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Review Article

Mapping Nutrition Education Factors Among Pregnant Women with Chronic Energy Deficiency: A Scoping Review in Educational and Ecological Assessment

Maxentia Septrierly, Bagoes Widjanarko, Farid Agushybana

Department of Faculty of Public, Universitas Diponegoro, Indonesia

ABSTRACT

Objective: To determine factors influencing the effectiveness of nutrition education in cases of Chronic Energy Deficiency among pregnant women.

Study Design: A Scoping review based on the Arksey and O'Malley framework, including articles published from 2014-2024.

Place and Duration Study: This study was conducted using articles retrieved from three databases (PubMed, Scopus, ScienceDirect). This study duration spanned over 10 years from Sep 2014 to Aug 2024.

Methodology: A total of 1,284 articles were initially identified. After applying PRISMA ScR filtering, 11 articles were selected based on their relevance to the topic. Factors that influence the effectiveness of nutritional intervention were categorized into predisposing, reinforcing, and enabling factors.

Results: Eleven selected articles indicated that educational interventions for cases of Chronic Energy Deficiency are influenced by numerous factors. These include economic conditions, education levels, residential location, cultural aspects, the methods and media used in the interventions, support from health workers and others, as well as prior training for counsellors before delivering nutrition education.

Conclusion: Strengthening these factors can improve pregnant women's knowledge, attitudes, and practices, reducing the prevalence of Chronic Energy Deficiency.

Keywords: Chronic Energy Deficiency, Educational Intervention, Nutrition Education, Pregnant Women.

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INTRODUCTION

The primary and most important component of human life, nutrition, is essential for growth and well-being at every stage of life, including pregnancy.[1] Chronic energy deficiency (CED) or malnutrition is are typical term used to describe the issue of malnutrition due to a wide range of causes. A lack of protein and energy intake during pregnancy is known as CED or malnutrition in pregnant women.[2] To sustain the health of the growing fetus and the mother, nutrition is crucial throughout pregnancy to fulfill the increased need for energy, macronutrients, and micronutrients. A minimum of 60 to 100 grams of protein per day is essential for the development of muscles, bones, and fetal body tissue. The fetus also requires enough folic acid, iron, minerals, vitamins A, B, C, D, and E, and protein.[3] Pregnant women with CED may experience bleeding that irreversibly impacts the fetus's physiological development and raises the risk of low birth weight, miscarriage, early birth, intrauterine growth retardation, and maternal morbidity and mortality.[4] Because poor physical conditions lead to a loss of productivity, which in turn leads to poor cognitive function, the high frequency of malnutrition might impede economic growth and worsen poverty.[5]

The United Nations General Assembly proposed the Sustainable Development Goals (SDGs) in 2015, which aim to enhance people's welfare through 17 global goals and targets by 2030. In the second point in the SDGs, namely "Ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture", the purpose of formulating this point is to address the community's nutritional needs, including pregnant women.[6] WHO has recommended education and health promotion efforts to increase protein and energy intake and use balanced protein and energy supplements for pregnant women in the malnourished population. This approach increases the adequacy of micronutrient intake in food for the entire household.[7] According to a 2015 WHO report, CED is responsible for about 40% of deaths in impoverished nations.

Countries like Bangladesh, India, Indonesia, Myanmar, Nepal, Sri Lanka, and Thailand also have a 15–47% prevalence of CED. With a frequency of 47%, Bangladesh has the highest incidence of CED.[8] According to a 2017 WHO report, CED affects 35–75%

Correspondence: Dr Maxentia Septrierly, Department of Faculty of Public, Universitas Diponegoro, Indonesia

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of pregnant women globally. Further, WHO stated that CED had proven to be the leading cause of maternal fatalities in 40% of pregnant women in developing nations.[9]

In light of the above facts reported over a few decades, there is a need to provide deeper insight into the effectiveness of providing nutritional education and highlight the prevalence of CED globally. Therefore, the main objective of this study was to map the factors related to nutritional education in pregnant women with CED exclusively reported in literature.

METHODOLOGY

This study design utilized the Arksey and O'Malley (2005) framework for Scoping Review. The general question of the scoping review is, "What are the factors that influence the effectiveness of providing nutritional education interventions for cases of malnutrition in pregnant women?"

Inclusion Criteria: The PCC (Population, Concept, Context) approach guided the inclusion criteria.[10]

Population: Pregnant woman experiencing CED.

Concept: Factors influencing the effectiveness of educational interventions.

Context: Articles published in English from 2014-2024.

