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NUTRITION EDUCATION MODELS IN PREGNANCY TO INCREASE KNOWLEDGE AND DIETARY PATTERNS: A SYSTEMATIC REVIEW

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ABSTRACT

Background. The misconception of nutritional principles causes dietary oversight, resulting in an excess or deficit of energy and specific nutrients essential for the proper course of pregnancy and a child's healthy growth. This review aims to evaluate the effectiveness of nutrition education in improving knowledge and dietary change conducted in pregnant women.

Methods. This review study complies with the 2009 PRISMA guidelines. The studies included in this review are mainly studies with experimental designs. Databases used in searching relevant literatures such as PubMed, ScienceDirect, Willey online Library, Web of Science, Cochrane, and Proquest that were published from 2010 to 2021, full text, English version, experimental studies. Two review authors conducted studies screening based on the eligibility criteria, and extracted important points in the studies included. Quality of the studies included were assessed using EPHPP.

Results. A total of 10 studies were identified in this review. Six studies in the high quality, and four studies in moderate quality. Overall outcomes of the studies included are Knowledge, Attitude, practice, dietary practice, awareness, hemoglobin blood level, and Gestational Weight Gain (GWG).

Conclusion. Nutrition education in many methods has a power to improve knowledge, and dietary change of pregnant women. It implies the need for future large high quality trials using a standardized approach to measuring and reporting similar findings across studies.

Keywords : *Pregnancy, Pregnant women, Education, Nutrition*

INTRODUCTION

Pregnancy is one of the most notable moments in a person's life, and at that time, diet is essential [1]. So far, maternal malnutrition or failure to meet nutritional needs has caused specific health problems for both mothers and newborns [2]. Due to insufficient and unbalanced nutrition, problems such as anemia, osteomalacia, and pregnancy toxemia often arise, and the chances of stillbirth in newborns, premature delivery, congenital abnormalities, and mental retardation increase [3,4]. Furthermore, poor maternal nutritional quality causes developmental maladaptation in the fetus [5]. This results in long-term structural, physiological and metabolic changes and an increased risk of cardiovascular, metabolic, and endocrine diseases in adults [6].

Poor eating habits are a leading contributor to the development of overweight and obesity across the world [7,8]. The frequency of home-cooked meals has decreased over the last five decades, while consumption of foods produced outside the house (i.e., fast food and restaurant food), often higher in calories, fat, and salt, has grown [9,10]. Consumption of home-cooked meals regularly is linked to better diet quality over the lifespan [11,12]. As a result, increasing the frequency of home-prepared meal intake is a significant health habit to target for preventing overweight and obesity in adults and children, and it has been the topic of extensive research over the last two decades [13,14].

International authorities define *pregnancy* as a moment of highly nutritional needs to promote mother and fetal growth [15]. Nutritional support needed in pregnancy includes carbohydrates, fiber, protein, and micronutrients, such as vitamin A, vitamin B complex folate, and iron [16]. However, a study in Canada found that people have insufficient micronutrients through food, such as high levels of iron (97 percent), vitamin D (96 percent), and folate (70 percent) intake [17]. Therefore, stakeholders intended to present food and nutrition education to encourage a

balanced diet based on food culture's valorization [18]. Food and nutrition education is an essential strategy for upgrading health because it encourages people to identify and tolerate their cultural discrepancies and empowers them to complete decisions concerning their health care [19]. Antenatal nutrition education is related to better eating patterns and a healthier pregnancy [20]. Healthy fetal growth and development, cognitive capacity, and immunological function are promoted by optimal nutrition throughout pregnancy [21]. Pregnant women's adherence to dietary guidelines decreases due to a lack of nutrition expertise and insufficient information from health providers [22]. Before and during pregnancy, the mother's behavior becomes a determining factor for both the mother and her child [23,24]. Many dietary mistakes can be caused by a lack of understanding of nutritional principles, resulting in an excess or deficit of energy and specific nutrients essential for the proper course of pregnancy and a child's healthy growth [25,26]. Adequate diet, in combination with sufficient physical activity and the avoidance of harmful habits, enhances the chances of a healthy pregnancy [27,28]. One of the previous systematic reviews on pregnant women's compliance in following dietary guidelines during pregnancy stated that knowledge was an essential predictor concerning adherence to the given nutritional guidelines [29].

