 g/dl for all trimesters.[5] Anaemia results from various causes, with iron deficiency being the primary contributor to anaemia and most widespread nutritional disorders.[2]

The basic approaches recommended globally to prevent and control iron deficiency anaemia during pregnancy are to supplement with iron tablets and provide health education to the mothers.[1] In Malaysia, the prevention of anaemia and the respective control strategies have been integrated into the maternal and child healthcare programmes initiated by the government, where iron supplementation is distributed for free to all pregnant women through all health clinics nationwide. The management of anaemia in pregnancy including a certain dosage of the iron supplements, with follow-ups and referrals is outlined in the Malaysian Perinatal Care Manual.[6] However, the effectiveness of such healthcare education and motivation programmes to ensure compliance with the treatment regiment, remains unknown. Evidence provided by Thirukkanesh and Zahara showed that, the compliance of daily intake of vitamins and/or mineral supplements among pregnant women in Malaysia is only 49%.[7] Compliance was noted to be 47% among women in urban Selangor and 52% among women in rural Johor.[7] These figures are considered to be low when compared to the compliance of mothers in other developed countries such as Denmark which was about 80%.[1]

Iron supplementation alone is not enough since the needs for calories and micronutrient such as iron increases during pregnancy. In Malaysia, all pregnant women also received health education aimed at empowering women with the importance of iron supplementation and increasing food intake rich in iron. Such health education advice are usually provided by nutritionists, nurses or doctors, during antenatal follow ups.[6] To date, there are no standard guidelines for a

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health education programme to follow; hence there are many variations of health education methods and materials being used in Malaysia.[8] Nonetheless, Malaysians also have a low mean dietary iron intake.[9] This would imply drastic changes in the daily dietary iron intake among pregnant women during short period of time.

Apart from that, beliefs and perceptions of women can affect their behaviour towards the anaemia-prevention programmes that are introduced. A previous study conducted in eight developing countries showed that women's perception of iron deficiency anaemia influenced their prevention and control, whereby half of the women did not consider suffering from anaemia as it was not their primary concern.[10] In addition to maternal perception, maternal knowledge of anaemia can be improved and corrected by giving regular health education during pregnancy.[11-15]

In order to improve the status of anaemia among pregnant women, major changes in behaviour are needed, which centred on compliance with supplementation regimes and on dietary modification. Among the many health education programmes, it was noted that Health Belief Model (HBM) guided health education programme has a higher potential in facilitating voluntary actions conducive to health, resulting in increasing the higher adoption of health behaviour changes among individuals and communities alike. The HBM has served as a valuable tool in the field of educational evaluation to explain preventive health behaviour and has been applied as a guide for predicting health behaviour.[16-19] In anaemia prevention and control programs, previous studies have proven that HBM-based interventions were able to improve the haemoglobin levels among anaemic pregnant women.[14,20-22] The HBM framework includes several constructs like perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action and self-efficacy.

Since anaemia constitutes a significant public health problem in Malaysia and as there is a lack of model-based studies, the present study is aimed to develop, implement and evaluate the effects of a HBM-based health educational intervention on the haemoglobin levels among a cohort of anaemic pregnant women living in Sepang, Selangor, Malaysia.

MATERIALS AND METHODS

Study design

This study used a quasi-experimental study design with pre and post-test with a control group conducted in Salak and Dengkil health clinics in Sepang District. These clinics were selected due to their close similarities in terms of health system management and the type of health facilities that provide treatment to the respondents.[23] Through simple randomisation, the participants in Dengkil Health Clinic (DHC) were assigned as the intervention group and those in the Salak Health Clinic (SHC) were assigned as the control group. Both groups received routine antenatal care which included iron supplementation from their respective clinics. Additionally, the intervention group was given HBM-based health education intervention on anaemia in pregnancy.

This study was approved by the Malaysian National Medical Research Register (NMRR -17-179-34162). All participants were briefed about the study prior to recruitment and informed consent were taken for their participation.

Study population

The sampling population is pregnant women in both clinics diagnosed as having anaemia in pregnancy with haemoglobin (Hb) levels of less than 11.0g/dl and meet all the inclusion criteria. Subjects who met the following inclusion criteria were selected: Malaysian, singleton pregnancy, Hb level between 7.0g/dl and 11g/dl, came for antenatal booking before 24 weeks of pregnancy and wished to continue her antenatal check-up at these clinics. Known cases of anaemia secondary to haematological disorders, women with severe anaemia (Hb<7g/dl) and twin pregnancies were excluded.

Sample size estimation

The sample size was calculated using the formula for two population mean formula for hypothesis testing.[24] Sample size (N) = 2 S2 (z(1-α/2) +z(1-β))2/ (μ1-μ2)2 with S = pooled standard deviation, Z1-α/2 = 1.96 (confidence level of 95%, α is 0.05), Z1-β=0.84 (power of 80%, β is 0.2), μ1-μ2 = estimated mean difference of two groups which μ1 and μ2 was selected from the study by Sennayake et al.[25] Based on the above calculation, the minimum sample size needed consists of 81 pregnant women per group; after adjustment made for 20% attrition, eligibility of respondents and considering the design effect.

