**Introduction**

Anaemia is characterised by low blood haemoglobin (Hb) concentration levels in the body, which reduces red blood cells' ability to deliver oxygen to tissues.[1] The Centres for Disease Control and Prevention describe anaemia in pregnancy as having a haemoglobin level of less than 11 g/L (or a haemoglobin percentage of less than 33%). Anaemia affects more than 1.62 billion individuals (or 25% of the world's population), 56 million of whom are pregnant. It is one of the most prevalent nutritional deficient disorders identified worldwide.[2][3] Anaemia has been suggested to be the cause of over 115,000 maternal and 591,000 perinatal deaths annually worldwide.[4] The World Health Organisation estimates that the prevalence of anaemia during pregnancy varies between 8.3% and 23% in high-resource countries and between 53.8% and 90.2% in low-resource countries.[1] According to Meseret et al.[5], the World Health Organization's most recent estimate indicates that approximately 38% (32 million) of expectant mothers worldwide are anaemic. Of these, 9.2 million, or 46.3%, are in Africa. Recent estimates in low-resourced countries including Nigeria put the prevalence at 60.0% in pregnancy and about 7.0% of the women are said to be severely anaemic.[6]

Oluwafemi et al.[7] stated that there is a significant prevalence of anemia during pregnancy, which necessitated the implementation of more health interventions, such as health education regarding the causes, risk factors, and prevention of anemia.

A study conducted by Talabi et al.,[8] in Ekiti State Nigeria revealed that the prevalence of anaemia in pregnancy was 33.4%. The causes of anaemia during pregnancy are complex and evidence suggests that up to 90% of cases of maternal anaemia may result from inadequate dietary iron intake. Others include folate, vitamin B12, parasitic infections such as intestinal parasite infections and malaria.[9] Prevention of anaemia in pregnancy is one of the components of antenatal care which is unsuccessfully implemented by nurse-midwives.[10][11] Health education can help avoid pregnancy-related anaemia.[2]

This emphasizes the necessity of using pictorial materials and visual aids in health education since they improve people's ability to remember and comprehend information.[12]

According to Abd-El-Rahman et al.[13], health education materials are instructional tools that provide health-related information and guidance to a certain group or spectator. To effectively transfer information into actions, high-quality health education resources are essential. According to Bhattad and Pacifico[14], the efficacy of health education materials is contingent upon their integration into a comprehensive patient education strategy. Flipcharts are instructional tools used to present knowledge in an engaging and fascinating way by listing concepts in sequential order. In light of cultural norms, current taboos surrounding our system, and the possibility of preventing anemia through behavior modification and knowledge retention, it is imperative that health education materials be developed.

**Methodology**

An exploratory sequential mixed method design was used. Exploratory sequential mixed methods design is characterized by an initial qualitative phase of data collection and analysis, followed by a phase of quantitative data collection and analysis. The setting encompassed six (6) comprehensive health centres from selected local governments within the three senatorial districts in Ekiti state. Pregnant women in selected comprehensive health care facilities in Ekiti State, Nigeria, made up the study's target group.

 **Sampling Technique**

Multistage sampling technique was used an in three stages;

**Stage one-** selection of all senatorial districts in Ekiti State.

**Stage two-** Simple random selection of two local Government Areas each from the senatorial district by balloting

**Stage three-** A purposive selection of Comprehensive Health Centres (CHCs) from the designated local government was carried out due to the presence of a large number of health professionals, particularly midwives, a high monthly volume of expectant mothers, and the provision of antenatal care services.

**Fig 1 Schematic framework for the development of Health Education Material on anaemia prevention in pregnancy**

**Experts validation of flipchart**

The experts used in this studywere a total number of eight (8) members which included two (2) Nurses/midwives, two (2) obstetric and gynaecology consultants, two (1) family physicians, one (1) nutritionist, (1) infographer and one (1) Health educator. Notable was the consideration given to choosing specialists with backgrounds in women's health (pregnancy), obstetric and gynaecology consulting, family medicine, and health education. On the other hand, professionals were specifically sought after by identifying women's health experts.

