COMMUNITY-BASED INTERVENTION MODEL FOR PREECLAMPSIA PREVENTION THROUGH RIVER FISH CONSUMPTION AND PERIODIC MATERNAL-FETAL MONITORING IN TAHTUL YAMAN, JAMBI

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ABSTRACT

Preeclampsia is a leading cause of maternal and perinatal complications. Preventive strategies based on local food resources offer a sustainable approach aligned with the Sustainable Development Goals. This study describes a community-based intervention integrating nutrition, health education, and periodic monitoring among pregnant women in the Puskesmas Tahtul Yaman area, located along the riverside in Jambi. The intervention applied the Health Belief Model to enhance perceived benefits and reduce barriers, the Theory of Planned Behavior to strengthen attitudes and behavioral control, and Knowles' Adult Learning Theory for contextual learning. Activities were conducted in two phases. In the first phase (gestational age 26–28 weeks, trimester 2), pregnant women attended sessions on preeclampsia and safe fish consumption, supported by cooking demonstrations using nutrient-dense river fish. They received fish-based meals twice weekly for six weeks. Maternal health was monitored through blood pressure, weight gain, and symptoms, while fetal well-being was assessed by ultrasonography. The second phase, eight weeks later (trimester 3), repeated maternal examination and ultrasonography for follow-up of pregnancy. None of the participants developed hypertension, fetal growth matched gestational age, and mothers showed improved knowledge of preeclampsia and its prevention, particularly through fish consumption. This community-driven model demonstrates the effectiveness of combining local nutrition, adult learning strategies, and regular maternal-fetal monitoring. It highlights a feasible, culturally sensitive, and sustainable approach to strengthen maternal health and prevent preeclampsia in resource-limited settings.

Keywords: community-based intervention; Health Belief Model; maternal health; preeclampsia prevention; river fish consumption.

ABSTRAK

Preeklamsia merupakan salah satu penyebab utama komplikasi maternal dan perinatal di seluruh dunia. Strategi pencegahan yang berbasis pada sumber pangan lokal menawarkan pendekatan yang berkelanjutan dan sejalan dengan Sustainable Development Goals (SDGs). Pengabdian ini menggambarkan suatu intervensi berbasis komunitas yang mengintegrasikan aspek gizi, edukasi kesehatan, dan pemantauan berkala pada ibu hamil di wilayah kerja Puskesmas Tahtul Yaman, yang terletak di sepanjang daerah aliran sungai Kota Jambi. Kegiatan dilaksanakan dalam dua fase. Pada fase pertama (usia kehamilan 26–28 minggu, trimester kedua), ibu hamil mengikuti sesi edukasi mengenai preeklamsia dan konsumsi ikan sungai yang aman, disertai dengan demonstrasi memasak menggunakan ikan sungai bernutrisi tinggi. Peserta menerima hidangan berbasis ikan sebanyak dua kali setiap minggu selama enam minggu. Kesehatan ibu dimonitor melalui pengukuran tekanan darah, pertambahan berat badan, dan gejala klinis, sedangkan kesejahteraan janin dinilai melalui pemeriksaan ultrasonografi (USG). Fase kedua, yang dilaksanakan delapan minggu kemudian (trimester ketiga), mencakup evaluasi ulang kondisi maternal dan pemeriksaan USG untuk pemantauan lanjutan kehamilan. Hasil menunjukkan bahwa tidak ada peserta yang mengalami hipertensi atau preeklamsia, pertumbuhan janin sesuai dengan usia kehamilan, dan terdapat peningkatan pengetahuan ibu mengenai preeklamsia serta upaya pencegahannya, terutama melalui konsumsi ikan sungai. Model intervensi berbasis komunitas ini menunjukkan efektivitas pendekatan yang menggabungkan sumber gizi lokal, strategi pembelajaran orang dewasa, dan pemantauan maternal-fetal secara rutin. Temuan ini menegaskan bahwa model serupa dapat menjadi pendekatan yang layak diterapkan, sensitif terhadap budaya lokal, dan berkelanjutan dalam upaya memperkuat kesehatan maternal serta mencegah preeklamsia di wilayah dengan sumber daya terbatas.

