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Effectiveness of Module Education on Fetal Growth among Chronic Energy Deficient Pregnant women in Kendari, Indonesia

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ABSTRACT Fetal growth during pregnancy serves as a critical indicator of fetal well-being and is strongly influenced by maternal health, particularly nutritional status. Chronic Energy Deficiency (CED) in pregnant women remains a significant public health concern in Indonesia, often leading to low birth weight, intrauterine growth restriction (IUGR), and increased risk of neonatal morbidity and mortality. Despite efforts to reduce maternal and fetal complications, educational strategies that effectively address maternal behavior in pregnancy care remain underutilized. This study aimed to evaluate the effectiveness of educational interventions particularly through structured maternal classes using modules on improving knowledge, attitude, and behavior regarding pregnancy care among CED pregnant women in Kendari, Indonesia. A quasi-experimental design with pre- and post-tests was implemented, involving two groups: one receiving maternal classes using a pregnancy care module (intervention group) and another receiving only the standard Maternal and Child Health (MCH) handbook (control group). The study involved 60 pregnant women with CED selected through simple random sampling. Data collection employed validated questionnaires and measurement tools, and statistical analysis was conducted using Wilcoxon and Kruskal-Wallis tests. The findings revealed significant improvements in knowledge, attitude, and pregnancy care behavior in the intervention group compared to the control group ($p < 0.05$). The module-based education was effective in facilitating positive behavioral changes in maternal care, which has direct implications for improving fetal outcomes. In conclusion, integrating structured educational modules into antenatal care programs is a valuable strategy to enhance maternal self-efficacy, promote health-seeking behavior, and potentially reduce adverse pregnancy outcomes among high-risk groups.

INDEX TERMS Pregnant women, maternal education, fetal growth, chronic energy deficiency, antenatal care.

I. INTRODUCTION

Fetal growth is a vital determinant of neonatal health and a key marker of successful pregnancy outcomes. Optimal fetal development is closely linked to maternal well-being, particularly nutritional status, which directly influences fetal size, weight, and organ development. In Indonesia, the prevalence of Chronic Energy Deficiency (CED) among pregnant women remains high, contributing to increased rates of low birth weight (LBW), intrauterine growth restriction (IUGR), and perinatal mortality [1]-[5]. This condition often goes undetected in routine antenatal visits, especially in low-resource settings where knowledge gaps and cultural practices hinder health-seeking behavior [6]-[9].

Current public health initiatives have made strides in addressing maternal and infant mortality, yet challenges persist in promoting consistent, behavior-based pregnancy care. The first 1000 days of life, spanning conception to a child's second birthday, is considered a critical developmental window. Inadequate care during this period may result in irreversible physical and cognitive impairments [10]-[12]. Despite the availability of services such as

antenatal counseling and nutritional support, utilization remains low, particularly among mothers with limited knowledge and socioeconomic constraints [13], [14].

Education has been widely recognized as a cost-effective and sustainable approach to improve maternal outcomes. Health promotion through structured pregnancy classes and the use of educational modules enables women to gain critical knowledge about fetal development, dietary requirements, danger signs in pregnancy, and available services [15]-[18]. Evidence suggests that maternal classes improve not only knowledge but also attitude and behavioral practices related to pregnancy care [19], [20].

However, the literature indicates a research gap in understanding the comparative effectiveness of different educational delivery models, particularly in high-risk populations such as CED mothers. While the Maternal and Child Health (MCH) handbook is widely distributed in Indonesia, its passive nature may not be sufficient to drive behavioral change without interactive reinforcement [21], [22]. This highlights the need for alternative, active learning

strategies such as module-based maternal classes that engage women in participatory education.

This study aims to assess the effectiveness of educational modules in improving knowledge, attitude, and behavior of CED pregnant women regarding pregnancy care in Kendari, Indonesia. The study seeks to:

1. Evaluate the extent to which structured maternal education can enhance pregnancy-related knowledge in women with CED.
2. Examine changes in maternal attitudes and behaviors following module-based interventions.
3. Provide evidence-based recommendations for improving antenatal education in similar resource-limited settings.

The structure of this article is as follows: Section II details the methodology including research design, participants, and data analysis techniques. Section III presents the research findings. Section IV provides a critical discussion and interpretation of results, followed by Section V which outlines the conclusion and implications for maternal health policy.