Outcome measures

We measured the change in haemoglobin levels among study participants as the primary outcome of this study. The secondary outcomes include compliance level towards iron supplementation, dietary iron intake, knowledge on anaemia and HBM construct (perceived susceptibility, perceived severity, perceived benefit, and perceived barrier). The haemoglobin levels were measured before the 24th week of gestation (T0) and between week 35 and 37 of gestation in the third trimester (T1). The difference between T0 and T1 in the intervention group was compared with the difference in the control group.

Study questionnaire

The questionnaire consisted of five sections. It was developed in English and translated to Malay by the first author. Back translation was done by a language expert who was fluent in English and Malay. Any meaningful differences were reconciled. Section one of the questionnaire was on socio-demographic factors and maternal obstetrics information. Section two looks at the knowledge related to anaemia in pregnancy of the participants. The knowledge and perception questionnaire for this study was developed through adoption of structured questionnaire.[26,27] Each question had three options, "Yes", "No", and "I don't know". Correct answers achieve one (1) mark and incorrect answers or "I don't know" achieve zero (0) marks. The total score for this section is 0 to 20, with higher values indicated better knowledge towards anaemia in pregnancy. The content validity as assessed by content validity index, was 0.70. For reliability of knowledge section, Kuder-Richardson 20 was used, the result was 0.81.

Section three tests the perceptions of the participants. Perceived susceptibility was assessed with 5 items, each rated on a 5-point Likert scale ranging from 'strongly agree' (5) to 'strongly disagree' (1). The total score for this section was 5-25 with higher values indicating better perceived susceptibility. Perceived severity consisted of 7 items, each rated on a 5-point Likert scale ranging from 'strongly agree' (5) to 'strongly disagree' (1). The total score for this section was 7-35 with higher values indicating better perceived severity. Perceived benefits were assessed with 5 items, each rated on a 5-point Likert scale ranging from 'strongly agree' (5) to 'strongly disagree' (1). The total score for this section was 5-25 with higher values indicating better perceived benefits. Perceived barrier consisted of 6 items, each rated on a 5-point Likert scale ranging from 'strongly agree' (5) to 'strongly disagree' (1). The total score for this section was 6-30 with higher values indicating poor perceived barrier. The content validity as assessed by content validity index, result was 0.75. For reliability of perception section, the Cronbach alpha was 0.77.

Section four focused on the level of compliance towards iron supplementation questionnaire. It consisted of four questions measuring participant level of compliance for iron supplementation.[28] Total score for this section was 0 to 4 with score of 0 indicated high compliance level, score of 1 to 2 indicated medium compliance level and score of 3 to 4 indicated low compliance level towards iron supplementation. The content validity as assessed by content validity index, was 0.70. For reliability of the compliance score, the Cronbach alpha was 0.73.

Section five looks at the dietary iron intake of the participants. Three-day food record (2 weekdays and 1 weekend) was used to measure dietary intake.[29] Instructions were stated on the food record on how to measure servings without any leftovers of food. Pictures of household measurements such as spoon and cups were attached to the food records to estimate the serving size. Also, other details such as method of cooking and ingredients such as condiments and fat on meat used were requested. The amount of food consumption including dietary iron by individuals were converted to milligrams by using dietary analysis software, Nutritionist Pro. Data on dietary iron intakes were transferred from the Nutritionist Pro to the SPSS for statistical analysis. Dietary iron intake adequacy was assessed by comparison of energy and iron intake with the recommended nutrient intakes (RNI) for Malaysia pregnant women.[30]

Intervention program

The intervention program was developed through the process of consultations with a group of experts including two public health specialists and one family medicine specialist, studying the relevant literature and received opinions from the community being served. The goal of this health educational intervention is to produce behavioural change. The HBM-based program addresses four major components for compliance with recommended health action: perceived barrier of recommended health action, perceived benefits of recommended health action, perceived susceptibility of the disease and perceived severity of the disease.

Intervention strategies

The HBM-based program was implemented using three strategies: Pre and post intervention assessment and health education intervention. The pre-test assessment was measured through study questionnaire given to the participating women before 24 weeks of gestation and followed by the health education intervention. Post intervention evaluation was measured between the 35th to 37th weeks of gestation in the third trimester.

Baseline assessment

Prior to starting the intervention programme, baseline or pre-test assessment need to be performed among the anaemic pregnant women at the selected health clinics prior to health education program to identify their baseline haemoglobin level, socio-demographic status, baseline status of their knowledge, perception towards anaemia in pregnancy, dietary iron status and compliance level. A set of self-administered study questionnaire was used to capture the baseline data. All participants were required to give their consent prior to answering the questionnaires and their answers are made confidential.