Exclusion Criteria: Studies focusing on interventions outside the scope of nutritional education, not involving pregnant women, or published in non-peer-reviewed sources were excluded.

Articles were searched using relevant keywords in three databases: PubMed, Scopus, and Science Direct. A total of 1,284 articles were obtained. All articles were downloaded and entered into the Mendeley reference manager. The Prisma ScR framework was applied for screening and selection of relevant studies. The authors filtered articles published before 2014, articles that were not original, and articles that did not meet the inclusion criteria (articles discussing pregnant women with HIV cases, pregnant women with malaria cases, pregnant women with obesity cases, interventions for pregnant women with additional food containing vitamins and zinc, and nutritional interventions for pregnant women during Covid-19). Finally, 11 articles met the eligibility criteria. Keywords, databases, and steps in filtering articles are shown in Table-I, and the Prisma ScR protocol is represented in Figure 1.

RESULTS

A total of 11 articles were included in this review. Each article described examples of interventions aimed at reducing the incidence of chronic energy deficiency (CED) in pregnant women. This study's most common intervention objectives were improving knowledge and attitudes. These studies were conducted in four different regions, namely Eritrea, Ethiopia, Kenya, and Indonesia. A thematic analysis identified key factors influencing the effectiveness of nutritional education interventions, categorized into three themes: predisposing factors, reinforcing factors, and enabling factors Table-II.

Table-I: Details of Keywords and Article Search Database

Database	Keyword	Number
PubMed	"Chronic Energy Deficiency"; OR "Malnutrition"; AND "pregnant women"; AND "Intervention"	758
Scopus	"Chronic Energy Deficiency"; OR "Malnutrition"; AND "pregnant women"; AND "Intervention"	455
Science Direct	"Chronic Energy Deficiency" AND "pregnant women" AND "Intervention"	71
Total		1,284

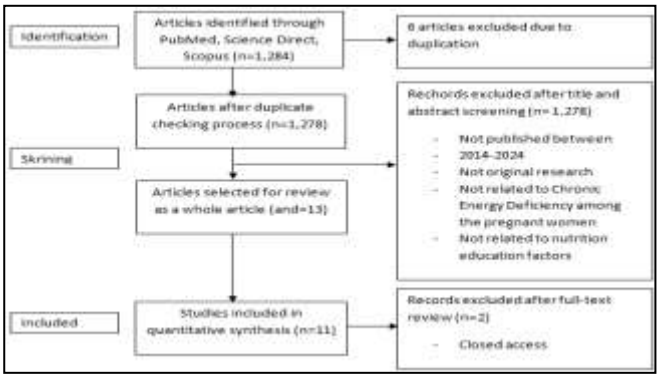

Figure-1: PRISMA ScR Protocol

DISCUSSION

The PRECEDE-PROCEED model, proposed by Johns Hopkins University, shows that there is an educational and ecological assessment phase. This phase explains that the determinants of a person's health prevention behavior are influenced by three factors, namely, Predisposing factors, reinforcing factors, and enabling factors.[11] In this Scoping Review, it was found that factors that influence the effectiveness of providing nutritional education interventions for pregnant women are predisposing factors, including economic level and education level.

Table-II: Literature Review Articles

Theme	Code	Major Explanation	References
Predisposing factors	Economic Level	Pregnant women from low-income households were more likely to experience CED due to limited access to nutritious food.	(1),(12),(14)
	Education Level	Maternal education was positively associated with better nutritional knowledge and practices. Women with higher education levels were more receptive to nutritional messages and demonstrated better dietary practices.	(13),(15)
Reinforcing factors	Cultural Context and Residence	Cultural and recidence included cultural beliefs, including food taboos, influenced dietary behaviour during pregnancy. Urban residence provided better access to health facilities and information compared to rural areas.	(1), (15)
	Methods and Media	Effective delivery methods included lectures, discussions, role playing, and the use of visual aids such as brochures, counseling cards, and mobile phone applications.	(13,15),(16),(18), (19,28)
Enabling factors	Health Worker Assistance	Support from trained health workers significantly improved the effectiveness of interventions. The role included delivering clear messages, providing counseling, and addressing participant concerns.	(1),(15),(19)
	Family Support	Support from husband and other family members played a crucial role in promoting positive dietary practices. Interventions involving family members showed greater effectiveness in improving maternal nutrition.	(21),(25)
	Counselor Training	Training provided to health workers and counselors enhanced the quality of educational sessions. This included role-playing, practice-based training, and the use of evidence-based guidelines to ensure effective communication and intervention delivery.	(1),(14,15),(16),(17), (19),(20)