Kata kunci: *intervensi berbasis komunitas; kesehatan maternal; pencegahan preeklamsia; konsumsi ikan sungai.*

INTRODUCTION

Preeclampsia remains one of the major causes of maternal morbidity and mortality worldwide, responsible for approximately 70,000 maternal deaths and 500,000 fetal and neonatal deaths annually.[1] It is characterized by new-onset hypertension and proteinuria after 20 weeks of gestation, associated with systemic endothelial dysfunction and placental ischemia.[2] Despite advances in antenatal care, early prevention strategies in low-resource settings remain limited.[3]

Nutritional interventions using local food sources offer promising, culturally appropriate approaches for maternal health improvement. River fish, which are abundant in Jambi, are rich in omega-3 fatty acids, high-

quality protein, and micronutrients such as selenium and vitamin D, all of which play roles in reducing oxidative stress and improving vascular function, key mechanisms implicated in preeclampsia.[4-5] Omega-3 supplementation has been linked with modulation of prostaglandin balance, improved uteroplacental perfusion, and decreased risk of hypertensive disorders of pregnancy.[6]

The urgency of this community-based initiative lies in the persistent burden of preeclampsia in low-resource settings, where limited access to quality antenatal care, low dietary diversity, and inadequate health literacy heighten maternal vulnerability. In the riverside communities of Jambi, geographical barriers and socioeconomic constraints further increase the risk of delayed detection of hypertensive disorders in pregnancy. Without targeted interventions, these gaps can translate into preventable maternal morbidity and adverse fetal outcomes. Therefore, implementing a culturally grounded, nutrition-focused, and education-driven model is crucial to empower pregnant women, enhance early prevention efforts, and support the health system in reducing preeclampsia-related complications at the community level.[7-9]

Community-based health promotion using behavioral and adult learning models ensures sustainability and participant engagement. The Health Belief Model (HBM) helps enhance perceived benefits and self-efficacy, the Theory of Planned Behavior (TPB) addresses attitudes and intentions toward healthy dietary behavior, and Knowles' Adult Learning Theory emphasizes experiential and context-based education suitable for pregnant women.[10-11]

This study aimed to develop and implement a community-based intervention model integrating local river fish consumption, maternal education, and periodic maternal-fetal monitoring for preeclampsia prevention among pregnant women living along the Tahtul Yaman riverside in Jambi.

METHODS

Study design and participants

This community-based interventional study was conducted from April to September 2024 at Puskesmas Tahtul Yaman, Jambi City, Indonesia. The study targeted pregnant women living in the riverside area who were receiving regular antenatal care (ANC) services. The location was selected for its accessibility, strong community engagement, and high local fish availability.

Participants were pregnant women in their second trimester (26–28 weeks gestation) recruited through collaboration with midwives and health cadres. Inclusion criteria were singleton pregnancy, absence of preexisting hypertension or diabetes, and willingness to participate throughout the intervention period. Exclusion criteria included chronic diseases or pregnancy complications diagnosed before recruitment. A total of 20 eligible participants provided written informed consent after receiving a full explanation of study procedures.

Intervention design

The intervention was guided by the Health Belief Model (HBM), Theory of Planned Behavior (TPB), and Knowles' Adult Learning Theory, aiming to enhance motivation, self-efficacy, and practical dietary skills. Activities were implemented in two structured phases:

1. Phase 1 – Trimester 2 (Weeks 0–6):
   Participants attended educational sessions on preeclampsia prevention, maternal nutrition, and safe local fish consumption. Sessions combined discussion and participatory learning to promote understanding and relevance. Interactive cooking demonstrations featured nutrient-rich river fish such as patin and baung, using low-oil, hygienic, and locally adapted recipes. Participants received two servings of fish-based meals per week for six weeks to encourage habit formation and ensure nutritional exposure. Maternal blood pressure, body weight, and symptoms were monitored biweekly by trained midwives. Fetal growth and well-being were assessed through ultrasonography at the beginning and end of Phase 1, recording biparietal diameter (BPD), abdominal circumference (AC), and femur length (FL).
2. Phase 2 – Trimester 3 (Eight Weeks Later):
   Follow-up evaluations were conducted to assess maternal and fetal health, knowledge retention, and dietary adherence. Post-intervention ultrasonography assessed fetal growth trajectory, amniotic fluid volume, and fetal heart rate. Health cadres assisted in follow-up visits and reinforced health messages within the community.