Post intervention assessment

After the completion of the twelve-week intervention period, the impact and outcome evaluation of the intervention programme was carried out using the same set of questionnaires that was used in the pre-intervention assessment, except their socio-demographic status. The post intervention Hb levels was taken from the antenatal book of the participants'. This assessment aimed to determine the post-intervention level of knowledge, perception and anaemia preventive behaviour after health education program.

Health education intervention

Health education interventions were implemented after a pre-intervention assessment has been conducted. The health education intervention periods were held within 12 weeks. The methods and material of the theory-based health intervention programme included health talk, small group discussion, poster presentation and pamphlets.

The health talk, given by the researcher, was on topics such as introduction to anaemia in pregnancy, predisposing factor, sign and symptoms, complication, prevention of anaemia in pregnancy, knowledge on wrong perception of anaemia and iron supplementation, misperception about protein-rich food and food taboos during pregnancy, and knowledge on the various sources of food that contain high iron. The health talk was given once for each participant during the intervention period in the form of power point presentation for about one hour. The outcome of the health talk would enable participants to gain knowledge on the facts of anaemia in pregnancy, complication of untreated anaemia and management of anaemia in pregnancy.

The second activity of the health education intervention programme was as small group discussions. This was conducted and facilitated by the researcher between two to four weeks after the health talk. The participants were divided into nine small groups with eight to ten participants in one group. Each group participated one session during the

intervention period based on timing of the participants. This activity dealt with the issues to enhance the compliance towards iron supplementation and to increase the dietary iron intake by identifying barriers towards anaemia preventive behaviours. The outcome of the discussion was to enable participants to understand the severity of anaemia in pregnancy, understand the susceptibility of anaemia in pregnancy, identify and overcome the barrier of not comply with iron supplement and dietary iron intake and identify the benefit of taking iron supplement and dietary iron intake. The participants were also provided with a checklist on compliance for iron supplementation. The time required to complete the group discussion session was within 60 minutes. The materials used in the health education intervention programme were posters and pamphlets. Two posters were used in this activity. A large poster (A1 size) was placed in the health clinic at all time during the intervention period. There was information regarding the complication of anaemia and importance of taking iron supplementation and consumption of iron rich food. In addition, the participants were given a small poster (A4 size) to take home as their continuous learning material after the small group discussion session. The small poster was to provide guidelines of various iron rich food. Apart from that, a pamphlet also was distributed to the participants as a self-learning tool and continuous material that aimed at enriching their information about anaemia after the health talk or small group discussion. The pamphlet also helped to deliver take home messages to the participants about anaemia in pregnancy. It was covered the information regarding the definition, causes, complications and prevention of anaemia in pregnancy and examples of food rich of iron. These materials were also aimed to maintain adherence towards anaemia preventive behaviour.

Statistical analysis

Data was analysed using IBM Statistical Package for Social Science (SPSS) version 25.0. Per protocol analysis was adopted as primary analysis in this study. Per protocol analysis were utilized for those completed all 2 data collection point and included in the final analysis.

Descriptive statistics using continuous data was analysed using means, standard deviation, median and inter-quartile range. While categorical data analysed using frequencies, percentage. Normality of the data was checked using histogram, Kolmogrov-Smirnov and Shapiro-Wilk normality test. An outcome variable was compared at the baseline and post-test. For within group difference, if data were assumed normal distributed data, parametric test such as paired t test was utilized. But if data were assumed non-normal distributed data, non-parametric tests such Wilcoxon Signed Ranks test was utilized. Apart from that, Mc Nemar Test was used to determine the association of two categorical related variables. For between groups difference, if data were assumed normal distributed data, parametric test such as Independent t test was utilized. But if data were assumed non-normal distributed data, non-parametric tests such Mann-Whitney U test were utilised. Chi Square test and Fisher Exact were used to test the association between two categorical variables. Generalised estimating equations (GEE) was conducted to determine the effect of intervention on the primary and secondary outcome after adjusting for the covariates. The effect of intervention on changes in outcome measures was determined three months after the intervention period.

RESULTS

A total of 171 participants were screened for eligibility. Of these, 9 were excluded as they did not meet the inclusion criteria. A total of 162 anaemic pregnant women who met all the inclusion and exclusion criteria were invited to participate. All 162 participants had completed their questionnaire at baseline giving a response rate of 100%. However, only 135 participants completed all the two time-point data collection due to dropout and non-response. Hence, at three-month post intervention, 19% and 20% dropped out from the intervention and control group respectively. The reasons for the study dropout are shown in Figure 1.