Reinforcing factors include the location of residence and culture, as well as methods and media in providing interventions. Enabling factors include assistance from health workers, support from others, and training for health workers before conducting interventions. Factors that influence the effectiveness of providing nutritional education interventions can be described in the following chart:

Predisposing Factors

Topic-1: The Impact of the Economic Level on Nutrition Education for Pregnant Women

Income and economic factors impact the effectiveness of nutrition education interventions.[1] An Indonesian study by Permatasari *et al*., indicates that pregnant women living in rural areas tend to have lower incomes, which correlates with a lack of food at home.[12] Women in poverty or with very low incomes are more likely to face malnutrition. Expectant mothers from low-income families often can only afford cheap, non-nutritious food, further deteriorating their nutritional status.[13] According to a study conducted in the Gedeo region of Southern Ethiopia by Beressa *et al*., stated that low birth weight is influenced by household wealth. This study found that children born to families with monthly incomes of 2000ETB (44.5USD) had a 39.6% higher likelihood of being born with low birth weight (LBW) than those whose families earned more than 2000ETB monthly.[14,15] In developing countries, particularly in rural areas or those affected by extreme poverty, the inability to purchase food with essential nutrients and fluctuating food prices pose significant barriers for pregnant women, who often lack adequate access to nutritious food.[15]

Topic 2: The Impact of Education Level on Nutrition Education for Pregnant Women

The next factor is the level of education. Maternal education is linked to improved nutritional knowledge, which can help decrease the risk of malnutrition during pregnancy. Pregnant women with lower levels of education often have poor nutritional status. Two articles indicate that the level of formal

education significantly influences the management of health care and well-being of respondents. Education level was identified as a significant risk factor for attitudes of pregnant teens in a study conducted by Tesfaye *et al*., in central India's West Arsi area.[14] Compared to participants without formal education, pregnant adolescents with a college degree were 7.5 times more likely to have a strong understanding of nutrition. This may be because more educated pregnant adolescents can better access various informational resources, including books, pamphlets, online articles, and other educational materials. Wakwoya *et al*., emphasized that mothers with less education should receive closer supervision from health workers. Pregnant mothers with less education should receive comprehensive nutrition instruction that is easy to understand and straightforward.[15,16]

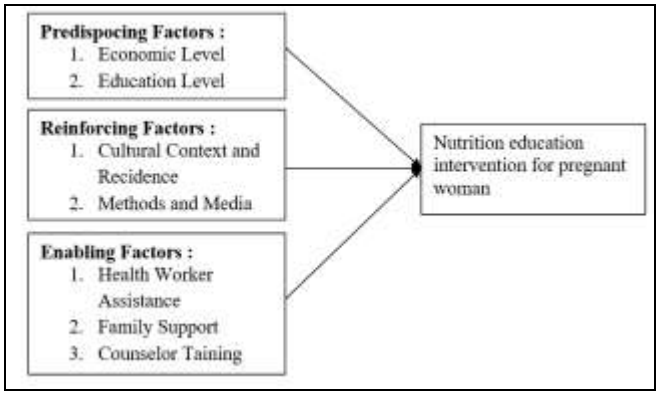

Figure-2: Conceptual Framework of Factors Influencing the Effectiveness of Nutritional Education Interventions for Pregnant Women

Reinforcing Factors

Topic-3: The Impact of Cultural Context and Residence on Nutrition Education for Pregnant Women

Other factors that influence pregnant women in the intervention process are access and affordability to public facilities and culture in the area where the pregnant woman lives. Two studies in the Asmara and Ethiopia regions state that pregnant women who reside in urban areas have better access to information and encounter fewer harmful cultural effects. Research conducted by Kuma et al., in Ethiopia on malnourished pregnant women showed that respondents have better access to health facilities if they live in urban areas. They also have a good socio-economic status, including education, employment, and family income.[17] In addition to the affordability of public facilities, culture, namely myths, can influence interest in changing behavioral patterns as studied by Razzazi *et al*., through the Health Action Process Approach (HAPA).[18] According to the myth of food taboos, some foods should be forbidden because they pose several risks to those who eat them. Masruroh *et al*., identified that pregnant women continue to believe in beliefs about taboos or restrictions on eating certain foods because they still think that threats or penalties will encourage them to eat less, which will eventually impair their nutritional status.[13] In a study in Asmara City, people still believe in myths about the side effects experienced by consuming iron supplements for pregnant women.[1]

Topic-4: The Impact of Methods and Media on Nutrition Education for Pregnant Women

