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A Quasi-Experimental Study in West Java on the Effects of Educational Interventions on Knowledge and Prevention Behaviors of Pregnant Women with Chronic Energy Deficiency (CED) in the Prevention of Stunting

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ABSTRACT
Serious health problems occur when children with stunting, a condition caused by poor nutrition and attention, are affected. Raising mothers' awareness could empower them and change their behavior in terms of stunting prevention. The purpose of this study is to investigate how education can help pregnant women with CED become more knowledgeable about how to prevent stunting in their unborn children. To gauge knowledge gain, the study employed a quasi-experimental approach using questionnaires and educational sessions. Pregnant women with chronic energy deficiencies were recruited in the study to learn how to prevent stunting in their offspring. The intervention's efficacy was evaluated using the Wilcoxon test, and the most important component avoiding stunting was determined by multiple linear regression. Pregnant participants in the study had better understanding of stunting behaviors ($p = 0.009$) and prevention ($p = 0.019$). It's interesting to note that there was no statistically significant improvement in knowledge scores overall (10.08 to 10.52; $p = 0.053$). Subsequent investigation showed that whereas pre-intervention behavior scores did not significantly affect improvement in prevention knowledge ($p = 0.786$), pre-intervention knowledge ($p = 0.011$) was the most significant factor driving this change.

Keywords: education, preventive, behavior, chronic energy insufficiency, stunting

1. INTRODUCTION

A child's growth potential is not fulfilled due to insufficient nutrition, health, or care, it is referred to as stunting. This delayed growth may have major, long-term implications on the body and mind.

Although stunting rates have decreased internationally, especially in developing nations, an estimated 144 million children under the age of five—or 21.3% of all children—continue to have stunted growth. This disorder has serious health repercussions and is characterized by limited height development as a result of inadequate nourishment and care. Compared to their healthy peers, children with stunted growth are more likely to pass away from illnesses like pneumonia and diarrhea.[1,2]

A child's nutrition may be impacted by stunting due to both direct and indirect reasons. This includes a child's sex, birth weight, and other direct influences like food availability and illnesses. Breastfeeding habits, availability to healthcare, and family traits like wealth and education are examples of indirect variables. Notably, there is a clear correlation between a child's increased risk of stunting and lower parental education, especially among mothers. The health of a mother's offspring is directly impacted by her level of nutrition understanding. Strong nutritional understanding allows mothers to feed their toddlers more selectively, giving them the

nutrients they require. On the other hand, women with inadequate awareness might not give priority to these activities, so putting their children at risk for malnourishment and stunting.[3,4]
In some areas of Indonesia, chronic energy deficiency (CED) in pregnant women is a serious issue. This disorder is associated with childhood stunting; chronic energy deficiency affects 27% of pregnant women. Preterm births, small-for-gestational-age or low-birth-weight newborns, stillbirths, and other pregnancy and childbirth difficulties are all markedly increased in cases of chronic energy shortage prior to conception. Furthermore, moms who have CED may experience reduced productivity as well as an increased risk of illness and mortality. The likelihood of malnutrition in children born to women with CED is higher. Long-term effects may result from this, including reduced growth capacity, impaired cognitive development, and increased susceptibility to disease and death.[5,6]

2. MATERIALS AND METHODS

2.1.1. Study design, setting, and participants

The design of this study is a quasi-experimental design with the aim to test the hypothesis that education regarding stunting, behavioural aspects, and prevention of stunting will increase maternal knowledge of stunting. This knowledge increment is hoped to further initiate mothers' behavioural change thus preventing stunting in the children born. The study was done in Kuningan, West Java in 2023, with the location chosen due to the convenience of sampling techniques.