The overall mean (±standard deviation) age of 162 respondents was 29 years old (±4.95). The mean gestational week of participant at baseline in the intervention and control group was 21 weeks and 22 weeks. Majority respondents in both groups booked their pregnancy during second trimester (96.9%), had parity between 2 to 4 (60.5%) and had gravida between 2 to 5 (68.5%). There were no significant differences in the socio-demographic and maternal obstetric history between the intervention and control groups at baseline as shown in Table I.

Initially, model construct was compared between two groups at baseline. Results showed no significant difference between two groups that baseline comparison on mean haemoglobin levels, mean knowledge score, mean HBM construct scores, compliance level and mean dietary iron intake. For post-intervention within group difference, results showed significant differences in all model construct, except for the mean score of perceived benefit and mean dietary iron intake in the intervention group (Table II).

Generalised estimating equation (GEE) was performed to determine the effect of the intervention on all model construct after adjusting for covariates. GEE was performed as GEE results are robust for correlated linear and binary outcomes. Results showed that, health education intervention based on health belief model was effective in improving the mean haemoglobin levels (β=0.75, 95%CI=0.52, 0.99, p<0.001). For secondary outcome, health education intervention was effective in improving the mean knowledge scores (β=1.42, 95%CI=0.36, 2.49, p=0.009), mean perceived severity scores (β=2.2, 95%CI= 1.02, 3.39, p<0.001) and high compliance level (AOR=4.59, 95%CI=1.58, 13.35, p=0.005) among study participants in the intervention group. The GEE result is tabulated in Table III(a) to Table III(d).

DISCUSSION

This study showed that HBM-based health education intervention was effective in improving the mean haemoglobin levels. The findings were similar with studies

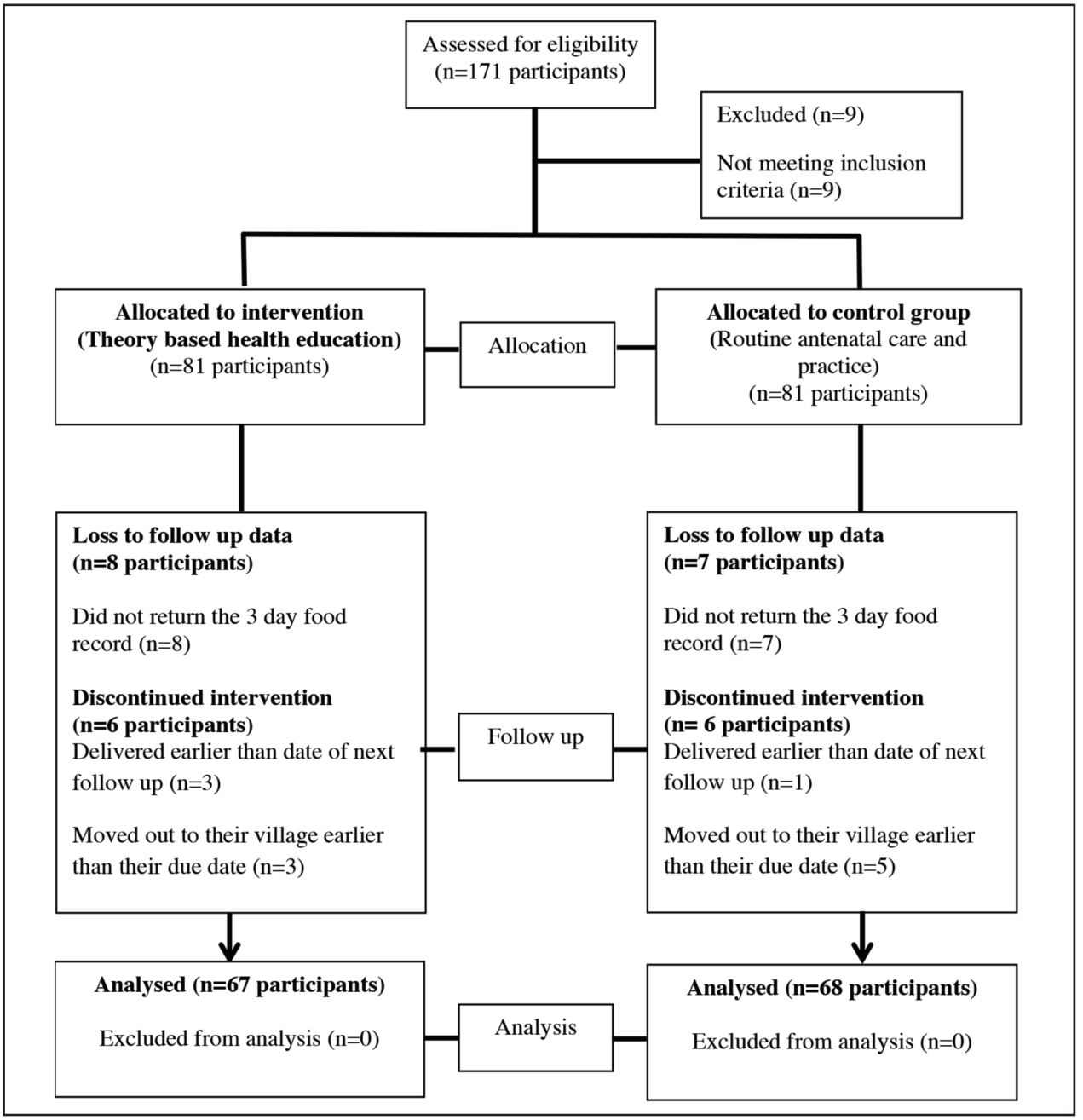

Fig. 1: Flow Chart of Diagram of the Study.