II. METHOD

This study utilized a quasi-experimental design with a pretest-posttest control group approach, aimed at evaluating the effectiveness of educational interventions in improving knowledge, attitudes, and behaviors related to pregnancy care among pregnant women with Chronic Energy Deficiency (CED) in Kendari, Indonesia. The research was conducted in two community health centers (Puskesmas): Puuwatu (intervention group) and Mekar (control group).

A. STUDY POPULATION AND SAMPLING

The population of this study comprised all pregnant women diagnosed with CED in Kendari City during the research period. A total of 60 participants were selected through simple random sampling, divided equally into two groups (30 per group). Inclusion criteria included pregnant women in the second or third trimester, diagnosed with CED (based on Mid-Upper Arm Circumference < 23.5 cm), and willing to participate by providing informed consent. Exclusion criteria included comorbid complications or refusal to complete the full intervention program.

B. INTERVENTION PROTOCOL

The intervention group received a structured educational session in the form of maternal classes conducted over a period of four weeks, supported by a module developed based on guidelines from the Indonesian Ministry of Health. The control group did not receive maternal classes but was provided with the standard Maternal and Child Health (MCH) handbook as a passive educational resource. Both groups underwent pretest and posttest evaluations using validated instruments.

The educational module focused on pregnancy care, fetal development, nutritional needs, risk signs, and self-care strategies. The delivery of sessions was interactive, involving group discussions, visual media, and take-home reading materials. The control group received no such structured learning.

C. INSTRUMENTS AND MEASUREMENT

Two primary instruments were used in this study:

1. Knowledge Questionnaire: Comprising 20 dichotomous items (correct/incorrect) developed using the Guttman scale. Correct answers were scored "1", and incorrect answers were scored "0". The instrument demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.701, indicating good reliability [23].
2. Attitude Questionnaire: Comprising 20 items using a 5-point Likert scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). This questionnaire also underwent a reliability test, resulting in a Cronbach's alpha of 0.690 and interclass correlation ranging between 0.610 to 0.778, which indicates a moderate to strong level of reliability and internal consistency [24].

Both instruments were validated through face and content validity assessments by subject-matter experts, and pilot-tested among 30 pregnant women not included in the final study.

D. DATA COLLECTION PROCEDURE

The initial data collection took place in October 2017, followed by the intervention in November 2017. After obtaining written informed consent, screening was performed to ensure eligibility. Participants were then allocated into either the intervention or control group. The intervention consisted of weekly educational sessions over four weeks, conducted by trained midwives and monitored by researchers. Each session lasted approximately 45–60 minutes.

Data were collected by three trained researchers, assisted by local midwives from the respective health centers. All participants completed pre- and post-intervention questionnaires under supervision to minimize bias and ensure completeness.

E. DATA ANALYSIS

Data were processed using SPSS version 23. Descriptive analysis was conducted to summarize demographic variables. The effectiveness of the intervention was evaluated using:

1. Wilcoxon signed-rank test: to analyze changes within groups (pre-post).
2. Kruskal-Wallis test: to assess differences between groups (intervention vs control).

A significance level of $p < 0.05$ was considered statistically significant [25].

F. ETHICAL CONSIDERATIONS

Collected this study obtained ethical clearance from the Health Research Ethics Committee of Poltekkes Kemenkes Kendari prior to data collection. Participation in the study was entirely voluntary, and written informed consent was obtained from all participants or their legal guardians. Confidentiality and anonymity were strictly maintained throughout all stages of the research process. No financial incentives or compensation were provided to the participants. Moreover, participants had the right to refuse or

withdraw from the study at any time without facing any form of penalty or negative consequences.

III. RESULTS

This study Characteristics of respondents are characteristics inherent in the respondent including age, ethnicity, education, occupation, history of disease, and parity. Mother's age ranged from 18 years to 35 years. Th on the safe age for pregnancy and childbirth is 20-35 years. So the age grouping is < 20 years and 20-35 years. The original Kendari tribes are Muna, Tolaki, Buton. The other tribes are immigrants so they are classified differently. Education is categorized according to the level of education completed.