2.1.2. Sampling and collection procedure

The sample size for this study was determined using the Lemeshow formula with the minimum sample size of 102 subjects. The participants included in the study were chosen by consecutive sampling method. A total of 305 mother was found in the area, with 102 having CED. With the inclusion criteria of mothers with CED during the research period, pregnant women consenting being respondents by informed consent, pregnant women with good memory, and pregnant women who were able to communicate well and exclusion criteria of pregnant women with complications and/or incomplete antenatal data, all 102 mothers were finally selected in the study. Data were collected by pre-interventional questionnaire to determine mothers' nutritional status and other demographic data, pre-test, and post-test using questionnaire to understand subjects' knowledge in stunting and its related behavioural and prevention aspects.

2.1.3. Survey questionnaire and educational method

The subjects included in the study was given a questionnaire of 10 set of questions regarding the general knowledge of stunting, 10 set of questions regarding the behavioural causes of stunting, and also 10 set of questions regarding the prevention of stunting. Each question of the knowledge questions consists of 2 Right/Wrong answers, with the score of each question of 1. Each question of the behaviour questions consists of 2 Yes/No answers, with the score of each question of 1. Each question of the prevention questions consists of 4 frequency-based (always, often, seldom, and never) answers, with the score of each question of 4. A maximum score of 12, 11, and 40 and minimum score of 0, 0, and 10 is obtainable through the questions, consecutively for knowledge, behaviour, and prevention aspects. These questionnaires are used as both pre-test and post-test of the interventional education given to the subjects. For the general knowledge questionnaire, all the items were valid and had excellent reliability ($\alpha = 0.93$). All items from the behavior questionnaire were also valid and had near excellent ($\alpha = 0.88$) reliability. Lastly, items from the prevention questionnaire were also deemed valid and had good reliability ($\alpha = 0.82$).
After the pre-test, the subjects were then given education and empowerment through interactive presentation regarding stunting, behaviour, and prevention. All aspects in the previously stated questionnaire were presented in the education through a pocketbook containing information about stunting prevention and good nutritional behaviors for pregnant women with CED. This pocketbook was designed to be simple and easy to understand, with the aim of providing a practical guide that could be accessed at any time by the study participants.

2.1.4. Statistical analysis

The analysis in this study was done using the SPSS 29 nutritional status) of the subjects and presented the data in a table. Normality test was done using the Komolgorov-Smirnof method due to the sample number being above 50, with tests showing non-normal distribution of data. A bivariate analysis using the Wilcoxon test was done due to the sample being paired, with data presented by table. A further multiple regression analysis was then done to understand which factors significant in the bivariate analysis is significant in the multivariate analysis.

2.1.5. Ethical approval and informed consent statement

We obtained ethical clearance from Faculty of Medicine Universitas Hasanuddin the ethical clearance reference number is 6529/UN4.14.1/TP.01.02/2023

3. RESULTS

This study included 54 pregnant women with chronic energy deficiency (CED) as subjects. The majority of participants were between the ages of 20 and 45 years old, with an average age of 28.3 years. Most of the participants (84.3%) had low levels of education, with only 1.0% completing high school. Economically, 96.1% of the participants came from low-income households, and the average household size was between 3 to 5 members. In terms of health, all participants had a body mass index (BMI) indicative of moderate to severe chronic energy deficiency. Additionally, 55.9% of the women were multiparous, and 70.6% were in their second trimester during the study period.