In general, education is carried out to ensure participants have a correct understanding of the concept, and participants can change their behavior as expected. Babik *et al*., explained that effective lectures, discussions, and role-playing dominate the delivery method in various forms of intervention.[19] Eight articles state the method of delivering material through lectures and discussions. Lectures are a method of delivering material where messages can be delivered based on evidence and adjusted to the needs and characteristics of the audience.[15] However, lectures are considered less effective if they are not balanced with group discussions or participatory activities to strengthen their impact on behavioral change.[19] Among the eight articles, in addition to using the lecture and discussion methods, four articles utilize the role-playing method. Muhamad *et al*., describbed that role-playing can increase engagement, self-confidence, empathy, and understanding of learning.[20] Discussions or questions and answers are used to assess participants' awareness of the session topic. Discussion is the most cost-effective health intervention method, and an approach that involves active dialogue and exchange of information between individuals or groups to influence understanding, attitudes, and behaviors related to health.[19]

The intervention media used are print media, nutrition discs, and electronic media. The print media used in the study were brochures, counseling cards, and images that supported the progress of the education session. Four articles state that brochure media is intended as a medium for pregnant women to increase their knowledge independently at home. Brochures contain clear and easy-to-follow core

messages, recommendations for mothers that can be followed up in essential points, and explanations of various aspects.[16] Brochures can contain explanations that are concise and easily accessible to the intended audience. Research shows that combining brochures with other educational tools, such as group discussions or multimedia materials, can increase the impact of interventions. Two articles utilize counseling card media. Counseling cards are designed to help health workers provide clear and easy-to-understand information. This card has a practical guide that facilitates communication between counselors and clients.[19] Two articles utilize images to convey key information. Images can overcome verbal and written limitations and are easier to understand, remember, and attract the audience's attention. Visual media, such as images, can increase information retention by up to 65% better than text. So, when the lecture intervention process occurs, it will be more effective if you balance the text with images. In addition to the print media mentioned, one article states that educational and simulations on nutrition during pregnancy, stunting, immunity, and simulations to assess nutritional status can be done by utilizing an educational tool called a nutrition disc developed by the Indonesian Association of Nutritionists and Food.[19]

Two articles utilize electronic media as an intervention medium, namely, research conducted in the East Shoa Zone and Nairobi City, Kenya. The electronic media utilized in the intervention effort include short messages via SMS and the development of applications on mobile phones.[16,13] SMS is used to transmit brief communications. The target (pregnant women) receives 18 weekly serial brief SMS messages. A health belief model is also included in the SMS sent to the intervention group to convey nutritional messages.[16] This approach is practical because it is fast, low-cost, and easily accessible to various groups of people.[18] In addition to using text messages, one article that utilizes electronic media as an intervention medium is to develop a visually appealing and easy-to-use mobile phone application. This study was conducted in Kenya. Pregnant women can access health information in the application, such as MUAC measurements and current health issues, under the health information feature. Another aspect of the app is the ability to track workout routines and levels of physical activity throughout pregnancy. The results of this study were that only 31.2% of respondents, or less than one-third, showed a high level of understanding of mobile phone applications. While 18.7% of participants had a poor degree of knowledge of mobile phone applications, 50.1% demonstrated a moderate level of understanding. The study also looked at the percentage of food diversity and used mobile phone applications as an intervention medium. According to the findings, the largest percentage ingested starchy basic foods (20.3%), followed by vitamin A-rich fruits (12.8%). Additionally, there was a percentage of fruit and offal intake, both of which were 11.3%, for a total of 48. About 10.9% ate seeds or nuts. Approximately 10.3% of pregnant women ate vegetables or green vegetables. Protein foods, such as meat or fish, poultry or eggs, and dairy items, made up the least quantity of food consumed by women, accounting for less than 10% of each food group.[19-20]

One article among the articles involved in this study discussed the method of delivering community empowerment interventions by gardening at home. This study was conducted in the Southwest Ethiopia region. Community empowerment is identifying health problems, planning, and finding solutions by utilizing local potential and existing resources. In addition to improving health, community empowerment aims to increase independence and encourage people to make decisions for their health.[21] Giving the intervention group four vegetable seeds is one way to empower them. The four vegetable seeds are carrot, cabbage, tomato, and lettuce. Research on home gardening and nutrition education in Southwest Ethiopia revealed that husband-led nutrition education programs, when paired with encouraging the consumption of locally grown household gardens, were successful in improving pregnant women's knowledge, attitudes, and nutritional practices. This, in turn, improved the nutritional status, birth weight of the mother, and remarkably increased neurodevelopment of the infant as highlighted by Murphy *et al*.[22]