It is essential to assess how successful nutrition educations are in improving the nutritional status of pregnant women especially their knowledge and dietary.

This systematic review aimed to assess the efficacy of nutrition education in knowledge and dietary change during pregnancy and their implications for future research. Therefore, the question for this review is, "what kind of nutritional education model is good for increasing knowledge and changes in the diet of pregnant women?".

METHODS

Design

When reporting this systematic review, the standards outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement were followed [30].

Eligibility Criteria

The participants, intervention, comparator, outcome, and study design (PICOS) criteria outlined in Table 1 were used to select studies for inclusion in this review.

Criteria	Inclusion criteria
Participants	Healthy pregnant women in any gestational weeks
Intervention	Health education or promotion
Comparisons	Treatments with a single arm and interventions with many arms (with a comparison intervention or nonintervention control group)
Outcomes	Knowledge, Weight gain, awareness, behavior, dietary changes
Study Design	Experimental studies (eg, randomized controlled trials, quasi-experimental, pre- and post-test study with no control)

Table 1. *Studies Criteria based on PICOS*

Type of Studies

The studies included in this review use experimental designs such as Randomized Controlled trials (RCT) and Quasi-experimental. Participants in the study should be pregnant women in any trimester of pregnancy.

Search Strategy

The following databases (platforms) were searched: PubMed, ScienceDirect, Willey online Library, Web of Science, Cochrane, and Proquest in the time frame between 2010 to 2021. We also searched the gray literature database for additional information such as Google Scholar, conference proceedings, and BASE. The keywords used are based on the Medical Subject Headings (MeSH) standard. Using Boolean operators and a combination of keywords used, namely: ((("pregnancy nutrition"[Title/Abstract]) OR ("pregnancy nutrition knowledge"[Title/Abstract])) AND ((("health education"[Title/Abstract]) OR ("nutritional education"[Title/Abstract])) OR ("health promotion"[Title/Abstract]))) AND (((("knowledge"[Title/Abstract]) OR ("attitude"[Title/Abstract])) OR ("practice"[Title/Abstract])) OR ("awareness"[Title/Abstract])).

Study selection

Two review authors independently assessed the titles and abstracts of the retrieved studies to see if they met the eligibility criteria (RUS and ASJ). The full-text publications for the remaining studies were obtained and evaluated for eligibility which obtained and read full texts of the studies that potentially met the inclusion criteria. The first ineligibility criterion from the following list determines why a publication was excluded: study design, population, intervention, and results. The first authors decided disagreements from review authors regarding the feasibility of the study (SUR and SOE), and this procedure was followed throughout the review.

Data Extraction and Quality Assessment

Two authors (SUR and SOE) independently extracted data in duplicate from studies that met the

inclusion criteria to avoid any chance of misinterpretation of conceptualizations in each study.

Data were synthesized in two ways: (1) research design and intervention strategies were presented. (2) the findings of each study were analyzed qualitatively by collecting the main findings with the design and intervention applied. Furthermore, data extraction was carried out to provide a brief description of the articles' substance, such as the characteristics of the respondents and the characteristics of the study. Data extracted included author, year, country, participant, study design, Intervention, outcome, and main findings. The researchers then examined each extraction and any discrepancies were discussed until consensus was reached.

The quality of the articles included was measured using an assessment tool for the Effective Public Healthcare Panacea Project (EPHPP) [31] which allows experts to apply this tool to articles on any public health topics. This tool uses STRONG, MODERATE, and WEAK categorizations based on the assessment results on eight components, namely Selection Bias, Study Design, Confounders, Blinding, Data Collection Methods, Withdrawals, and Drop-outs, Intervention Integrity, and Analyzes. Articles in the STRONG category are the article reached four strong from the EPHPP component without any of the components being considered weak, the MODERATE category if four components reach strong. One component is rated "weak," and for the WEAK category, it is given if two or more components reach a "weak" value.

Data synthesis

Data from the included studies could not be pooled for meta-analysis because to the substantial diversity in the methodological design of the investigations. Consequently, the narrative synthesis of the included study findings was provided using the Synthesis without Meta-analysis in Systematic Reviews: Reporting Guideline [32].