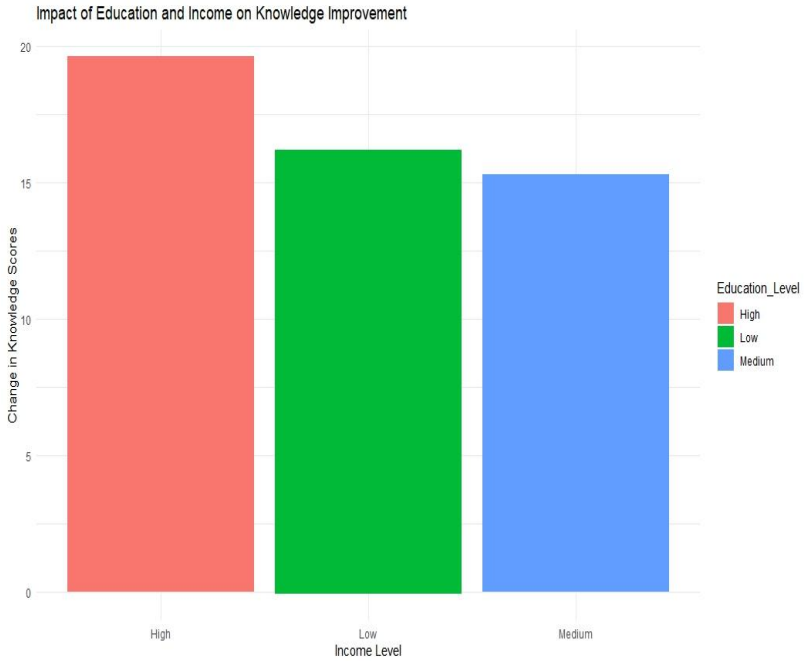

Figure 1. Impact of Educational Intervention on Knowledge Scores Related to Stunting Prevention.

In this study, bivariate analysis of the pretest and posttest found that there is a significant increase of knowledge in the behavioural (p = 0.009) and prevention (p = 0.019) of stunting in the CED pregnant women. In the knowledge section, there is an increase of mean score with pre-test score of 10.08 (SD 1.38) and post-test score of 10.52 (SD 0.84). However, the score increment was not found to be significant statistically (p = 0.053). The details of the bivariate analysis could be found in Table 1.

Table 1. Bivariate analysis of the pre-test and post-test

Variable	Mean	SD	Median	Minimum	Maximum	P value
Pre-test knowledge	10.08	1.38	10.00	5.00	12.00	0.053
Post-test knowledge	10.52	0.84	10.00	9.00	12.00	
Pre-test behaviour	9.42	0.95	10.00	6.00	11.00	0.009
Post-test behaviour	9.92	0.72	10.00	8.00	11.00	
Pre-test prevention	33.74	3.08	34.00	25.00	40.00	0.019
Post-test prevention	34.92	2.85	35.00	28.00	40.00	
* Wilcoxon test						

Figure 2. Improvement in Behavioral Scores Among CED Pregnant Women After Education

Multivariate analysis was conducted to identify the factors that influence prevention. Multiple linear regression was employed to determine the most dominant factor affecting prevention. The regression analysis results are in the form of coefficients for each independent variable. These coefficients are obtained by predicting the value of the dependent variable using an equation. The t-test indicates the extent to which the influence of each independent variable individually explains the variation of the dependent variable. Based on Table 2, it can be used to determine whether the independent variable has a significant effect on the dependent variable.

Table 2. Multiple linear regression analysis

Variable	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig**
	B	**Std. Error**	**Beta**		
Pre-test (knowledge)	0.252	0.161	0.273	2.132	0.038
Pre-test (behaviour)	0.339	0.118	0.331	2.602	0.012
Dependent variable: Pre-test prevention					