Enabling Factors

Topic 5. The Impact of Health Worker Assistance on Nutrition Education for Pregnant Women

Three articles state that one factor for successful implementation is the source of information through health care assistance.[1,19] In a study conducted in the Asmara region, it was found that 70.2% of pregnant women sought information from doctors/nurses/midwives.[1] The active role of health cadres in providing information and support can lead to better dietary changes, positively impacting

maternal and infant health.[22] In addition, a study conducted in Ethiopia examined how nutrition education carried out by public health specialists can increase MUAC in pregnant women.[15] The intervention and control groups' mean MUAC differences were 0.59±0.05 cm, a statistically significant difference.[11] Pregnant women's conduct before and after receiving intervention through medical aid in pregnancy exams differed significantly (p<0.05).[19]

During ANC activities, health workers deliver key messages through greeting, asking, listening, identifying, and discussing.[15] This can significantly improve knowledge, attitudes, and pregnant women after receiving nutrition education from health workers. Health cadres accompanied all short-term pregnant women in the intervention group to educate and teach them about pregnancy danger indicators, risk factors, and prenatal exams.[19] According to a study conducted in Ethiopia, pregnant adolescents who attended ANC were eight times more likely to have proper nutritional knowledge. ANC programs can improve nutrition, increase health literacy, and encourage preventive health care habits. Pregnant women have sufficient time to talk to the facilitator during ANC appointments.[14] Besides mentoring carried out through lectures and discussions, one study in Indonesia stated that role-playing sessions ending with feedback and improvements could improve cadre mentoring quality. In addition, training is also carried out using research modules/guidebooks.[19]

One of the factors that causes nutritional education activities for pregnant women during ANC to significantly increase maternal knowledge is the training of counselors, supervisors, and collectors conducted by health workers who work as midwives, nutritionists, and MPH professionals.[16,23]

Topic-6: The Impact of Family Support on Nutrition Education for Pregnant Women

Assistance is needed during the prenatal phase to ensure a successful pregnancy. To maintain mental health, pregnant women need help from their partners and in-laws. This family support was highlighted by Naz *et al*., who clearly explained that pregnancy and fetal weight can be affected by depression. 10% of pregnant women worldwide suffer from stress and sadness due to the authoritarian behavior of their in-laws. Their family relationships greatly influence the physical and emotional well-being of pregnant women.[25] The behavior and communication of family members in providing psychological support are essential components that affect maternal health. Pregnant women who receive social support from their family members, both emotional and cognitive, as well as positive reinforcement and feedback, have a lower mental risk and better well-being. Prematurity, low birth weight in fetuses, extended labor, increased incidence of cesarean deliveries, and delayed fetal neurodevelopment are all consequences of inadequate psychological support throughout pregnancy. Two articles in Jimma Zone, Southwest Ethiopia state that the family support factor, namely the husband's support, influences the effectiveness of nutrition education for pregnant women.[21,25] There is a study conducted in Lilli Aba Bor, Southwest Ethiopia, involving married couples using plantation areas to encourage household garden consumption.[17] The results showed that pregnant women who received intervention with their husbands consumed more food diversity.[21] This could be because couples communicated more during or after the nutrition education sessions, which could have improved comprehension.[20]

Topic-7: The Implementation of Counselor Training on Nutrition Education of Pregnant Women

Eight of the eleven articles provided research to counselors, supervisors, and data collectors. Obonyo et al explained various cadres of experts that can help pregnant women and nursing women in diverse roles. Certified nutritionists provided training to counselors from health workers who work as midwives, nutritionists, and MPH professionals.[26] Training for counselors in addition to basic principles of nutrition and nutritional interventions, but also the ability to speak clearly and effectively, improve skills, evidence-based approaches, and understanding of social and cultural factors. The rural health department of the U.S has highlighted these aspects through the rural health information manual.[27]

The study conducted by Westmoreland *et al*., identified that women who received intervention through mentoring and role-playing from teams of health workers showed significant changes in the attitudes of pregnant women.[28] According to the articles studied, the training was conducted for two to five days. Three of the articles stated that the training was conducted for two days.[19,29] The training was carried out using presentation, practice, discussion, and role-play methods. One article stated that the role-play session ended with feedback and improvements

provided by the speaker, which could aim to improve the quality of mentoring cadres.[28] In addition, Ginnard *et al*., also emphasized that the training was also conducted using a research module/guidebook.[30]