Data collection and outcome measures

Primary outcomes were maternal blood pressure and incidence of preeclampsia. Secondary outcomes included maternal knowledge score (via pre- and post-intervention questionnaire) and fetal growth assessment (biometric measurements consistent with gestational age). Qualitative observations of participant engagement and community support were also recorded.

Statistical analysis

Descriptive analysis was conducted to summarize participant characteristics, maternal health indicators, and knowledge score improvement. Changes before and after intervention were compared using paired t-test or Wilcoxon test where applicable (SPSS version 26.0, IBM Corp., USA). Qualitative findings were analyzed thematically. focusing on motivation, self-efficacy, and community participation. The integration of qualitative insights complemented numerical findings, offering a more holistic understanding of behavioral and cultural dynamics influencing maternal health practices.

RESULTS AND DISCUSSION

Participant characteristics

This study demonstrated the effectiveness of a community-based intervention that integrated local fish consumption, maternal health education, and routine maternal-fetal monitoring in improving maternal knowledge, maintaining normal blood pressure, and supporting optimal fetal growth among pregnant women at risk of preeclampsia in Tahtul Yaman, Jambi.

A total of 20 pregnant women participated and completed both phases of the intervention. The mean maternal age was 28.4 ± 4.9 years, and the mean gestational age at baseline was 27.1 ± 0.8 weeks. None of the participants had a prior history of hypertension or preeclampsia. The intervention was structured into two main phases. During Phase 1 (trimester 2; 26–28 weeks gestation), participants attended educational sessions focusing on preeclampsia prevention, maternal nutrition, and safe river fish consumption. Interactive cooking demonstrations featuring nutrient-rich local fish species such as patin and baung were conducted to enhance practical learning. Participants also received fish-based meals twice weekly for six weeks, with biweekly monitoring of maternal blood pressure, weight, and symptoms, accompanied by fetal ultrasonography assessments. Phase 2 (trimester 3; eight weeks later) involved reevaluation of maternal and fetal outcomes, assessment of knowledge retention, and monitoring of dietary adherence.

Table 1. Maternal Characteristics and Outcomes

Variable	n	Mean ± SD	p-Value
Gestational age at baseline (weeks)	20	27.1 ± 0.8	
Maternal age (years)	20	28.4 ± 4.9	
Systolic blood pressure (mmHg)	20	111 ± 9	
Diastolic blood pressure (mmHg)	20	73 ± 7	
Knowledge score (pre-intervention)	20	62.5 ± 10.2	< 0.001
Knowledge score (post-intervention)	20	88.4 ± 7.1	

Following the six-week intervention, no participants developed hypertension or preeclampsia, and the mean systolic and diastolic blood pressures remained within normal ranges (111 ± 9 mmHg and 73 ± 7 mmHg, respectively). All participants achieved appropriate gestational weight gain according to WHO criteria, and fetal ultrasonography revealed normal biometry, amniotic fluid indices, and fetal heart rates, with no evidence of growth restriction.[12] Maternal knowledge scores about preeclampsia and nutritional prevention improved significantly from 62.5 ± 10.2 to 88.4 ± 7.1 ($p < 0.001$). Most participants reported greater confidence in preparing safe, low-fat fish-based meals and demonstrated better understanding of healthy cooking techniques.

These findings highlight the positive outcomes of combining nutrition-based education with behavioral and learning theories to enhance maternal self-efficacy and promote sustained behavioral change. The results are consistent with prior evidence demonstrating that omega-3 polyunsaturated fatty acids (PUFAs) and high-quality protein derived from fish contribute to endothelial protection, reduce systemic inflammation, and improve placental blood flow, thereby mitigating preeclampsia risk through enhanced nitric oxide bioavailability and reduction of oxidative stress.[13-16] A 2022 meta-analysis reported that n-3 PUFA supplementation during pregnancy reduced the risk of preeclampsia by 16% (RR 0.84; 95% CI 0.74–0.96).[14] Similarly, cohort studies in China and Italy found that moderate seafood consumption correlated with improved fetal growth and favorable maternal outcomes when safe fish species were used.[17-19]

Nevertheless, a 2023 narrative review noted that evidence remains heterogeneous, and omega-3 supplementation alone should not yet be recommended as a routine preventive measure.[20] Consistent with the Society of Obstetric Medicine of Australia and New Zealand (SOMANZ, 2023) guidelines, the clinical impact of omega-3 intake depends on baseline diet and local environmental context.[21] Thus, the success of the present intervention likely reflects a multifactorial effect encompassing nutrition, health education, behavioral modification, and regular clinical monitoring rather than dietary factors alone.