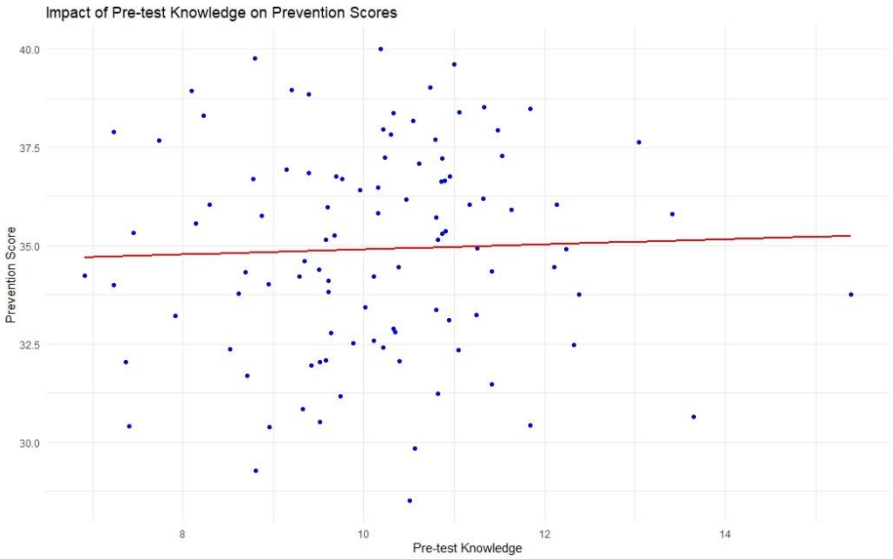

Figure 3. Changes in Prevention Knowledge Scores Pre- and Post-Intervention

The result of the test of partial influence significance on the knowledge variable yielded a significance of 0.011, concluding that the hypothesis stating that knowledge has an effect on prevention can be accepted. The result of the test of partial influence significance (t-test) on the attitude variable yielded a significance of 0.786, concluding that the hypothesis stating that attitude has an effect on prevention cannot be accepted.

The coefficient of determination measures the ability of the model to explain the variation of the dependent variable, finding the value of R^2 of 0.139, meaning that 13.9% of the variation in prevention can be explained by the variation of the two independent variables, while the rest (100% - 13.9% = 86.1%) is explained by other causes outside the model.

The F-test indicates whether all the independent variables included in the model have a combined effect on the dependent variable. The result of the F-test calculation is shown in Table 3. Based on the ANOVA or F-test, the calculated F value is 3.803 with a probability level of 0.029, showing the use of regression model in predicting the prevention variable or it can be said that the independent variables together have a significant effect on the prevention variable.

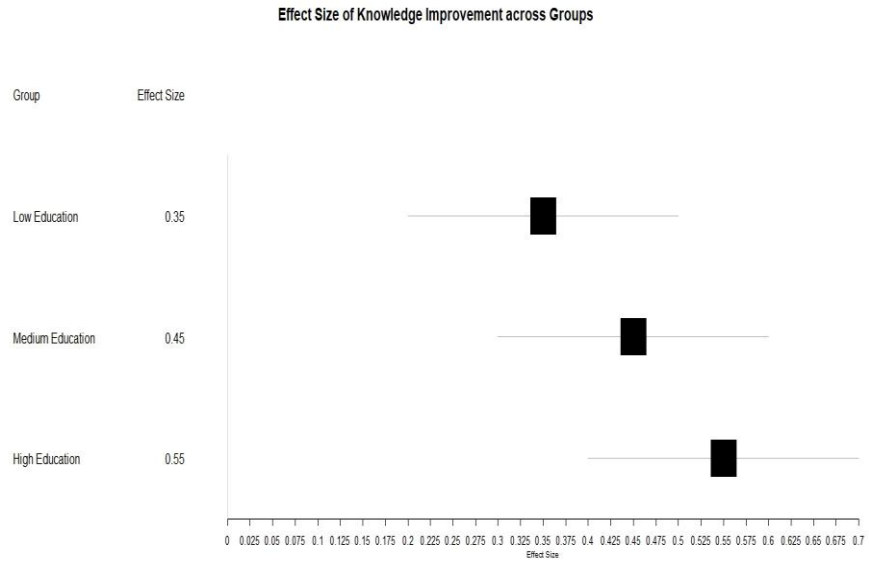

Figure 4. Multiple Linear Regression Analysis of Factors Affecting Prevention Knowledge.