According to a study conducted by the United Nations International Children's Emergency Fund (UNICEF), the Federal Ministry of Health should ensure that its training manual for trainers is well-documented and includes structured guidelines. These guidelines aim to mitigate gestational diseases by providing effective interventions in nutrition education. Additionally, well-trained healthcare providers should be accessible for counselling and discussions to improve the overall health of mothers and infants.[31] Research conducted by Galmirini *et al*., and Mbunge *et al*., has provided comprehensive, evidence-based insights into strategies for improving the quality of life for pregnant women and nursing mothers, as well as supporting child health development. Their studies emphasize the importance of prenatal and postnatal care, highlighting factors such as nutritional support, mental health resources, and community engagement. By addressing these elements, the findings suggest that targeted interventions can significantly enhance maternal well-being and promote healthier developmental outcomes for children, leading to improved family dynamics and community health.[32,33]

The objectives of the training before conducting the intervention include the knowledge and counseling skills of health workers regarding nutrition, and minimizing interviewer bias also highlighted by Mitran *et al*.[34] Materials discussed in the introduction to nutrition during pregnancy can cover food group categories, estimated weight gain, energy requirements, other food items, lifestyle changes, food safety issues, common pregnancy problems, benefits of meeting nutritional needs, and the impact of malnutrition on pregnant women have also been highlighted by Stark *et al*., in coherence with literature.[35]

The training also aims to improve knowledge material regarding nutritional intake during pregnancy and stunting prevention, as well as for anthropometric procedures. It was framed as per the given guidelines by WHO for pregnant women, maternal and infant nutrition education, and psycho-social support from family and healthcare workers. According to one publication, WHO's recommendations on essential nutrition activities (ENA) to improve maternal nutrition guidelines and maternal nutrition operational guidelines for low- and middle-income countries served as the basis for the adaptation and preparation of the maternal nutrition education intervention guidelines. WHO's recommendations on the Infant and Early Childhood Feeding Counselling Package served as the basis for the development of training and educational materials. WHO created training guidelines aimed at facilitators, participants, and guidelines for post-training follow-up.[36]

Recommendations for Future Research

Further research is needed to evaluate the long-term impact of nutrition education on maternal and child health. Studies that explore intervention designs that leverage local wisdom can provide deeper insights into addressing challenges in the context of intervention implementation. Future interventions should explore the potential of digital tools to improve the accessibility and effectiveness of nutrition education.

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CONCLUSION

The study concluded that interventions in providing education to pregnant women can significantly increase their knowledge, attitudes, and behavior. Health cadres' Mentoring activities can substantially impact if certified health workers train counselors before carrying out the intervention. This results in lectures, discussions, and role-playing methods that can improve pregnant women's knowledge, attitudes, and behavior. In addition, other factors influence the effectiveness of interventions, including the culture of the place of residence, economy, level of education, husband's support, and media that support intervention activities. The better the influence of culture, economy, education level, husband's support, and the more effective the media used, the better the pregnant women's knowledge, attitudes, and behavior. So that it can have a long-term impact on the nutritional status of pregnant women, which is improving.

Conflict of Interest: None

Disclosure

This scoping review article was created based on the topic of my thesis research that I am working on in the Health Promotion Master's Department, Universitas Diponegoro.

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Authors' Contribution

The following authors have made substantial contributions to the manuscript as under :

MS & BW: Conception, conducting review article, study design.