TABLE 1
Characteristics of Respondent

Characteristics	Group				P
	1		2		
	n (30)	%	n (30)	%	
Age					0.516
< 20	3	10,0	3	10,0	
20-35	27	90,0	27	90,0	0.328
Ethnic					
Muna	6	20,0	6	20,0	
Buton	3	10,0	1	3,3	
Tolaki	17	56,7	22	73,3	
lainnya	4	13,3	1	3,3	0.495
Education					
SMA	29	96,7	27	90,0	
DIploma	0	0	1	3,3	
S1	1	3,3	2	6,7	0.335
Work					
Work	2	6,7	4	13,3	
No work	28	93,3	26	86,7	0.500
Illness History					
No	28	93,3	29	96,7	
Yes	2	6,7	1	3,3	0.500
Parity					
Prime	1	3,3	0	0	
Multi	29	96,7	30	100	

Source: Primary Data Information:

Group 1: Intervention group

Group 2: Control Group

Employment status is divided based on working and not working. Medical history is the presence or absence of diseases suffered by the mother during pregnancy. Parity is the number of children who have been born alive. Parity was differentiated into nullipara (parity 0, pregnant for the first time) and primipara (parity 1) and multipara if the mother had given birth at least 2 times. Characteristics of respondents can be seen in **TABLE 1**.

TABEL 2
Changes in The Knowledge Scores of Respondents Before and After Intervention Based On Intra-Group

Knowledge	Pre test	Post
Group 1 (n=30)	7,90±2,52	13,47±0,68 (0.000)
Group 2 (n=30)	6,73±2,44	7,07±2,52 (0.000)

TABLE 2 shows that all respondents had increased knowledge compared to the pre-test measurements. This shows that there is a difference in knowledge in the pre-test with post-test measurements. The results of statistical tests with Wilcoxon show that respondents' knowledge

scores began to be significant in the post test in all groups.

TABLE 3
Changes in Respondents' Attitude Scores Of Respondents Before and After Intervention Based On Intra-Group

Attitude	Pre test	Post
Group 1 (n=30)	5,83 ±1,88	9,03±0,85(0.000)
Group 2 (n=30)	5,87± 2,51	5,70 ± 1,34 (0,000)

TABLE 3 shows that the increase in respondents' attitudes began to be significant in the second measurement (post-test), namely in all groups. The results of the statistical test with Wilcoxon showed that respondents' attitude scores began to be significant in the post test in both groups. This shows that there is an influence of education on changes in respondents' attitudes.

TABLE 4
Changes in Respondents' Behavior Scores of Respondents Before and After Intervention Based on Intra-Groups

Behavior	Pre test	Post
Group 1 (n=30)	9,20 ± 2,455	14,13± 0,94(0.000)
Group 2 (n=30)	8,77 ± 2,37	9,30 ± 2,26 (0,000)

TABLE 4 shows that all respondents had increased pregnancy care behavior compared to the initial measurements. The results of the statistical test with Wilcoxon showed that the respondent's pregnancy care score began significantly in the post test in both groups. This shows that there are differences in gestational care behavior at the beginning of the measurement with the second measurement.

IV. DISCUSSION

A. INTERPRETATION OF RESULTS

The findings of this study demonstrate that education through structured maternal classes using a module significantly enhances knowledge, attitudes, and behaviors of pregnant women with chronic energy deficiency (CED) regarding pregnancy care. The pre- and posttest results show a marked improvement in all three outcome domains within the intervention group compared to the control group. These results affirm the cognitive-behavioral learning theory, which posits that interactive education facilitates long-lasting internalization of health-related knowledge and practices [31].

The notable increase in post-intervention knowledge scores implies that the module delivered in maternal classes was effective in conveying essential concepts about nutrition, fetal health, and antenatal care. Furthermore, significant improvements in attitudes reflect not only cognitive acceptance but also emotional and motivational readiness to act upon learned information. Lastly, enhanced behavioral scores indicate that participants translated knowledge and attitude into tangible pregnancy care actions, aligning with previous findings that behavioral change is most likely when supported by both understanding and belief [32].

B. COMPARISON WITH PREVIOUS STUDIES

These results are in line with findings from studies conducted in other low-resource settings. For example, Turan et al.

reported similar outcomes from community-based antenatal education programs in Turkey, which led to better health service utilization and pregnancy preparedness [33]. Likewise, Shimpuku et al. found that family-oriented education models in East Africa significantly improved maternal awareness and reduced delays in seeking care [34].