conducted in Indonesia, Saudi Arabia and India, wherein they reported the effectiveness on theory-based health education and found improvement in the mean haemoglobin levels after their intervention.[21,25,31,32] At three months post-test, the difference in mean (SD) haemoglobin levels between the intervention group and control group was 0.5g/dl. Differences in the haemoglobin of ≥0.5g/dl were also found in a study conducted in Indonesia.[31] The differences (Hb≥0.5g/dl) were based on the women with higher supplementation who achieved an increase in the haemoglobin levels around 0.5g/dl compared to those with lower supplementation.[33] This can be supported by the fact that there is a significantly higher compliance to iron supplementation among women in the intervention group compared to the control group.

For secondary outcomes, this study shows that the health education intervention was effective in improving the mean knowledge scores, mean perceived severity scores and high compliance level in the intervention group. For knowledge scores, similar findings were noted in studies done in Iran and Indonesia which reported that the health educational

Table I: Baseline comparison on socio-demographic characteristics and maternal obstetric history

Variables	Frequency, n (%)		t	χ^2 (df)	P-value
	Intervention	Control			
Age, mean (± sd)	30.1(±4.84)[c]	29.23(±5.05)[c]	1.11		0.26[a]
Ethnic					
Malay	57(70.3)	62(76.5)			0.11[b]
Chinese	8(9.9)	1(1.2)		5.80(3)	
India	12(14.8)	14(17.3)			
Others	4(4.9)	4(4.9)			
Education level (Finished sec school)					
Yes	50(56.2)	39(43.8)		3.01(1)	0.08[b]
No	31(42.5)	42(57.5)			
Employment status					
Working	58(54.7)	48(45.3)		2.72(1)	0.09[b]
Not working	23(41.1)	33(58.9)			
Income					
0-2999	49(51.6)	46(48.4)		0.22(1)	0.63[b]
3000 and above	32(47.8)	35(52.2)			
Parity					
Primipara	34(42.0)	27 (33.3)		3.96(2)	0.13[b]
2-4	47(58.0)	51(63.0)			
≥4	0(0)	3(3.7)			
Gravida					
Primigravida	26 (32.1)	20(24.7)		1.20(2)	0.54[b]
2-5	53(65.4)	58(71.6)			
6 and above	2(2.5)	3 (3.7)			
Gestational week					
1st trimester (<12 week)	1(1.2)	4(5.0)			0.18[d]
2nd trimester (12 to <28 week)	80(98.8)	76(95.5)			
Birth spacing					
Less than 24 month	24(47.1)	24(41.4)		0.35(1)	0.55[a]
24 month and more	27(52.9)	34(58.6)			

[a]Independent t test, [b]Chi-square test, [c]Mean (±SD), [d]Fisher exact test.

intervention were able to improve the knowledge level during the pregnancy after 3 month.[13,34] Mean perceived severity scores was the highest mean score increased after intervention. This finding is in agreement with another study done in Iran that reported that perceived severity score was significantly improved after implementation of health education.[14,22]

For our high compliance levels, this result is similar with a study conducted among anaemic pregnant women in India which reported that about 70.0% of pregnant women were compliant to iron supplementation after health education intervention was given and they became non-anaemic after 3 months.[21] Among the reasons of not complying with iron supplementation in this study was fear of side-effects and no interest to take the iron tablet, was reduced after the intervention. The perceived taboos on iron supplementation causing big babies may have been the cause of the poor compliant. This common misperception was highlighted and clarified in the intervention module. The result reflects that the current study focused on imparting correct information and knowledge not only on anaemia but also for them to assess their own perception, belief and behaviour according to the information given and make their decision on the changes they need to make. This could have helped by the participant in the intervention group as they had some level of education as compared to control group that make them more receptive towards information. This result reflects that the improvement for mean haemoglobin levels after intervention is most probably due to the high compliance level towards iron supplementation.

