

Changes in Energy and Protein Intake After Local Food-Based Nutrition Education for Pregnant Women in Tukka Village

Fitri Khoiriyah, Mei Yati Simatupang, Oktaviani Putri Zega*

STIKes Nauli Husada, North Sumatra, Indonesia

*Correspondent Author: Oktaviani Putri Zega (oktaviani07zega@gmail.com)



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ABSTRACT

Background: Energy and protein intake during pregnancy is important for maternal health and fetal growth. Education using local food samples can help mothers implement nutritional recommendations in their daily consumption. This study aims to describe changes in energy and protein intake following local food-based nutrition education among pregnant women in Tukka Village, Central Tapanuli Regency.

Methods: A pre-experimental study with a single-group before-after design was conducted in March 2025. A total of 30 pregnant women were recruited through total sampling. Education using leaflets or modules on energy and protein sources, portion sizes, meal frequency, and examples of local food-based menus was provided. Data collection used a questionnaire. Intake before and after the intervention is presented as the mean and standard deviation.

Results: Most participants were aged 20–35 years (76.7%), had a high school education (46.7%), and were in their second trimester (43.3%). Mean energy intake increased from $1,645 \pm 285$ to $1,980 \pm 270$ kcal/day, with a difference of 335 kcal/day. Mean protein intake increased from 55.8 ± 12.4 to 69.7 ± 11.8 g/day, with a difference of 13.9 g/day.

Conclusion: Reported energy and protein intakes were higher after local food-based nutrition education. The design without a control group limits causal conclusions. Controlled studies with standardized intake measurements are needed to confirm the effectiveness of the intervention and its impact on maternal nutritional status.

BACKGROUND

Maternal nutritional status is a crucial component of maternal and child health. Malnutrition before and during pregnancy is associated with suboptimal fetal growth and adverse birth outcomes. Nutrition improvement efforts should address diet quality, food access, and health services throughout the reproductive lifespan (Victora et al., 2021; United Nations Children's Fund [UNICEF], 2023). Intervention evidence also suggests that addressing malnutrition requires a combination of population-specific approaches, including targeted nutrition counseling and interventions (Keats et al., 2021).

In Indonesia, the results of the 2023 Indonesian Health Survey provide a basis for monitoring the risk of chronic energy deficiency (CED) in pregnant women and planning nutrition services (Health Development Policy Agency, 2024). In program services, an upper arm circumference (MUC) of less than 23.5 cm is used to identify CED risk. This risk assessment should be distinguished from dietary intake assessment because changes in consumption do not directly indicate changes in anthropometric status (Ministry of Health of the Republic of Indonesia, 2023). The national Nutritional Adequacy Intake (RDA) takes into account age groups and additional needs during pregnancy by trimester; therefore, an adequacy assessment should be conducted for each participant (Ministry of Health of the Republic of Indonesia, 2019).

The World Health Organization (WHO, 2016) recommends education to increase energy and protein intake in pregnant women with malnutrition. Systematic reviews indicate that education and counseling during pregnancy can improve some maternal consumption and health outcomes, although outcomes are influenced by the type of intervention and participant characteristics (Girard & Olude, 2012; Ota et al., 2015). A more recent review also found improvements in energy and protein intake through interactive counseling, supporting the importance of tailored nutrition communication for mothers (Dewidar et al., 2023).

The local food approach provides examples of food choices that can be tailored to family consumption habits and resources. In Indonesia, the use of local foods is part of the policy of providing supplementary feeding for pregnant women and toddlers (Ministry of Health of the Republic of Indonesia, 2023). Research on nutrition and reproductive health education in Indonesia shows improvements in knowledge, attitudes, and practices related to nutrition (Permatasari et al., 2021). Another study used picture books alongside counseling for pregnant women with anemia, providing a basis for using print media as a communication support, while still considering differences in research objectives and outcomes (Nahrisah et al., 2020).

Controlled trial evidence from Ethiopia suggests that targeted counseling can improve eating practices and nutritional status in pregnant women (Demilew et al., 2020a, 2020b). Behavioral theory-based education has also been shown to improve dietary diversity (Beressa et al., 2024). However, these findings cannot be directly generalized to Tukka Village due to differences in context, intervention intensity, and measurement methods. This study aims to describe changes in energy and protein intake before and after local food-based nutrition education among pregnant women in Tukka Village, Central Tapanuli Regency.