RESULTS

Search Results

The process of searching for articles up to the determination of articles that meet the inclusion requirements can be illustrated in Figure 1.

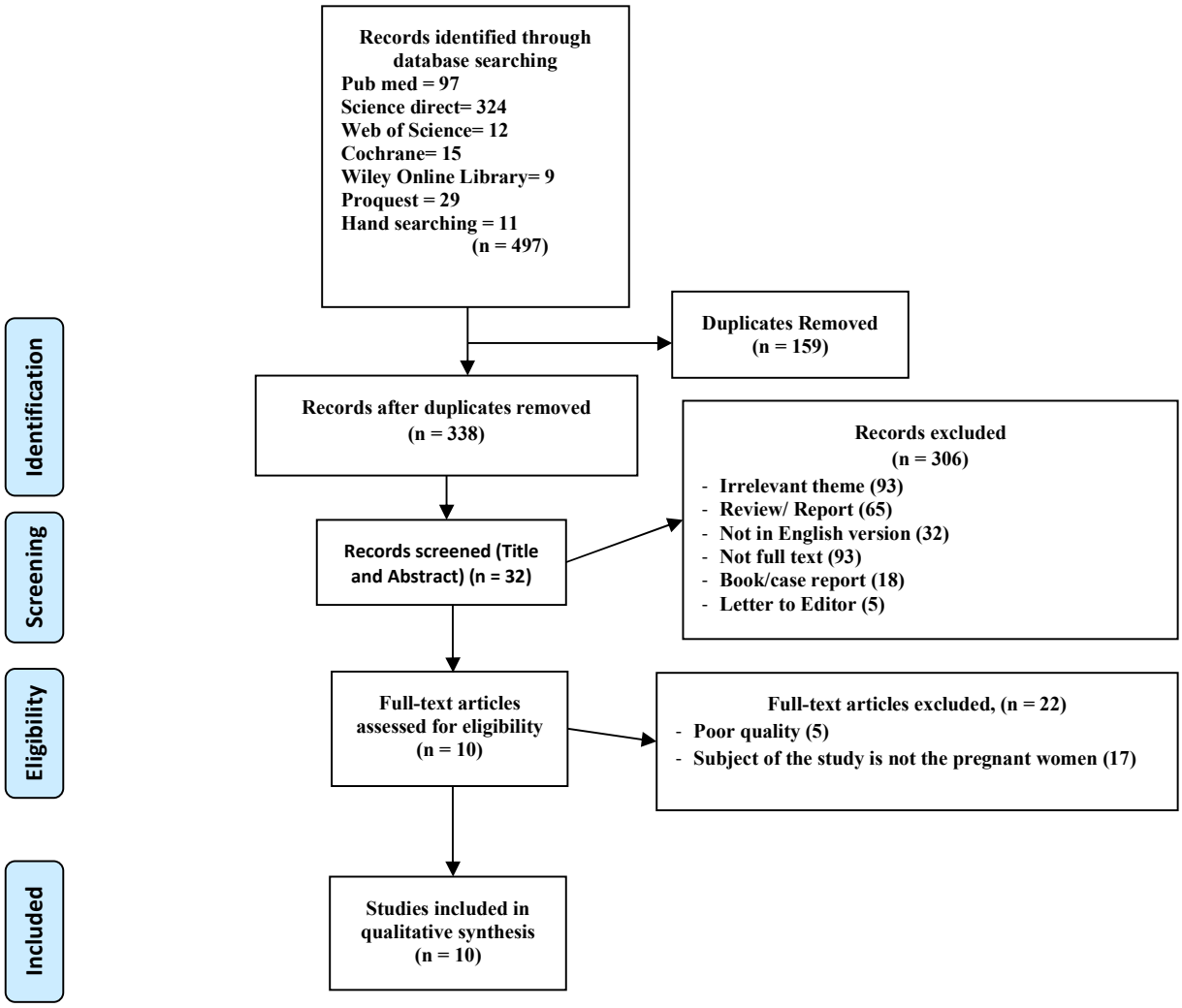

Figure 1. *PRISMA Flowchart for Literature Search*

Search results from five databases yielded 486 articles according to the keywords applied, and then 159 articles were eliminated because they were duplicates, leaving 327 articles. Furthermore, the screening stage was carried out on the remaining articles; as many as 295 articles were excluded because they did not discuss the nutrition status in pregnancy. At the end of the screening, ten articles met the inclusion criteria (Table 2). Those were included in the moderate and robust categories based on the EPHPP assessment tool for article quality assessment.