However, the health education intervention was not effective in improving the mean for perceived susceptibility, barrier, benefit and mean dietary iron intake scores. Our results are not in line with the study conducted in Palestine and India which found that health education intervention given was effective in improving the mean perceived susceptibility score, barrier and benefit score.[14,20,22] All of these studies used health education based on Health Belief Model and similar teaching methods including group discussions, lectures and pamphlets. However, the time interval used to measure the effect of intervention was four months after intervention was given; much longer as compared to the present study. This fact reflects that the current study time interval may be too short to detect the effect of intervention on the perceived susceptibility score. We chose a three-month time interval due to time limitation, as post-test haemoglobin level was routinely done at respective health clinic as their requirement for management of anaemia in pregnancy at 35th to 37th gestational week.

For the perceived benefit, the current study was found to be not effective and this could be due to a 'ceiling' effect, as

Table II: Change in mean haemoglobin level, knowledge score, Health Belief Model construct score, dietary iron intake score and high compliance level in the both groups

Outcome measures	Mean (±SD)		Mean Difference	95% CI	t (df)	P-Value
	Baseline	Post test				
Haemoglobin level[a]						
Intervention	10.00 (0.69)	11.76 (0.51)	1.75	1.56, 1.94	18.07 (66)	<0.001*
Control	10.22 (0.52)	11.27 (0.40)	1.04	0.88, 1.19	13.47 (67)	<0.001*
Knowledge score						
Intervention[b]	15.00 (3.50)[c]	19.00 (1.00)[c]	-6.63[d]			<0.001*
Controla	15.58 (3.45)	17.85 (1.84)	2.26	1.57,-2.95	6.57 (67)	<0.001*
Perceived susceptibility score[a]						
Intervention	17.89 (2.52)	19.33 (1.72)	1.43	0.65, 2.22	3.66 (66)	<0.001*
Control	18.01 (1.98)	19.17 (2.22)	1.16	0.58, 1.73	4.02 (67)	<0.001*
Perceived severity score[a]						
Intervention	26.89(3.73)	30.25(2.92)	3.35	2.43, 4.28	7.26 (66)	<0.001*
Control	26.30(3.42)	27.42(2.25)	1.11	0.31, 0.91	2.79 (67)	0.007*
Perceived benefit score[a]						
Intervention	22.35 (2.56)	23.05 (1.95)	0.70	-0.06,1.46	1.83 (66)	0.07
Control	21.51 (2.47)	22.67 (2.24)	1.16	0.54, 1.77	3.77 (67)	<0.001*
Perceived barrier score[a]						
Intervention	24.50(4.04)	23.52(4.42)	-0.98	-1.94,-0.02	-2.05(66)	0.04*
Control	24.16(3.82)	23.15(5.69)	-1.01	-2.26, 0.23	-1.61 (67)	0.11
Level of Compliance						
Interventione						0.002*
Low	15(22.7)	7(10.6)				
Medium	41(62.1)	30(45.5)				
High	10(15.2)	29(43.9)				
Control[e]						
Low	15(22.1)	17(25.0)				0.64
medium	42(61.8)	40(58.8)				
High	11(16.2)	11(16.2)				
Dietary iron intake score[a]						
Intervention	22.96 (10.38)	24.81 (9.39)	1.84	-1.51, 5.20	3.66 (66)	0.27
Control	23.17 (8.21)	23.25 (9.95)	0.08	-2.27, 2.91	0.06 (67)	0.95

[a]Paired t test, [b]Wilcoxon signed rank test, [c]Median(IQR), [d]Z statistic, [e]McNemar Test, *Significant at P<0.05

Table III: GEE analysis of mean haemoglobin level knowledge score and perceived severity score

Variable	B	SE	95 % CI		P -Value
			Lower	Upper	
Haemoglobin level[b]					
Trial group					
Intervention	-0.232	0.104	-0.436	-0.028	0.026*
Control[a]					
Timepoint					
3 month	1.004	0.073	0.860	1.149	<0.001*
Baseline[a]					
Trial group x timepoint	0.758	0.121	0.521	0.995	<0.001*
Knowledge Score[c]					
Trial group					
Intervention	-0.576	0.578	-1.709	0.558	0.320
Control[a]					
Timepoint					
3 month	2.265	0.342	1.594	2.935	<0.001*
Baseline[a]					
Trial group x timepoint	1.429	0.543	0.365	2.494	0.009*
Perceived severity score[d]					
Trial group					
Intervention	0.859	0.6042	-0.325	2.043	0.155
Control[a]	0[a]				
Timepoint					
3 month	1.118	0.3971	0.339	1.896	0.005*
Baseline[a]	0[a]				
Trial group x timepoint	2.206	0.6049	1.021	3.392	<0.001*

*Significant at P<0.05, [a]Reference group,
[b]GEE adjusted for group, time, birth spacing, gestational week
[c]GEE adjusted for group, time, parity, household income, birth spacing.
[d]GEE adjusted for group, time, age, household income, status, parity.