Compared to passive learning through the standard Maternal and Child Health (MCH) handbook, this study supports arguments made by Brixval et al., who noted that small-class interventions enhance learning retention and psychosocial engagement [35]. Group-based learning has the advantage of fostering peer discussion, addressing local myths, and enhancing motivation factors which are limited in passive educational formats.

The significance of this study lies in its population pregnant women with CED who represent a particularly vulnerable demographic. Studies by Mizawati & Patroni emphasized that targeted interventions for malnourished pregnant women significantly reduce the risk of poor fetal outcomes and improve maternal health literacy [36].

C. LIMITATIONS AND IMPLICATIONS

Despite its promising outcomes, this study has certain limitations. First, the sample size ($n=60$) limits generalizability to broader populations. While simple random sampling was employed, future studies may benefit from stratified or cluster sampling to capture more demographic variation. Second, the duration of the intervention (4 weeks) may not fully capture long-term behavioral changes, and follow-up assessments were not conducted to determine whether the gains were sustained beyond delivery.

Third, the intervention's delivery was resource-dependent, involving trained midwives, structured modules, and interactive sessions factors that may limit scalability in remote or under-resourced settings. However, the findings provide a basis for designing cost-effective, community-level antenatal education programs, which can be adapted to different localities by involving community health workers.

The implications of this study are twofold. Clinically, it suggests that structured educational interventions should be incorporated into routine antenatal care to improve maternal and fetal outcomes, particularly in women with nutritional deficiencies. From a policy perspective, the findings advocate for the standardization and institutionalization of maternal classes within national maternal health programs.

V. CONCLUSION

This study aimed to evaluate the effectiveness of educational interventions specifically, pregnancy classes utilizing modules on improving knowledge, attitudes, and behaviors related to pregnancy care among pregnant women with chronic energy deficiency in Kendari, Indonesia. The findings demonstrated that the provision of structured education significantly enhanced maternal understanding and practices regarding antenatal care. Quantitatively, the intervention group showed a marked improvement in knowledge scores from 7.90 ± 2.52 to 13.47 ± 0.68 , attitude scores from 5.83 ± 1.88 to 9.03 ± 0.85 , and behavioral scores from 9.20 ± 2.455 to 14.13 ± 0.94 , all with p-values of 0.000 indicating high statistical significance.

In contrast, the control group, which received only the standard MCH handbook, exhibited minimal changes in these domains. These outcomes underscore the positive impact of interactive educational modules in facilitating sustainable behavior change in maternal health practices. Moreover, the significant improvements observed in the intervention group reinforce the importance of active learning strategies over passive informational dissemination. Given the persistent challenges of maternal morbidity, low birth weight prevalence, and nutritional deficiencies in developing regions, these findings suggest that embedding comprehensive antenatal education into routine maternal healthcare services can serve as an effective strategy to improve maternal and fetal outcomes. Future research should expand this study by incorporating larger and more diverse populations, extending follow-up periods to assess long-term impacts on neonatal and maternal health, and evaluating the cost-effectiveness and scalability of such educational models in varied healthcare settings. Furthermore, qualitative assessments of participant experiences may provide deeper insight into cultural, emotional, and systemic barriers affecting educational intervention uptake. Integrating these findings into national maternal health policies could potentially contribute to the reduction of pregnancy-related complications and support the broader goal of enhancing maternal and child health indicators in Indonesia and similar contexts.

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DATA AVAILABILITY

No datasets were generated or analyzed during the current study.

AUTHOR CONTRIBUTION

All authors contributed substantially to the development of this study. Halijah conceptualized and designed the study, supervised data collection, and led the manuscript preparation. Elyasari performed data analysis and contributed to the interpretation of results. Wahida was responsible for the instrument development and participant recruitment. Kartini assisted in the literature review and manuscript revision. All authors reviewed and approved the final version of the manuscript for submission.

DECLARATIONS

ETHICAL APPROVAL

The authors declare no conflict of interest related to this publication. Ethical approval was obtained from the Health

Research Ethics Committee of Poltekkes Kemenkes Kendari prior to conducting the study. Informed consent was obtained from all participants. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONSENT FOR PUBLICATION PARTICIPANTS.

Consent for publication was given by all participants

COMPETING INTERESTS

The authors declare no competing interests.

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