This instrument consisted of three rounds with twelve (12) figures and twelve (12) scripts; the first round measured relevance of drafted flipchart using a four-likert scale of not relevant= 1, of little relevance= 2, relevant= 3 and very relevant= 4[15]. The second round comprised of the clarity with a likert scale of very clear, clear, slightly clear, not clear[15]. The third round which is the last round consisted of two items to be reviewed (ease of understanding and applicability to professional practice). They both also consisted of twelve figures and scripts as well with the use of a 4-likert scale. The flipchart's content included pertinent details about the health requirements of expectant mothers, presented in an easily understandable format with graphics that were well-suited for comprehension. Since the sessions were conducted online and via email, both the length of each session and the time allocated for them were enough[15].

**Effectiveness of flipchart**

The Cochran (1977) formula was utilized to estimate the sample size for this study. In order to make sample decisions based on data, the researcher gathered the sample and applied the results.[16]

Using the Cochrane formula:

Z2(1-α/2)π(1-π)

 n =

 d2

 where;

 n = sample size estimate

Z = 95% Confidence Interval (Z = 1.96),

Z2(1-α/2) =critical value at 5% level

Π = population proportion of women attending selected health facilities (π=0.5)

d2 = margin of error

Therefore:

 n= 1.962 (0.5) (0.5)

 d 2

d2 = 1.962 (0.5)2 = 0.098

 100

d = 0.1

n= 1.962 (0.5)2 = 96

 0.1

Sample size= 96

So, using equal proportion for the six selected comprehensive health centres= 96/6

=16

Hence, 16 Antenatal women were utilized for the intervention and control group at 2 randomly selected facilities.

**Sampling technique**

Sixteen (16) pregnant women were selected by simple random sampling for the pre and posttest. Comparison was made to determine the effectiveness of two educational methods; simple health education by mere words only which is the most common method of health education among Nurses and; Flip chart which is an educational material in delivering health education on anaemia prevention to pregnant women. Effectiveness of the methods were measured based on the scores obtained in pre and posttests.

One point was awarded for each accurate response; 0 points were awarded for each wrong response. Each of the twenty (20) knowledge questions had a possible score between 0 and 20 points. Using a modified version of Bloom's cut-off point, participants' overall knowledge was categorised as inadequate when it was less than 50% (<10 points), moderate when it was between 50% and 79% (10–15 points), and adequate when it was between 80% and 100% (16–20 points).[17] In addition to being frequently used in matched pair and case-control study analysis, the McNemar test was utilised to analyse pretest-posttest study designs.[18]

**Inclusion and exclusion criteria**

**Inclusion criteria**

Pregnant women willing to partake in the research**,** pregnant women who are scheduling or having their first prenatal visit, and only first and second trimester pregnant women.

**Exclusion criteria**

Pregnant woman who declined to take part in the study and pregnant woman in her third trimester

**Instrument**

The instrument is a standardized adapted questions which consisted of two sections.[17] The twenty items in Sections A and B served as the instrument for gathering data from the expectant mothers. Twenty (20) general knowledge questions were used covering the idea of anaemia in pregnancy, its causes, symptoms, and effects on the mother's health as well as its prevention

**Section A**: assessed the sociodemographic information pertaining to the respondents' (pregnant women's) age, religion, level of education, employment, marital status, parity, number of years married, gestational week, ethnic group, and annual income.

**Section B:**  assessed the pregnant women's level of knowledge retention regarding preventing anaemia during pregnancy. Only one of the four (4) alternatives (A–D) on each of the twenty (20) multiple-choice questions that make up the assessment have the right answer. Elsharkawy et al.[17] state that the score spans from 0 to 20, with 0–9 representing low knowledge retention, 10-15 representing moderate knowledge retention, and 16–20 representing high knowledge retention.