Table 3. Simultaneous significance test (F statistic test)

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	69.891	2	34.946	3.803	.029[b]
Residual	431.889	47	9.189		
Total	501.780	49			
b. Predictors (Constant), Behaviour pre-test, and Knowledge pre-test					

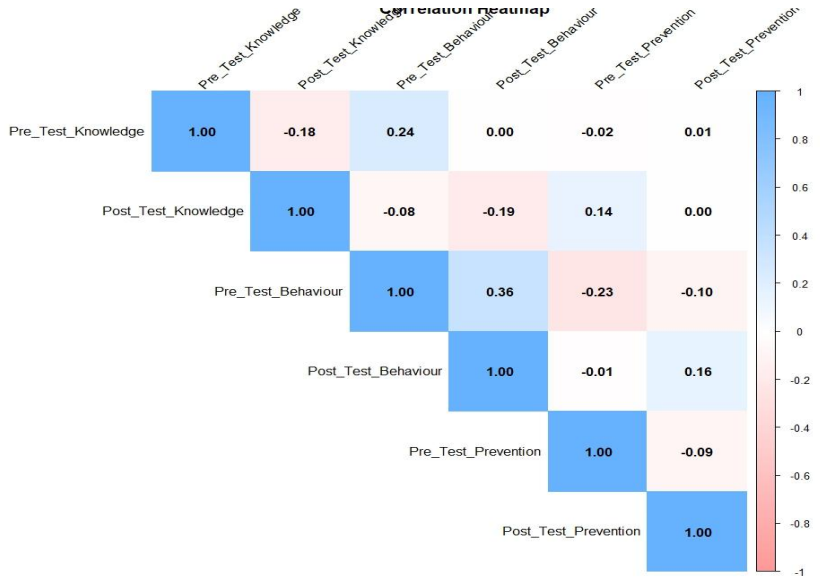

Figure 5. Correlation Heatmap of Knowledge, Behavior, and Prevention Scores Pre- and Post-Intervention.

The analysis of the correlation among various pre-test and post-test scores of knowledge, behavior, and prevention reveals insightful patterns pertinent to the educational interventions implemented for pregnant women with chronic energy deficiency (CED). The Correlation Heatmap illustrates a positive correlation (r = 0.24) between Pre-Test Knowledge and Post-Test Knowledge, indicating that participants who entered the intervention with a higher baseline knowledge level were more likely to maintain or enhance their understanding post-intervention. A stronger correlation (r = 0.36) was observed between Pre-Test Behavior and Post-Test Behavior, suggesting that pre-existing positive behaviors were likely reinforced through the educational approach. Conversely, the correlation between Post-Test Knowledge and Post-Test Behavior (r = 0.14) indicates that increased knowledge did not consistently result in improved behaviors related to stunting prevention. Furthermore, the correlations involving Pre-Test Prevention were generally weak, underscoring a potential disconnect between knowledge acquisition and practical application in preventive measures.

4. DISCUSSION

This study found that amongst 54 women with CED included in the study, the majority were aged between 20 and 45 years old, with an average age of 28.3 years. Approximately 84.3% of the participants had a low education level, with only 1.0% having completed high school. Most participants (96.1%) came from low-income households, with an average of 3-5 household members. Additionally, the majority of participants had a body mass index (BMI) indicating moderate to severe chronic energy deficiency.

This study found that pregnant women with CED showed a significant increase in knowledge about stunting prevention behaviors (p = 0.009) and overall prevention knowledge (p = 0.019) after the intervention. This finding may be related to external and internal factors. Internally, we hypothesize that this finding was related to increased interaction with healthcare providers. However, previous result showed that pregnant women with CED had lower ANC visit compared to without pregnant women without CAD.[7,8]Hence, the quality of education and nutritional counseling by healthcare providers on giving education on maternal and child health, including the risks and complications of CED and prevention of stunting for maternal CED during routine ANC may elucidate the finding. Internal factors such as self-awareness and perception regarding the risks and complication of CED may affect the behaviors and knowledge of stunting prevention. These awareness and perception were related to individuals' status, such as maternal age and maternal education.[9]Younger or older maternal age (<20 or >35 years old) and low education status were showed to yield less perception regarding CED and stunting[10] along with higher CED incidence.[11]Moreover, economic status and number of household was also related to CED, although no study explain the relationship between these factors with self-awareness or perception.[12]