FA: Study design, conception, and approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Teweldemedhin LG, Amanuel HG, Berhe SA, Gebreyohans G, Tsige Z, Habte E et al. Effect of nutrition education by health professionals on pregnancy-specific nutrition knowledge and healthy dietary practice among pregnant women in Asmara, Eritrea: a quasi-experimental study. BMJ Nutr Prev Hea 2021; 4(1): 181–194. https://doi.org/10.1136/bmjnph-2020-000159
2. Wahab I, Fitriani A, Wahyuni YF, Mawarni S. Faktor-faktor yang berhubungan dengan kejadian Kurang Energi Kronis (KEK) pada ibu hamil di wilayah kerja Puskesmas Pembina Kota Palembang tahun 2024. IJHS 2025; 5(2): 410-418. http://dx.doi.org/10.54957/ijhs.v5i2.1442
3. Gernand AD, Schulze KJ, Stewart CP, West KP, Christian P. Micronutrient deficiencies in pregnancy worldwide: health effects and prevention. Nat Rev Endorinol 2016; 12(5): 274–289. https://doi.org/10.1038/nrendo.2016.37
4. Kpewou DE, Poirot E, Berger J, Som SV, Laillou A, Belayneh SN WF et al. Maternal mid-upper arm circumference during pregnancy and linear growth among Cambodian infants during the first months of life. Matern Child Nutr 2020; 162(1): e12951. https://doi: 10.1111/mcn.12951
5. Bagriansky J, Champa N, Pak K, Whitney S, Laillou A. The economic consequences of malnutrition in Cambodia, more than 400 million US dollars lost annually. Asia Pac J Clin Nutr. 2014; 23(4): 524–531. https://doi.org/10.6133/apjcn.2014.23.4.08
6. Sekretariat Nasional SDGs. SDGs KNOWLEDGE HUB [Internet]. Available from: https://sdgs.bappenas.go.id/
7. WHO recommendations on antenatal care for a positive pregnancy experience. [Internet] 2016. Available from: https://efaidnbmnnnibpcajpcglclefindmkaj/https://iris.who.int/bitstream/handle/10665/259947/WHO-RHR-18.02-eng.pdf
8. Ananda A, Baso YS, Hidayanty H, Syarif S, Aminuddin A, Bahar B et al. Providing education chronic energy deficiency (CED) uses web-based She Smart to improve knowledge, attitudes, and practice in adolescent girls. Int J Heal Med Sci 2022; 5(1): 56–62. https://doi.org/10.21744/ijhms.v5n1.1833
9. Kundarti FI, Titisari I, Kiswati, Rahayu DE, Riyadi BD. Improving the Nutritional Status of Pregnant Women Who Experience Chronic Energy Deficiency with Spirulina Platensis. Heal Technol J 2024; 2(4): 384–397. https://doi.org/10.53713/htechj.v2i4.221
10. University of South Australia. What is PCC? [Internet]. p. 2024. Available from: https://guides.library.unisa.edu.au/ScopingReviews
11. University JH. The PRECEDE-PROCEED Model. Johns Hopkins University Press, Edition [Internet]. 2022. Available from: https://www.lgreen.net/precede-proceed-2022-edition
12. Permatasari TAE, Rizqiya F, Kusumaningati W, Suryaalamsah II, Hermiwahyoeni Z. The effect of nutrition and reproductive health education of pregnant women in Indonesia using quasi-experimental study. BMC Pregnancy Childbirth 2021; 21(1): 1–15. https://doi.org/10.1186/s12884-021-03676-x
13. Masruroh U. Identification of Food Avoidance Myths in Pregnant Women, Kedungwringin Village, Jatilawang District, Banyumas Regency. Int Proc Nusant Raya 2022; 1(1): 213–216. https://doi.org/10.24090/nuraicon.v1i1.130
14. Tesfaye A, Adissu Y, Tamiru D, Belachew T. Nutritional knowledge, nutritional status, and associated factors among pregnant adolescents in the West Arsi Zone, central Ethiopia. Sci Rep 2024; 14(1): 6879. https://doi.org/10.1038/s41598-024-57428-w
15. Beressa G, Whiting SJ, Belachew T. Effect of nutrition education on the nutritional status of pregnant women in Robe and Goba Towns, Southeast Ethiopia, using a cluster randomized controlled trial. Sci Rep 2024; 14(1): 19706. https://doi.org/10.1038/s41598-024-70861-1
16. Wakwoya EB, Belachew T, Girma T. Effects of intensive nutrition education and counseling on nutritional status of pregnant women in East Shoa Zone, Ethiopia. Front Nutr 2023; 10: 1144709. https://doi.org/10.3389/fnut.2023.1144709
17. Kuma MN, Tamiru D, Belachew T. Effects of nutrition education and home gardening interventions on feto-maternal outcomes among pregnant women in Jimma Zone, Southwest Ethiopia: A cluster randomized controlled trial. PLoS One 2023; 18(10): e0288150. https://doi.org/10.1371/journal.pone.0288150
18. Razzazi A, Griffiths MD, Alimoradi Z. The effect of nutritional education based on the health action process approach (HAPA) on the pregnancy outcomes among malnourished pregnant mothers. BMC Pregnancy Childbirth. 2024; 24(1): 83. https://doi.org/10.1186/s12884-024-06276-7
19. Babik JM, Luther VP. Creating and Presenting an Effective Lecture. J Contin Educ Health Prof 2020; 40(1): 36–41. https://doi.org/10.1097/ceh.0000000000000281
20. Muhamad Z, Mahmudiono T, Abihail CT, Sahila N, Wangi MP, Suyanto B, et al. Preliminary Study: The Effectiveness of Nutrition Education Intervention Targeting Short-Statured Pregnant Women to Prevent Gestational Stunting. Nutrients 2023; 15(19): 1–11. https://doi.org/10.3390/nu15194305
21. Tsegaye D, Tamiru D, Belachew T. Theory-based nutrition education intervention through male involvement improves the dietary diversity practice and nutritional status of pregnant women in rural Illu Aba Bor Zone, Southwest Ethiopia: A quasi-experimental study. Matern Child Nutr 2022; 18(3): e13350. https://doi.org/10.1111/mcn.13350
22. Murphy R, Marshall K, Zagorin S, Devarshi PP, Hazels Mitmesser S et al. Socioeconomic Inequalities Impact the Ability of Pregnant Women and Women of Childbearing Age to Consume Nutrients Needed for Neurodevelopment: An Analysis of NHANES 2007–2018. Nutrients 2022; 14(18): 3823. https://doi.org/10.3390/nu14183823
23. Iqbal S, Ali I. Maternal food insecurity in low-income countries: Revisiting its causes and consequences for maternal and neonatal health. J Agric Food Res 2021; 3(1): 100091. https://doi.org/10.1016/j.jafr.2020.100091
24. Gokhale D, Rao S. Socio-economic and socio-demographic determinants of diet diversity among rural pregnant women from Pune, India. BMC Nutr 2022; 8(1): 1–8. https://doi.org/10.1186/s40795-022-00547-2