Table IV: GEE analysis of high compliance level

Variable	B	SE	Adjusted Odds Ratio	95 % CI		P-Value
				Lower	Upper	
Trial group						
Intervention	-0.081	0.481	0.922	0.359	2.368	0.867
Control[a]	0[a]		1			
Timepoint						
3 month	-6.387E					
	-017	0.310	1.000	0.544	1.838	1.000
Baseline[a]	0[a]		1			
Trial group x timepoint	1.525	0.544	4.593	1.580	13.350	0.005*

*Significant at P<0.05, [a]Reference group, GEE adjusted for group, time, birth spacing.

subjects in the intervention group had high mean perceived benefit scores at baseline. The fact subjects had high scores for perceived benefit suggests that the mothers were knowledgeable regarding perceived benefits of taking iron supplementation and taking nutritious food over time, but still neglect to practice it.

For the perceived barrier, the results revealed that they had perceived barrier regarding types of iron rich food and they still had poor diet rich iron at post-test. Even though pregnancy is a good time for health education, decreasing barriers to dietary changes and promoting appropriate iron-rich food selection takes time to change. Furthermore, effective nutrition education would require several sessions and focusing more on practical applications to achieve better results.

The mean (±sd) dietary iron intake of respondents at post-test was 24.8mg (±9.3) and still below the Malaysian recommended iron intake for pregnant women of 27mg per day. Our finding is contrary with the study conducted in Palestine and Iran that found effectiveness of their health education intervention whereby statistically significant improvements were seen in dietary iron intake after intervention.[14,20,35] These findings suggest that dietary changes and ability to select appropriate iron-rich food takes time to occur. This study also found that 54.4% of participants in the intervention group had consumed low protein and only 16.2% had enough fat consumption at post test. Thus, the generally low intake of iron could be due to the lower protein intake as reported in this study. With lower protein intake, the intake of micronutrients including iron was expected to decrease. Besides, most of the participants in the intervention group had low income status of less than RM 3000 per month. This implies that the economic status of the pregnant mothers could have contributed to their diet because of their inability to purchase more protein-valuable products such as red meat which is high in iron but relatively expensive.

CONCLUSION

Health education intervention based on the HBM is proven to be effective in improving the mean haemoglobin levels, knowledge score, perceived severity score and compliance level of study participants. The study results emphasized the effectiveness of such an approach, therefore it is recommended that future educational intervention aimed at increasing preventive healthy behaviour in pregnant women could benefit from applying this model in primary health care settings.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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REFERENCES

1. Millman N. Iron deficiency and anaemia in pregnant women in Malaysia-still a significant and challenging health problem. Journal of Pregnancy and Child Health. 2015; 2: 168
2. World Health Organization. The Global Prevalence of Anaemia in 2011. WHO Report. 2011. Available from http://apps.who.int/iris/bitstream/10665/9789241564960_ eng.pdf.
3. World Health Organization. Prevalence of anaemia among pregnant women. The World Bank data; 2016. Available from http://data.worldbank.org
4. National Health and Morbidity Survey Report, volume two; maternal and child health findings. Institute of public health, National Institute of Health; 2016.
5. World Health Organization. Iron Deficiency Anemia: Assessment Prevention and Control: A Guide for Programme Mangers. Geneva. World Health Organization Publication. 2001. Available from http://www.who.int/nutrition/publications /micronutrients/anaemia_iron_deficiency/WHO _NHD_01.3/en/.
6. Ministry of Health Malaysia. Perinatal Care Manual 3rd Edition. Malaysia; 2013.
7. Thirukkanesh S, Zahara AM. Compliance to vitamin and mineral supplementation among pregnant women in urban and rural areas in Malaysia. Asia Pacific Journal of Nutrition. 2010; 9: 744-50.
8. Noraini J, Jamaliah J, Norraliza MZ, Norizzati B, Roswati M, Hashim S. A study on the compliance of antenatal mothers to haematinics and outcome after structured interventions among antenatal mothers in the health clinics of two districts in Selangor, Unpublished study. 2011.
9. Mirnalini K, Zalilah MS, Yusof S, Tahir A, Siti HMD, Siti RD, Normah H. Energy and nutrient intakes: findings from the Malaysian adult nutrition survey (MANS). Malays J Nutr 2008; 14(1): 1-24.
10. Galloway R, Dusch E, Elder L, Achadi E, Grajeda R, Hurtado E, Favin M, Stephen C. et al. Women's perceptions of iron deficiency and anemia prevention and control in eight developing countries. Soc Sci Med 2002; 55(4): 529-44.