Despite the increased mean knowledge score from pre-test to post-test, we found no significant difference (p = 0.053) of this variable. Several factors may explain this finding, such as baseline knowledge, literacy levels, the education reach, and the measurement methods. The proportion of pregnant woman with adequate knowledge regarding CED may yield lesser increase of knowledge score compared to pregnant woman with inadequate knowledge. The no blinding measurement methods in this arise the risk of bias in reporting the result, which become the limitation of this study. The other factors such as literacy levels and the education reach were not assessed in this study. Moreover, despite the insignificant differences, it is hard to tell whether the differences were clinically significant due to lack of control group. The use of a pocketbook as an educational tool made it easier for pregnant women with CED to access information beyond formal sessions. This pocketbook served as an empowering resource, supporting long-term behavior change. Previous studies have shown that printed materials like pocketbooks can effectively improve health knowledge, particularly in populations with varying literacy levels. By providing accessible information, the pocketbook reinforced knowledge and facilitated behavior change.

Multivariate analysis in this study revealed that pre-test knowledge was the most dominant factor influencing prevention knowledge scores (p = 0.011). Previous study demonstrated that adequate baseline knowledge of CED was associated with lower incidence of CED.The low level of knowledge regarding CED or nutrition during pregnancy was related to more deviant eating behaviors, limiting the ability of the pregnant woman to choose the appropriate foods. Moreover, the level of pre-test knowledge was also related to the maternal education level, age, and experience.[11,13]While the education level affect the self-awareness and perception regarding the maternal and fetal health, age was related to maturity of individuals' mindset.[13]Experience may be evaluate from individual or external experience. Interestingly, previous study showed that parity was not associated with CED incidence, giving a clue that individual experience may not play a significant role of maternal CED. External experience may come from family, friends, or healthcare provider, which play a significant role on the perception of maternal CED.[10] However, there is no previous study regarding the impact of experience on the prevention behavior and knowledge of stunting-related-CED.

Additionally, multivariate analysis also found that pre-test behavior scores did not significantly influence prevention knowledge scores (p = 0.786). Several factors that may related to these findings is the effectiveness of education and the level of maternal drive to change their habits. This finding increased the urge to give a

more effective and motivational education methods for pregnant women with CED. Moreover, the statistical model used can explain 13.9% of the variation observed in prevention knowledge scores. The remaining variation is likely due to other factors not considered in the study. This study had several limitations, including the lack of a control group, reliance on self-reported data, and a small sample size. Additionally, factors such as literacy levels and the reach of educational interventions were not assessed, which may have impacted the knowledge outcomes. The findings underscore the importance of designing educational programs that take into account baseline knowledge and focus on motivational aspects to encourage behavior change in high-risk populations, such as pregnant women with CED.

The Correlation Heatmap provides a comprehensive overview of the interrelationships between the pre-test and post-test scores for knowledge, behavior, and prevention in the context of the educational interventions. The observed positive correlation ($r = 0.24$) between Pre-Test Knowledge and Post-Test Knowledge suggests that participants with a foundational understanding were better positioned to benefit from the intervention, which underscores the role of prior knowledge as a facilitator of learning. Moreover, the robust correlation ($r = 0.36$) between Pre-Test Behavior and Post-Test Behavior highlights the potential for existing positive behaviors to be reinforced through educational efforts, indicating that behavioral habits may be more resistant to change without tailored interventions. Notably, the weak correlation ($r = 0.14$) between Post-Test Knowledge and Post-Test Behavior raises critical questions about the efficacy of knowledge transfer into actionable behaviors, suggesting that simply enhancing knowledge may not suffice in altering behaviors related to stunting prevention. This finding emphasizes the necessity of integrating practical applications and ongoing support in educational programs to foster behavioral change. Additionally, the minimal correlations involving Pre-Test Prevention suggest that further exploration is warranted to understand how knowledge and behaviors translate into effective preventive strategies. Overall, these insights provide valuable implications for refining educational interventions, stressing the need for a holistic approach that not only enhances knowledge but also translates that knowledge into sustained behavioral practices among vulnerable populations.