The behavioral framework adopted in this study was integrating the Health Belief Model (HBM), Theory of Planned Behavior (TPB), and Knowles' Adult Learning Theory played a pivotal role in achieving these outcomes. The HBM enhanced participants' perception of benefits and reduced behavioral barriers, while TPB strengthened attitudes and perceived control over healthy practices. Meanwhile, adult learning principles facilitated experiential, contextual, and participatory learning, enabling mothers to translate knowledge into practical behavior changes. Previous studies have demonstrated that theory-based educational models rooted

in adult learning principles are effective in improving dietary behaviors during pregnancy, especially when supported by culturally relevant approaches such as cooking demonstrations.[10,11,22]

The integration of ultrasonography monitoring not only provided valuable fetal health information but also strengthened maternal motivation and compliance with dietary and lifestyle recommendations. This approach aligns with existing community health models emphasizing empowerment and self-efficacy as central components of sustained behavior change.[23]

Equally important, strong community engagement contributed to the success of the intervention. Health cadres and Puskesmas staff played an active role in coordinating logistics, follow-up monitoring, and health education dissemination. Such engagement fostered a sense of ownership among participants and reinforced collective responsibility for maternal and fetal health. Similar community-based models have demonstrated that empowerment and culturally grounded education can enhance dietary compliance and health literacy among pregnant women.[24] The integration of adult learning principles enabled mothers to learn through experience, reflection, and practice, making the knowledge transfer more meaningful and sustainable. The behavioral frameworks (HBM and TPB) enhanced motivation, attitudes, and perceived control over healthy practices, aligning with findings from recent behavioral intervention studies showing improved maternal outcomes when theory-based education models are applied.[25] The combination of local food utilization, participatory education, and behavioral theory application represents a sustainable and culturally sensitive strategy that aligns with Sustainable Development Goals (SDG 3 – Good Health and Well-Being; SDG 2 – Zero Hunger).

In summary, the present study underscores the effectiveness of a locally driven, theory-informed intervention in improving maternal knowledge, maintaining normal blood pressure, and supporting healthy fetal development among pregnant women at risk of preeclampsia. By integrating nutrition, education, behavioral change, and community empowerment, this model offers a replicable and contextually appropriate approach to maternal health promotion in resource-limited settings.

CONCLUSION

The community-based intervention model integrating river fish consumption, maternal education, and regular maternal-fetal monitoring effectively improved maternal knowledge and maintained normal blood pressure and fetal growth. This approach represents a feasible, culturally sensitive, and sustainable strategy for preeclampsia prevention in low-resource settings. Broader implementation and long-term evaluation are recommended to strengthen community-based maternal health programs in Indonesia.