11. Salama AM. Utilizing health belief model to enhance the preventive behaviour against iron deficiency anaemia among pregnant women. Journal of Nursing and Health Sciences. 2018; 7(4): 59-69.
12. Nimbalkar PB, Patel JN, Thakor N, Patni M. Impact of educational intervention regarding anaemia and its preventive measures among pregnant women: an interventional study. International Journal of reproduction, Contraception, Obstetrics and gynaecology. 2017; 6(12): 5317-21.
13. Egryani NPR, Saktini F, Susilaningsih N, Puspitasari VD, Gumay AR. The effect of one to one counseling to pregnant women's knowledge about anemia in Semarang. Environmental Science Journal. 2016; 55: 12-36.
14. Khoramabadi M, Dolatian M, Hajian S, Zamanian M, Taheripanah R, Sheikhan Z, Seyedi-Moghadam A. Effects of education based on health belief model on dietary behaviors of iranian pregnant women. Glob J Health Sci 2016; 8(2): 230-9.
15. Abd AlHammed HS, Mohammed AI, Abd Al Hameed LT. Effect of nutritional educational guidelines among pregnant women with iron deficiency anemia at rural areas in Kalyobia Governorate. Life Science Journal. 2012; 9(2): 1212-17.
16. Daddario DK. A review of the use of the health belief model for weight management. Medsurg nursing. Medsurg Nurs 2007; 16(6) 363-6.
17. Nayak S, Roberts MS, Chang CCH, Greenspan SL. Health beliefs about osteoporosis and osteoporosis screening in older women and men. Health Educ J 2010; 69(3): 267-76.
18. Sharifirad GR, Tol A, Mohebi S, Matlabi M, Shahnazi H, Shahsiah M. Effectiveness of nutrition education program based on health belief model compared with traditional training on the recommended weight gain in during pregnancy. J Educ Health Promot 2013; 2: 15.
19. Glanz K, Rimer BK, & Viswanath K. Health Behaviour and Health Education. Health Education. 2008 :(63). http://doi.org/10.1016/S0033-3506(49)81524-1.
20. Mariam A, El-guindi FK. Effect of nutritional interventions on anaemic pregnant women's health using health promotion model. The Medical Journal of Cairo University. 2010; 78(2): 109–118.
21. Noronha JA, Mphil N, Bhaduri A, Former ED, Bhat HV, Pro F. Interventional study to strengthen the health promoting behaviours of pregnant women to prevent anaemia in Southern India. Midwifery 2013; 29(7): e35-41.
22. Baharzadeh K, Marashi T, Saki A, Javid AZ, Araban M. Using of health belief model to promote preventive behaviour againts iron deficiency anemia among pregnant women. Journal of Research & Health. 2014; 7 (2): 754-62.
23. Margaret AH, Courtney RL, Charles M, Aditya C. Selecting and improving quasi-experimental designs in effectiveness and implementation research. Annu Rev Public Health 2018; 39: 5-25.
24. Lemeshow S, Hosmer DW, Klar J, Lwanga SK. Adequacy of sample size in health study. World Health Organization. John Wiley & Sons. 1990
25. Sennayake HM, Premaratne SP, Palihawadana T, Wijeratne S. Simple educational intervention will Improve the efficacy of routine antenatal iron supplementation. J Obstet Gynaecol Res 2010; 36(3): 646-50.
26. Food and Agriculture Organization of United Nations. Guidelines for assessing nutrition related knowledge, attitude and practice. United Nations. 2014
27. Conner M, Norman P. Predicting health behaviour: research and practice with social cognition models. Second Edition. Open University Press; 2007.
28. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. Med Care 1986; 24(1): 67-74.
29. Shahar S, Safii NS, Abdul Manaf Z, Haron H. Atlas of food exchanges & portion sizes. Third Edition. MDC Publisher, Kuala Lumpur; 2015.
30. Ministry of Health Malaysia. Recommended nutrients intake for Malaysia, a report of the technical working group on nutritional guidelines. National Coordinating Committee on Food and Nutrition. Malaysia; 2005.
31. Widyawati W, Jans S, Bor HHJ, Dillen JV, Lagro-janssen ALM. The effectiveness of a new model in managing pregnant women with iron deficiency anaemia in Indonesia : a nonrandomized controlled intervention study, study. Birth 2015; 42(4): 337-45.
32. Yakout SM, Taha N, Badawy AS, Al-Salooly HA. Effect of iron supplementation and nutritional education among a group of anemic pregnant women on their perinatal outcome in riyadh. Journal of Current Research in Science 2014; 2(1): 41-7.
33. Sloan NL, Jordan E, Winikoff B. Effect of iron supplementation on maternal hematologic status in pregnancy. Am J Public Health 2002; 92(2): 288-93.
34. Kamalifard M, Mohammad-Alizade-Charandabi S, Ebrahimi-mamegani M, Asghari-Jafarabadi M, Omidi F. The effect of an educational package on nutritional knowledge, attitude, and behavior of pregnant women. Iranian Journal of Medical Education 2012; 12 (9): 686-97.
35. Araban M, Baharzadeh K, Karimy M. Nutrition modification aimed at enhancing dietary iron and folic acid intake: an application of health belief model in practice. Eur J Public Health 2017; 27(2): 287-92.