Author, year	Country	Participants	Design	Intervention model	Evaluation strategy	Outcomes	Main findings	Study quality
Oliveira et al., 2018 [33]	Brazil	Intervention: 76, Control: 79 of pregnant women	RCT	A booklet entitled Healthy Diet during Pregnancy with Regional Foods. The dimensions were 148 mm x 210 mm, and the publication had eight pages.	The Brazilian Food Insecurity Scale	KAP	Knowledge (P < .001) Attitude (P < .001) Practice (P < .001)	High
Demilew et al., 2020 [34]	Ethiopia	356 pregnant women	RCT	Community-based guided counseling using the HBM and the TPB through a home visit on non-working days (40 to 60 minutes each session) for eight months	Questionnaire (FFQ) through one-to-one interviews	attitude, subjective norms, self-efficacy, perceived control, intention, knowledge, and dietary practices	Dietary practice (P < .001)	High
Diddana et al., 2018	Ethiopia	Intervention: 69, Control: 69 pregnant women	RCT	Nutrition education every 15 day	Questionnaire	Knowledge, and dietary	Knowledge (P < .001)	High

[35]				in 5 months		practice	Dietary practice (P < .001)	
Al-Tell et al., 2010 [36]	Palestine	102 (51 intervention; 51 control) pregnant women aged 20 – 30 y.o	Quasi-experimental	The complementary nutritional intervention (CNI) in 10 sessions	Interviewing - questionnaire	Hemoglobin in blood level	Improve of Iron supplementary use, hemoglobin level, and perception	Moderate
Fallah et al., 2013 [37]	Iran	100 pregnant women age 16 to 40 y.o	Quasi-experimental	Nutritional education	Interviewing - questionnaire	Awareness	Improved knowledge (P <.001)	Moderate
Goodarzi-Khoigani et al., 2017 [38]	Iran	Intervention= 88, Control= 86 of primiparous pregnant mothers	RCT	The nutrition education intervention design, based on Pender's HPM experimental group, included three 45–60 min training sessions in 6–10, 18, and 26 weeks of pregnancy.	Recording daily food intake	Dietary pattern	Improved food servings (P<.001)	High
De Stephano et al., 2010 [39]	Somalia	28 refugees pregnant women	RCT	Video based Health education (3-4 min per topic)	Questionnaire	Acceptability of the educational video Knowledge	Acceptable Improved knowledge	Moderate
Shakeri, 2013 [40]	Iran	280 pregnant women	Quasi-experimental	Lecture held in 8 sessions each planned for three sections taking 90 minutes	BASNEF model questionnaire	KAP	Knowledge (P<.001) Attitude (P<.001) Practice (P<.001)	Moderate

Baruth et al., 2019 [41]	USA	43 pregnant women 14–20 weeks gestation		the SELF intervention (Supporting hEaLthy Futures: Creating a Healthy Family by Investing in YourSELF) for 4 weeks	Self Monitoring using FitBit Charge to monitor physical activity (daily) and an Eat Smart Precision digital scale (model ESBS-01) to monitor weight.	Gestational Weight Gain	no significant difference in GWG (P = 0.87)	High
Olson et al., 2018 [42]	USA	465 in control group, and 930 in intervention (1395) ofpregnant women	RCT	e-health intervention for 12 months	Online surveys using EARLY questions	Gestational Weight Gain Behavior change	No effect on GWG	High

Table 2. *Extraction of Literature Included*

Description of studies included

The articles reviewed in this study are located in several countries such as Iran [37], Ethiopia [34], USA [41], Brazil [33], Palestine [36], and Somalia [39]. Study design including Randomized Controlled Trial (RCT) [33–35,38,39,42], and Quasy experimental [36],[37,40,41].

Characteristics of participants

All reviewed studies included pregnant women with variations in gestational age including below 36 weeks (Oliveira et al., 2018), below 16 weeks [34,35] below 20 weeks [41,42], 14-16 weeks [36], 6-10 weeks [38], 18 – 24 weeks [40], 14-20 [41]. Two studies were not applied the gestational age [37,39].