25. Naz S, Muhammad D, Ahmad A, Shabnam, Ali P. Pregnant women perceptions regarding their husbands' and in-laws' support during pregnancy: a qualitative study. 2021; 39(229). https://doi.org/10.11604/pamj.2021.39.229.25659
26. Obonyo KO, Kaindi DWM, Ngala S, Kogi-Makau W. Maternal Nutrition Knowledge and Mothers' Ability to Utilize Mobile Phone Application For Health Information Sharing at Kenyatta National Hospital, Nairobi City, Kenya. African J Food, Agric Nutr Dev [Internet]. 2024; 24(7): 23980–97. https://www.scopus.com/inward/record.uri?eid=2-s2.085200972802&doi=10.18697%2Fajfand.132.24885&partnerID=40&md5=a387000f9c4bd74f3f3f270a942d2c6b
27. Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS). Rural Health Information Hub [Internet]. Health Promotion and Disease Prevention Theories and Models. Available from: https://www.ruralhealthinfo.org/toolkits/health-promotion/2/theories-and-models
28. Westmoreland KD, Banda FM, Steenhoff AP, Lowenthal ED, Isaksson E, Fassl BA. A standardized low-cost peer role-playing training intervention improves medical student competency in communicating bad news to patients in Botswana. Palliat Support Care 2019; 17(1): 60–65. https://doi.org/10.1017/s1478951518000627
29. Galaviz KI, Weber MB, Straus A, Haw JS. Global Diabetes Prevention Interventions : A Systematic Review and Network Meta-analysis of the Real-World Impact on Incidence, Weight, and Glucose. 2018; 41: 1526–1534. https://doi.org/10.2337/dc17-2222
30. Ginnard OZB, Todd Alonso G, Corathers SD, Demeterco-Berggren C, Golden LH, Miyazaki BT, et al. Quality improvement in diabetes care: A review of initiatives and outcomes in the T1D exchange quality improvement collaborative. Clin Diabetes. 2021; 39(3): 256–263. https://doi.org/10.2337/cd21-0029
31. UNICEF. Supporting Infant and Young Child Feeding Counselling : Orientation for Supervisors and Mentors.
32. Galmarini E, Marciano L, Schulz PJ. The effectiveness of visual-based interventions on health literacy in health care: a systematic review and meta-analysis. BMC Health Serv Res [Internet]. 2024; 24(1): 1–10. https://doi.org/10.1186/s12913-024-11138-1
33. Mbunge E, Sibiya MN. Mobile health interventions for improving maternal and child health outcomes in South Africa: a systematic review. Glob Heal J 2024; 8(3): 103–112. https://doi.org/10.1016/j.glohj.2024.08.002
34. Mitran AM, Popa AD, Gherasim A, Nita O, Mihalache L, Arhire LI, et al. Dietary Patterns of Pregnant Women and Their Association with Diet Quality Measures: A Comparative Analysis. Nutrients 2024; 16(11): 1–17. https://doi.org/10.3390/nu16111736
35. Stark CM, Garner CD, Garg A, Bégin F. Building Capacity of Health Professionals in Low- and Middle-Income Countries Through Online Continuing Professional Development in Nutrition. J Contin Educ Health Prof 2021; 41(1): 63–69. https://doi.org/10.1097/ceh.0000000000000334
36. WHO. Infant and young child feeding: counselling cards for health workers [Internet]. 2021. Available from: https://www.who.int/publications/i/item/WHO-HEP-NFS-21.24