**3.6.1.5 Method of data collection**

The officer in charge provided her office for use at both control and intervention facilities to avoid heat and undue noise during each class. This was carried out in three stages;

**Stage one:** the pretest instruments were administered to the pregnant women at both control and intervention groups on their antenatal booking day and they were retrieved same day from the respondents. Both groups had nil health education prior to their pre-test.

**Stage two:** The intervention group had three sessions of health education with the validated material while the control group had three sessions of health education using the traditional methods. Each session took place once in every month at the two designated facilities with same set of participants. The session did not exceed 45 minutes per health education

**Stage three:** This stage involved the administration of post test instruments for both groups which was done exactly after three months of monthly intervention classes as their antenatal clinics were still on monthly basis. The posttest instrument was the same questionnaire used in stage one.

**Method of data analysis**

Data collected at pretest and posttest were sorted and coded to ensure that there was no error or missing data. Data was analyzed using McNemar’s test. Pre and Post test results were compared to determine the knowledge retention of the pregnant women that may influence positive behavioural change in the prevention of anaemia in pregnancy.

**Fig 2 Flowchart diagram of the development and validation of health education material**

**Ethical consideration**

The study was designed and executed in line with the dictates of The National Code for Health Research Ethics in Nigeria. Ethical approval with protocol number; ABUADHREC/16/11/2023/222 and a letter of introduction was collected from the Research and Ethics committee of ABUAD University, Ado Ekiti, and copies of the research proposal were forwarded to the Research and Ethics Committee of PHCs in Ekiti state for scrutiny and approval of permission to collect data was given to the researcher with ref number; K/PHCDA/ADM/316/178. Participants were duly and adequately informed of the purpose, risks, benefits, and process of the study. Participant responses at every phase and their information was kept confidential. Verbal consent was also obtained from the respondents before embarking on the collection of data. The participants in the study were allowed to leave at any time without incurring any penalties, and their participation was entirely voluntary. The respondents' informed consent was obtained by providing them with a sufficient description of the goal of the research, the use of the information they provided for academic purposes, and the assurance of data confidentiality.

Table 1 describes the analysis of pregnant mothers into themes and subthemes as analysed

The experts' socio-demographic characteristics in Table 2 revealed that the age of the participants ranged from 39 years to 58 years above with a mean age of 46.91 ± 8.85 years. The professional status of the respondents revealed that they are all at the peak of their chosen careers.

From Table 3 analysis, results revealed that all the experts consensually rated the newly developed flipchart on anaemia prevention as very good for utilization and promotion of health awareness for all women in their reproductive age.

**Effectiveness of Two Educational Methods (With and Without Flipchart) among Pregnant Women**

The result presented in Table 4 revealed a significant difference in the efficacy of two educational methods (with and without Flipchart) among pregnant women. It was found that there was a difference in the level of knowledge retention on the prevention of anaemia in pregnancy between the group educated with flip charts and those without flipcharts at Comprehensive health care centres in Ekiti State. The McNemar p-value of 0.000 is significant at less than 0.05 significant level. To show where the efficacy of the two educational methods (with and without Flipchart) among pregnant women lies, a t-test statistical tool was used as shown in table 4.

**Discussion of Findings**

**Expert panel consensus rating of the newly developed flipchart on anaemia prevention**

This research question which stated "What is the expert panel consensus rating of the newly developed flipchart on anaemia prevention among pregnant women in Ekiti State?" was the study question posed. showed that, with an S-CVI of 0.96 to 1.00 and an S-CVI/UA of 0.75 to 1.00, the recently created flipchart on anaemia prevention was excellent. Everybody agreed that the anaemia health education materials were excellent in terms of their relevance, clarity, readability and practical application. This suggests that the recently created flipchart on preventing anaemia was deemed usable and capable of fulfilling its intended use.