Description of interventions

Some studies provided booklet regarding Healthy Diet during Pregnancy [33], Counseling regarding dietary practice [34], Nutrition education (theoretical session, poster, brochures, flipchart, and whiteboard) [35,37,40], theoretical and practical [36], the nutrition-education intervention based on Pender's HPM [38], video health information [39], exercise, self-monitoring, facebook private group [41], web-based health information [42].

A booklet entitled "Healthy Diet during Pregnancy with Regional Foods (Alimentação Saudável na Gravidez com os Alimentos Regionais)" was used as the main intervention which contains the concept of healthy nutrition, allowed and avoided foods during pregnancy, the benefits of healthy dietary habits for mothers and babies, food hygiene, and recipes with regional foods. The intervention group participated in the individual intervention in a private room, in a single session, with an average duration of 20 minutes. During the meeting, the booklet was introduced, read, and the patients kept a copy to take home [33].

The counseling model has also been used in a study in Ethiopia. The intervention package was community-based guided counseling using the HBM and the TPB. The core content of counseling guide including meal frequency, portion size with increasing gestational age and taking diversified meals, consumption of iron/folic acid supplementation, iodized salt use, reducing of a heavy workload, taking day rest, use of impregnated bed nets, and health services. Counseling was given monthly using a counseling guide and leaflets with core contents. Individual Nutrition counseling was given through a home visit on non-working days. Each counseling session lasted for 40 to 60 minutes. Participants attended four counseling sessions during pregnancy. The first counseling was given before 16 weeks of gestation, the second and third counseling sessions were given during the second trimester of pregnancy, the fourth

counseling was given during the early third trimester of pregnancy. The control group received nutrition education given by the health system [34].

Nutrition education intervention recorded in three studies was given to pregnant women between 1 and 4 months at baseline. The education was given every 15 days for 5 consecutive months. For intervention group, education intervention was given based on Health Belief Model theory: (1) susceptibility of the pregnant women and fetus to malnutrition due to inappropriate dietary practices nutrient deficiency or over nutrient intake; (2) severity of malnutrition such as wasting/thinness and overweight/obesity and high risk of fetus to intrauterine growth retardation, brain development, and cognitive function due to macro- and micronutrient deficiency; (3) benefits of right eating or dietary practices on women nutritional status and fetus health, (4) barriers to practice appropriate good dietary practices; and (5) self-confidence/efficacy to follow right dietary practices. The education was provided using theoretical session, poster, brochures, flipchart, and whiteboard. For the control group, nutrition education was given by trained community health volunteers based on the general usual nutrition education which is currently provided by health extension workers [35]. Fallah et al [37] conducted face-to-face nutritional education which contains two to four lessons based on a nutrition package by Iranian ministry of health. Another study by Shakeri [40] nutrition education conducted in groups of 12 people, held in 8 sessions each planned for three sections taking 90 minutes. An educational CD, educational booklet, tract, and pamphlet about the advantages of good nutrition for mothers and embryo, appropriate ways of doing activities during pregnancy, and false beliefs were given to the participants. Furthermore, lecture, question and answer, group discussion, and film screening methods were used to educate the patients. Paticipants in control group received the routine prenatal instructions [40].

The complementary nutritional intervention (CNI) program proposed by Al-Tell and colleague, it was developed based on the educational principles using the principles of health belief model that aimed to behavior change. The program composed of two parts that were presented within 16 hours and through 8 grouped sessions, in addition to another 2 individualized/ follow-up session for each woman. The content of the theoretical part consisted of 60% of program hours, and the practical part consisted of 40% of program hours. The study also used educational booklet for additional materials. It included information regard iron deficiency anemia in term of causes, complication, treatment inhibitors and promoters of iron absorption and examples of prepared meals rich of iron [36].

Khoigani and colleague conducted nutritional education based on the Pender's HPM for intervention group, included three 45 – 60 minutes training sessions in 6 – 10, 18, and 26 weeks of pregnancy. Each participant had a meeting with the study nutritionist at the time of enrollment for nutritional assessment. In the first session, the dietary pattern, including the average daily servings of five food groups, was explained to the participants. In the second session, practical steps (goal‐setting techniques) to increase self‐efficacy [38].