Taken together, these findings suggest that the intervention was effective in improving both knowledge and prevention behaviors related to stunting in CED pregnant women. Future research should explore the role of literacy and the reach of educational interventions in preventing CED, as well as investigate the long-term impact of educational interventions on maternal behaviors and child health outcomes.

5. CONCLUSIONS

In conclusion, this study highlights the effectiveness of educational interventions in improving knowledge and prevention behaviors among pregnant women with chronic energy deficiency (CED). This study examined an intervention designed to help pregnant women with chronic energy deficiency (CED) prevent stunting in their children. The intervention successfully improved the women's knowledge of specific behaviors that can prevent stunting. Interestingly, the overall knowledge scores increased slightly, but this change wasn't statistically significant. The study identified a woman's existing knowledge of stunting prevention as the strongest factor influencing how much she learned from the intervention.

Declarations

Data availability statement

Not applicable

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REFERENCES

1. de Onis M, Branca F. Childhood stunting: a global perspective. Matern Child Nutr. 2016 May 17;12(S1):12–26.
2. Vaivada T, Akseer N, Akseer S, Somaskandan A, Stefopulos M, Bhutta ZA. Stunting in childhood: an overview of global burden, trends, determinants, and drivers of decline. Am J Clin Nutr. 2020 Sep;112:777S-791S.
3. Yani DI, Rahayuwati L, Sari CWM, Komariah M, Fauziah SR. Family Household Characteristics and Stunting: An Update Scoping Review. Nutrients. 2023 Jan 2;15(1):233.
4. Rahman A, Lahdimawan A, Arifin S, Husaini. The Analysis of Risk Factors Associated with nutritional status of toddler in Posyandu of Beringin Village, Alalak sub-District, Barito Kuala District. Indian J Public Health Res Dev. 2018 Mar;9(10):505–10.
5. Sartika AN, Khoirunnisa M, Meiyetriani E, Ermayani E, Pramesthi IL, Nur Ananda AJ. Prenatal and postnatal determinants of stunting at age 0–11 months: A cross-sectional study in Indonesia. PLoS One. 2021 Jul 14;16(7):e0254662.