"What is the expert panel consensus rating of the newly developed flipchart on anaemia prevention among pregnant women in Ekiti State?" revealed that the newly developed flipchart on anaemia prevention was very good with S-CVI of 0.96 to 1.00 and S-CVI/UA of 0.75 to 1.00. The health education material on anaemia in terms of clarity, ease of understanding, degree of relevance, and applicability to practice were all unanimously rated very well. This implies that the newly developed flipchart on anaemia prevention was found adequate to use and able to meet the purpose for which it was developed. This result was no This finding suggests the necessity for high-quality educational resources in the medical field that can support patients' well-being. This is consistent with the study conducted by Dodt et al.[15], who said that the sub-theme was used to catalogue the figures and scripts. In addition to calculating the global CVI for the flipchart, the CVI for each figure and script were also determined. There was an exceptional degree of concordance among the professionals, as evidenced by the values of 0.92 and 0.97 for the figures (Fi) and scripts, respectively. This conclusion disagreed with a study by de Oliveira et al.[18], in which 20 pregnant women and 22 judges participated in a convenience-selected validation process. With a minimum score of at least 0.80, the item-level Content Validity Index (I-CVI) was deemed to be good in terms of content validation. The judges found that five of the six elements were relevant, and the mean I-CVI was 0.91.

Therefore, not every item was approved. Similar findings were reported by Isa et al.[19] on the validation of a bilingual educational brochure on the safety of prenatal ultrasounds. Following a round of reviews, the experts came to a consensus to validate the brochure with an I-CVI equivalent to 1.00. Only one item out of the 21 in the first round had an I-CVI below 1.00, thus the recommended changes were implemented. All 21 items in the second round received an I-CVI of 1.00, however the experts recommended making the brochure better. Since all 21 items had been validated, the third evaluation round served as the final one.

**Effectiveness of two educational methods (intervention and control group)**

On the efficacy of two educational methods (with and without Flipchart) among pregnant women, it came to light that the group of participants who were taught using flip charts possessed a different level of knowledge on the prevention of anaemia in pregnancy than the group who did not at primary health care centres in Ekiti State. This corroborated the previous findings by Stephen et al.[20] and Rukmaini et al.[21] that showed that antenatal education programs without health education material as an intervention brought about a mild improvement in preventing anaemia in pregnant women. Munyogwa[22] and Udho et al.[23] concurred that pregnant women are more susceptible to anaemia than non-pregnant women, particularly in low-resourced nations, due to poor environmental cleanliness, malnourishment, hookworm infestation in addition to malaria, and physiological changes that occur during pregnancy.
Furthermore, Elsharkawy et al.'s study from Saudi Arabia in 2022, which assessed the effect of the Health Information Package on expectant mothers' awareness of anaemia during pregnancy, is congruent with this particular study. Pregnant women (n = 196), aged 18–45, who were diagnosed with anaemia during the first trimester of their pregnancy, were randomly assigned to one of two groups: the intervention group (Health Information Package Programme plus routine care, n = 98), or routine care only (n = 98). At baseline and three months later, knowledge and the capacity to choose the right meal were evaluated, and at the conclusion of the three months, compliance was also tested. According to this study, the intervention group's post-education/test mean knowledge scores were considerably higher than those of the control group. According to this study, Balcha et al.[24] used two tools to increase the women's knowledge. The results showed that there are statistically significant differences in total satisfactory knowledge between pre- and post-implementation of health education programmes, as well as in pregnant women's reported practices regarding dietary diversity, eating habits, and meat and vegetable cooking methods.

**Conclusion**

The finding of this research has also proved the relevance of health education material in enhancing knowledge retention in anaemia prevention among pregnant women. It is therefore very necessary for every woman to be well trained on the use of health education material to sensitize pregnant women on the need for wellness throughout pregnancy and thus, prevent morbidity and mortality. It was discovered that the recently created flipchart on anaemia prevention was sufficient in its definition, causes, prevention and complication aspects. This suggests that to support patients' wellness, healthcare services need to provide high-quality educational resources. To effectively transfer knowledge into actions, high-quality health education resources are essential, and newly created resources underwent validation testing to ensure maximum efficacy.

**Conflict of interest**

The authors declare no competing interest.

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