METHOD

Research design and location

This study used a one-group pretest–posttest pre-experimental design, without a control group. The study was conducted in Tukka Village, Central Tapanuli Regency, in March 2025. This design allows for observation of changes within the same group, but cannot separate the influence of education from other changes that occurred during the observation period.

Participants and sampling techniques

The study population consisted of 30 pregnant women living in Tukka Village. All members of the population were recruited through total sampling, resulting in a reported sample size of 30 participants. Inclusion criteria were pregnant women living in the study area and willing to participate. Exclusion criteria were illnesses that prevented interviews; participants who withdrew consent during the study did not continue data collection.

Nutrition education intervention

The intervention involved local food-based nutrition education using leaflets or modules. The materials covered energy and protein source choices, portion control, meal frequency, and simple menu examples. The food ingredients mentioned in the materials were rice, corn, sweet potatoes, cassava, fish, eggs, meat, tempeh, tofu, and nuts. The term "local food-based" in this study refers to examples of food ingredients in the educational materials, not proof that all of these ingredients are produced in the study area.

The intervention description needs to be completed so that it can be replicated according to the reporting components of the Template for Intervention Description and Replication (TIDieR), especially the materials, procedures, implementers, schedules, and implementation of the intervention (Hoffmann et al., 2014).

Variables and measurement

The study's outputs were energy intake in kcal/day and protein intake in g/day, measured before and after the education program. Participant characteristics included age, education, and trimester of pregnancy. The source text mentions the use of a questionnaire but does not explain the instrument for assessing consumption and converting it into nutrients.

The selection and reporting of intake assessment methods should take into account inter-day variation in consumption, the accuracy of portion sizes, and the completeness of the food composition database (Food and Agriculture Organization of the United Nations [FAO], 2018).

Data analysis

Data processing was performed using SPSS [complete version]. Participant characteristics are presented as frequencies and percentages. Energy and protein intakes are presented as mean $\pm$ standard deviation (SD), with the difference calculated as the mean minus the pre-education mean. The source table contains $p = 0.001$ for both outcomes, but the test type and analysis output are not yet available.

Reporting of evaluations without randomization needs to clarify participant flow, intervention implementation, and potential bias according to TREND, while statistical reporting needs to state the method and uncertainty of estimates according to SAMPL (Des Jarlais et al., 2004; Lang & Altman, 2015).

RESULTS**Participant characteristics**

Thirty pregnant women were included in the characteristics data. Most were aged 20–35 years (23 women; 76.7%), had a high school education (14 women; 46.7%), and were in their second trimester (13 women; 43.3%). The distribution of participants is presented in Table 1.

Table 1. Characteristics of pregnant women in Tukka Village (n = 30)

Characteristics	n	%
Age <20 years	3	10.0
Age 20–35 years	23	76.7
Age >35 years	4	13.3
Elementary School Education	4	13.3
Junior High School Education	8	26.7
High School Education	14	46.7
College education	4	13.3
First trimester	6	20.0
Second Trimester	13	43.3
Third Trimester	11	36.7

Note: Percentages are calculated using a denominator of 30 and rounded to one decimal place; amounts in the education category may differ slightly from 100% due to rounding.

Changes in energy and protein intake

Mean energy intake increased from $1,645 \pm 285$ kcal to $1,980 \pm 270$ kcal/day, a difference of 335 kcal/day. Mean protein intake increased from 55.8 ± 12.4 g to 69.7 ± 11.8 g/day, a difference of 13.9 g/day. These differences equate to increases of approximately 20.4% and 24.9%, respectively, compared to the baseline average for energy and protein. These percentages represent a comparison of group means, not the average percentage change per participant.

Table 2. Energy and protein intake before and after nutrition education

External	Before Mean $\pm$ SD	After Mean $\pm$ SD	Average difference	p reported*
Energy (kcal/day)	$1,645 \pm 285$	$1,980 \pm 270$	335	0.001
Protein (g/day)	55.8 ± 12.4	69.7 ± 11.8	13.9	0.001

*The p-value is copied from the source manuscript table and has not been verified. The test name, number of complete data pairs, test statistic, and SPSS output must be confirmed before submission. SD = standard deviation. Difference = post - pre. Confidence intervals and pairwise effect sizes cannot be

calculated because individual data or SD of the difference are not available. Do not assume this p value is derived from a paired t-test without checking the original analysis.