6. Wubie A, Seid O, Eshetie S, Dagne S, Menber Y, Wasihun Y, et al. Determinants of chronic energy deficiency among non-pregnant and non-lactating women of reproductive age in rural Kebeles of Dera District, North West Ethiopia, 2019: Unmatched case control study. PLoS One. 2020 Oct 29;15(10):e0241341.
7. Rachmawati NC, Dewi YLR, Widyaningsih V. Multilevel Analysis on Factors Associated with Occurrence Chronic Energy Deficiency among Pregnant Women. Journal of Maternal and Child Health. 2019;4(6):474–85.
8. Rachmi R, Marjan AQ, Sufyan DL, Wahyuningsih U. Factors Affecting Chronic Energy Deficiency among Pregnant Women in East Nusa Tenggara Province, Indonesia. J Gizi Pangan. 2024 Jan;19(Suppl.1):95–104.
9. Hayati F. Persepsi Ibu Hamil tentang Terapi Komplementer dalam Kehamilan. Jurnal Akademika Baiturrahim Jambi. 2021 Sep 18;10(2):289.
10. Rezkillah AR, Surjoputro A, Sriatmi A. Comparative Study of Perceptions of Pregnant Women with Chronic Energy Deficiency (CED) on the Fulfilment of Nutrition in the Prevention of Stunting in Semarang City. Indonesian Journal of Global Health Research. 2024 Feb 19;6(1):299–308.
11. Wati EK, Murwani R, Kartasurya MI, Sulistiyani S. Determinants of chronic energy deficiency (CED) incidence in pregnant women: A cross-sectional study in Banyumas, Indonesia. Narra J. 2024 Apr 25;4(1):e742.
12. Dagne S, Menber Y, Wassihun Y, Dires G, Abera A, Adane S, et al. Chronic Energy Deficiency and Its Determinant Factors among Adults Aged 18–59 Years in Ethiopia: A Cross-Sectional Study. J Nutr Metab. 2021 Jan 6;2021:1–8.
13. Triyawati L, Yuliani E. Knowledge, education, and information affect chronic energy deficiency among pregnant mothers in the area of Public Health Center Balen, Bojonegoro, Indonesia. Majalah Obstetri & Ginekologi. 2023 Apr 27;31(1):1–10.
14. Astuti RDP, , Mallongi A, , Rauf AU. Natural enrichment of chromium and nickel in the soil surrounds the karst watershed. Glob J Environ Sci Manag. 2021; 7(3): 1–18. http://doi.org/10.22034/GJESM.2021.03.05
15. Eny., Thaha, R. M., Suriah., Syafar, M., Amiruddin, R., Yahya, M., Mallongi, A. (2023). Health Literacy Using Snakes and Ladders on HIV/AIDS Knowledge and Attitudes Among Adolescents. Journal Of Law And Sustainable Development., Miami, v.11, n. 10| pages: 01-13| e01418 |2023
16. Azis ASFW, Darmawansyah, Razak A, Arifin A, Syafar M, Mallongi A. Analysis of Policy Implementation of The First 1000 Days of Life Program in Overcoming Stunting in Phcogj.com Maros District. Pharmacogn J. 2023;15(3): 405-410.
17. Hilda, Supriadi, Widiastuty HP, Arsyawina, Mallongi A. Development of Patient Safety Management Learning Model Based on Problem Based Learning Integrated Soft Skill
18. Phcogj.com Higher Level Thinking for Health Students in Samarinda. Pharmacogn J. 2023;15(2): 418-423
19. Syahriani N, Palutturi S, Birawida AB, Hidayanty H. Clean Water Supply as an Indicator for Healthy Island in Makassar City. Open-Access Maced J Med Sci. 2022 Feb 24; 10(E):320-325. https://doi.org/10.3889/oamjms.2022.8350
20. Mallongi, A., Rauf, A., Astuti, R., Palutturi, S., & Ishak, H. (2023). Ecological and human health implications of mercury contamination in the coastal water. Global Journal of Environmental Science and Management, 9(2), 261-274. doi: 10.22034/gjesm.2023.02.06
21. Ernyasih, E., Mallongi, A., Daud, A., Palutturi, S., Stang, S., Thaha, R., Ibrahim, E., & Al Madhoun, W. (2023). Health risk assessment through probabilistic sensitivity analysis of carbon monoxide and fine particulate transportation exposure. Global Journal of Environmental Science and Management, 9(4), 933-950. doi: 10.22034/gjesm.2023.04.18
22. Anwar Mallongi, Ruslan La Ane and Agus Bintara Birawida. Ecological risks of contaminated lead and the potential health risks among school children in Makassar coastal area, Indonesia. J. Environ. Sci. Technol., 2017; 10: 283-289.
23. Ishak, H., Mallongi, A., Wahid, I., Bachtiar, I. Spatiotemporal factors related to dengue hemorrhagic fever in makassar city, 2010 – 2014, Indian Journal of Public Health Research and Development, 2018.
24. Astuti RDP., Mallongi A., Rauf AU., Risk identification of Hg and Pb in soil : a case study from Pangkep Regency, Indonesia. Soil Sci Annu. 2021; 72(1): 1–15. https://doi.org/10.37501/soilsa/135394