Destephano et al evaluated the use of DVD to spread information about caesarean birth, episiotomy, nutrition and exercise, the father's role, preparation and prevention, and pregnancy myths and facts. Each video topic ranged from 3 to 4 min in length, incorporated traditional songs and poetry, and had English subtitles [39].

Baruth et al used the social cognitive theory to develop SELF intervention (Supporting hEaLthy Futures: Creating a Healthy Family by Investing in YourSELF). The intervention included four key components: Exercise is Medicine™, self-monitoring, opportunities for support, and walking groups (optional). In self monitoring, Participants were given a FitBit Charge to monitor their

physical activity (daily) and an Eat Smart Precision digital scale (model ESBS-01) to monitor their weight. Participants were instructed to weigh themselves once a week using the scale provided, and enter their weight into their FitBit account [41].

Participants (control and intervention groups) in Olson et al [42] trials given access to the intervention website and to the placebo control website. The self-directed, integrated online and mobile phone behavioral intervention was designed using the Integrative Model of Behavior Prediction and the Behavior Model for Persuasive Design based on a non-electronic pregnancy lifestyle intervention. Participants in intervention group received access to three behavior change tools including a weight gain tracker, a diet and a physical activity goal-setting and self-monitoring tool, as well as, health information including tips, articles, frequently asked questions; a description of pregnancy and parenting-related resources available in the local community; a blogging tool; and an event and appointment reminder [42].

Quality Assessment

Assessment of the methodological quality of studies resulted in 6 studies with a high quality score [33–35,38,41,42] and 4 studies with a moderate quality score [36,37,39,40].

Description of Outcomes

Outcome measures reported in the included studies were Knowledge, attitude, practice [33–35,37,39,40], Dietary practices [34,35,38], Gestational Weight Gain (GWG) [41,43], behavior change [42], Hemoglobin blood level [36]. One study collected the result of outcomes measurement immediately after the intervention [39], Three studies conducted the evaluation in

two times for 6 weeks [40], 5 months [36], and 8 months [42]. The rest of the studies evaluated the outcomes in the range of one to five months [33–35,37,38,41].

As mentioned in Oliveira et al study, the knowledge was considered adequate when used to prepare varied meals and/or juices, knew three or more types of regional foods, and mentioned at least two types of meals prepared with regional foods. The attitude was considered adequate when pregnant women prefer to use regional foods and know the advantages. The practice was considered adequate when pregnant women referred to use regional foods at least twice a day [33]. In Diddana study, knowledge measurement is based on the Health Belief Model consists of 15 nutrition question [35]. In Fallah study, Knowledge as a primary outcome was measured before the intervention and two posttests within three weeks interval [37]. Another study in Iran with knowledge and attitude as primary outcome completed the evaluation immediately and 6 weeks after the educational intervention for the samples of experimental and control groups [40]. For dietary practice outcome, assessment used a food frequency questionnaire (FFQ) collected between 36 to 37 weeks of gestation. Women who didn't attend all counseling sessions were considered non-adherent to the guideline. But, women who withdraw from participating in the study were labeled as lost to follow up [34]. In Diddana study, dietary practice variable was collected by using 17 dietary habit questions [35].

DISCUSSION

Overview study included

This review provides evidence that interventions with a health education on pregnancy issue can improve pregnant women knowledge, attitude, practice, dietary pattern, awareness, hemoglobin level, and weight gain outcomes. There is somewhat more persuasive evidence that health

education interventions are favorably linked with healthy living change during pregnancy of pregnant women as participants due to the number of RCTs that revealed significant findings. Because of the high variability of research designs and methodology utilized in the included papers, meta-analysis cannot be conducted. Furthermore, the goal of this evaluation was to serve as a first step in identifying evidence-based treatments that would help transfer prenatal nutrition research and guidelines into practice. Although the evidence highlighting the importance of nutritional status during pregnancy has been documented, and numerous practice guidelines, including the recently consolidated inter-professional practice guidelines, have existed for some time, there is still a significant gap in translating this evidence to pregnant women through health promotion efforts. Overall, there are few dietary promotion treatments during pregnancy, and only 10 interventions have been assessed on specified health outcomes, according to this analysis.