Data on KEK status based on LiLA, changes in body weight, and birth outcomes were not available in the source text and therefore were not presented as research results.

DISCUSSION

This study showed that mean reported energy and protein intakes were higher after local food-based nutrition education. Increases of 335 kcal/day and 13.9 g/day indicate changes in consumption in the observed groups. However, these findings should be interpreted as before-after changes, as the study design did not provide a comparison group and inferential analysis cannot be verified.

The direction of these changes aligns with evidence that nutrition education and counseling during pregnancy can improve dietary intake. Girard and Olude (2012) and Ota et al. (2015) reported benefits for several nutrition and health outcomes, with variations by intervention and participant condition. Dewidar et al. (2023) showed that interactive counseling can increase energy and protein intake. The similarity in the direction of the results supports the feasibility of further developing the education program, but the magnitude of changes between studies cannot be directly compared regardless of intervention intensity and measurement method.

Using examples of everyday foods can help translate nutrition messages into more concrete menu choices. Materials on rice, tubers, fish, eggs, tempeh, tofu, and nuts provide examples of combinations of energy and protein sources. However, this study did not measure price, availability, cultural acceptability, or family food security. Therefore, affordability and sustainability of benefits remain possibilities that need to be tested. Local food policies and UNICEF reports emphasize the need to address access to nutritious diets and the structural barriers faced by women (Ministry of Health of the Republic of Indonesia, 2023; UNICEF, 2023).

Print media can support education because participants can reread the messages. Research by Nahrisah et al. (2020) used picture books alongside counseling for pregnant women with anemia; the results are relevant for nutrition communication, but do not isolate the benefits of print media alone. Research by Permatasari et al. (2021) also showed that education tailored to mothers' needs can improve knowledge, attitudes, and practices. In the Tukka study, knowledge, media readability, reading frequency, and adherence to the materials were not measured or reported, so the mechanisms of change cannot be ascertained.

Controlled studies by Demilew et al. (2020a, 2020b) and Beressa et al. (2024) showed that counseling or education using behavioral models can improve eating practices, dietary diversity, or nutritional status. However, these studies did not report measures of Health Belief Model constructs or other behavioral theories. The findings in Tukka cannot yet be used to suggest that perceptions of vulnerability, motivation, or self-efficacy changed; behavioral theories could inform future research designs.

An increase in intake does not automatically mean that all participants' nutritional needs have been met. Assessments should take into account age, trimester, and individual needs based on the RDA, rather than using a single requirement for all pregnant women (Ministry of Health of the Republic of Indonesia, 2019). Daily variations and misreporting of consumption also need to be considered when interpreting group averages (FAO, 2018). Without data on the Life Cycle Activity (LiLA) and weight monitoring, this study cannot conclude that the risk of CED is reduced.

Implications for birth outcomes require separate assessment. Jahan et al.'s (2014) study assessed nutrition education alongside pregnancy outcomes in Bangladesh, while Keats et al.'s (2021) review and WHO guidelines (2016) placed education within the continuum of maternal interventions. This evidence supports the development of nutrition services, but does not prove that the education in this study reduced low birth weight (LBW) or birth complications. For practical purposes, local food materials can be considered as a complement to antenatal counseling, accompanied by nutritional status assessment and follow-up as needed.

Research limitations

The single-group design without a control group is susceptible to changes related to gestational age, other antenatal care services, changes in food availability, repeated measures effects, and regression to the mean. The sample size was limited to 30 participants from a single sub-district, thus limiting generalizability. Methods for assessing consumption, intervention dosage, measurement intervals, and

completeness of paired data need clarification. Dietary reporting may also be influenced by recall and the tendency to provide answers deemed appropriate after education. The absence of anthropometric and birth outcome data limits clinical interpretation. Future research requires a control group, standardized consumption measurements, nutritional status monitoring, and comprehensive intervention and statistical reporting (Des Jarlais et al., 2004; Hoffmann et al., 2014; Lang & Altman, 2015).

CONCLUSION

In 30 pregnant women in Tukka Village, the average reported energy intake increased by 335 kcal/day and protein intake by 13.9 g/day after local food-based nutrition education. These findings indicate changes in consumption in the observed group. The design without a control group and limitations in reporting measurements and analysis limit conclusions regarding the effectiveness of the intervention. Reduction in CED risk and improvement in birth outcomes are inconclusive.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest in this research.

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