Overall, the studies comprised a wide range of pregnant women from six different nations, resulting in some findings. Furthermore, all of the research was done in a communal context. A previous evaluation noted that complete prenatal care treatments should be available in remote regions or with less infrastructure and that their duties and those of trained CHWs should be harmonized across nations to assure basic levels of care [44]. Pregnant women who did not take advantage of offered interventions, so missing out on the possibility of a better pregnancy outcome, exemplified the lack of access to services in remote regions [45].

We recommend that maternal and family health service managers at the national, state, and local levels devote resources to adapting and testing existing culinary nutrition programs or, as appropriate, developing new culinary nutrition programs tailored to these life stages, as a result of the potential benefits of culinary nutrition interventions during pregnancy and postpartum

identified in this review. Culinary nutrition programs for pregnant or postpartum women might be incorporated into existing health education programs or offered separately. A workforce with culinary nutrition expertise in maternity and family health care would be required to support such initiatives.

Nutrition Education

For this group is included in the demographic group prone to nutrition and health concerns, nutrition education is crucial during pregnancy [46]. According to cross-sectional research, pregnant women's understanding of nutrition during pregnancy went from 53.9 percent to 97 percent after receiving nutrition education, while their pregnancy-specific dietary practices increased from 46.8 percent to 83.7 percent [47].

Besides knowledge, GWG is also an important issue to be discussed In both the short and long term, excessive GWG is linked to unfavorable health outcomes for mother and child health [48]. Excess GWG is linked to an increased risk of hypertensive disorders [49], glucose intolerance [50] and and poor delivery outcomes during pregnancy [51]. It also predicts more significant baby morbidity and fetal development, such as birth weight, big for gestational age, and macrosomia, among other things [52].

Olson et al., [42] In their experiment, a self-directed, integrated online and mobile phone behavior modification intervention failed to show a beneficial effect on the proportion of the sample with excessive total GWG when compared to an information-only placebo control condition (which is included in this review). It was most likely discovered because the intervention was self-directed. That may have been a wrong decision. Structured, personalized

treatments were more likely to be successful in promoting dietary change, according to a recent assessment of the research on e-behavioral nutrition interventions [42].

One research included in this review, which focuses on the hemoglobin blood level as an outcome, was done in Palestine. Compared to the control group, the study found a substantial beneficial link between dietary behaviors and improved hemoglobin levels. Compared to the control group, there was also a good connection between maternal hemoglobin levels in the third trimester and tiredness levels in the study group [36]. According to review research, nutrition education such as counseling, web-based, and text messages may enhance pregnant women's adherence to iron supplements. The research also stressed the significance of a more extended trial period to assess the intervention's effectiveness correctly [53].

According to the World Health Organization, pregnant women who reside in areas with high nutritional deficits should get some primary nutritional treatment. Nutrition counseling on a healthy diet, energy and protein dietary supplements, iron and folic acid supplementation (all settings), calcium supplementation to reduce the risk of pre-eclampsia in settings where dietary calcium intake is low. Zinc supplementation is only recommended for pregnant women in the context of rigorous research, and multiple micronutrient supplementation is all recommended in settings where 20% or more of women are underweight. Nonetheless, in areas where nutritional shortages are common, several micronutrient supplements include iron and folic acid, may be recommended for maternal health [54].

CONCLUSION

Nutrition education in many methods has a power to improve knowledge, and dietary change of pregnant women. However, there is a need for future large high quality trials using a

standardized approach to measuring and reporting similar findings across studies. A future study might use a double-blind RCT approach with larger sample size and a variety of nutritional outcomes. Longer duration in implementing the trials will improve the outcomes of the study as expected.

Limitation

Our study has several flaws, including a lack of access to the most often recommended databases for searching relevant literature and, ultimately, trial trials. Some research relied on self-reported outcome measures, which might be vulnerable to various biases (e.g., recall bias and response bias). Because some of the studies are of intermediate quality, their conclusions should be read with care. We should also consider that non-English paper were not considered and included in this review, with a potential bias to not identify as many eligible studies as possible.

Conflict of interest statement

The author(s) declares no conflict of interest.

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