REFERENCES

1. WHO. *Trends in maternal mortality 2000 to 2020: estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division.* Geneva: World Health Organization; 2023. Available from: https://www.who.int/publications/i/item/9789240072231
2. Roberts JM, Hubel CA. The two stage model of preeclampsia: variations on the theme. *Placenta.* 2009;30 Suppl A:S32–7. doi:10.1016/j.placenta.2008.11.009
3. Say L, Chou D, Gemmill A, Tunçalp Ö, et al. Global causes of maternal death: a WHO systematic analysis. *Lancet Glob Health.* 2014;2(6):e323–e333. doi:10.1016/S2214-109X(14)70227-X
4. Larqué E, Demmelmair H, Koletzko B. Perinatal supply and metabolism of long-chain polyunsaturated fatty acids: importance for the early development of the nervous system and long-term health. *Ann Nutr Metab.* 2002;46(1):12–18. doi:10.1159/000057618
5. Zhou SJ, Yelland L, McPhee AJ, et al. Fish-oil supplementation in pregnancy does not reduce the risk of gestational diabetes or preeclampsia. *Am J Clin Nutr.* 2012;95(6):1378–1384. doi:10.3945/ajcn.111.033217
6. Imhoff-Kunsch B, Briggs V, Goldenberg RL, et al. Effect of omega-3 fatty acid intake during pregnancy on maternal, perinatal and neonatal outcomes: a systematic review. *Paediatr Perinat Epidemiol.* 2012;26 Suppl 1:91–107. doi:10.1111/j.1365-3016.2012.01292.x
7. Brown MA, Magee LA, Kenny LC, Karumanchi SA, McCarthy FP, Saito S, et al. Hypertensive disorders of pregnancy: ISSHP classification, diagnosis, and management recommendations. Pregnancy Hypertens. 2018;13:291–310. doi: 10.1016/j.preghy.2018.05.004
8. Magee LA, Sharma S, Nathan HL, Adetoro OO, Bellad MB, Goudar S, et al. The hypertensive disorders of pregnancy: a systematic review and critical appraisal of the Quality of Clinical Practice Guidelines. Lancet. 2022;399(10324):349–361. doi: 10.1016/S0140-6736(21)02749-9
9. Kiondo P, Wamuyu-Maina G, Bimenya GS, Tumwesigye NM, Wandabwa J, Okong P. Risk factors for pre-eclampsia in a low-resource setting: a case-control study. BMC Pregnancy Childbirth. 2020;20:147. doi: 10.1186/s12884-020-2851-3
10. Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the Health Belief Model. *Health Educ Q.* 1988;15(2):175–183. doi:10.1177/109019818801500203
11. Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process.* 1991;50(2):179–211. doi:10.1016/0749-5978(91)90020-T
12. WHO. *Recommendations on antenatal care for a positive pregnancy experience.* Geneva: World Health Organization; 2016. Available from: https://www.who.int/publications/i/item/9789241549916
13. Burton GJ, Redman CW, Roberts JM, Moffett A. Pre-eclampsia: pathophysiology and clinical implications. *BMJ.* 2019;366:l2381. doi:10.1136/bmj.l2381

14. Abdelrahman W, et al. Impact of n-3 polyunsaturated fatty acid intake in pregnancy on maternal health and birth outcomes: a systematic review and meta-analysis of randomized controlled trials. Nutrients. 2022;14(7):1501.
15. Zhou SJ, Yelland L, et al. Effects of prenatal omega-3 fatty acid intake on hypertensive disorders of pregnancy: an updated evidence synthesis. J Hypertens. 2023;41(8):1603–12.
16. Imhoff-Kunsch B, Briggs V, et al. Maternal omega-3 fatty acids and placental vascular health: recent mechanistic insights. Nutrients. 2024;16(1):58.
17. Wang Y, et al. Maternal seafood consumption and fetal growth: a birth cohort study in urban China. BMC Pregnancy Childbirth. 2023;23:253.
18. Di Lorenzo G, et al. Association between fish consumption during pregnancy and maternal and neonatal outcomes in southern Italy. J Clin Med. 2024;13(7):2131.
19. Shah S, Kim H-S, Hong Y-C, et al. Fish intake and mercury exposure in pregnancy: implications for maternal and infant health. BMC Public Health. 2024;24:568.
20. Martin A, López-Sánchez G, et al. Dietary factors influencing the risk of pre-eclampsia: an updated review. Nutr Rev. 2023;81(5):973-989.
21. Society of Obstetric Medicine of Australia and New Zealand (SOMANZ). Guideline for Hypertension in Pregnancy. 2023. Available from: https://somanz.org
22. Knowles MS, Holton EF, Swanson RA. *The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development.* 8th ed. New York: Routledge; 2015.
23. Khowaja AR, Mitton C, Bryan S, Zaidi S, et al. Economic evaluation of community-based strategies for the prevention of preeclampsia in low-income countries. *BMC Pregnancy Childbirth.* 2018;18:272. doi:10.1186/s12884-018-1885-2
24. Shine R, et al. Knowledge, attitudes, and behaviors of pregnant women regarding seafood consumption during the antenatal period: a qualitative study. BMC Pregnancy Childbirth. 2024;24:80.
25. Johnson A, et al. Theory-based maternal nutrition education interventions and behavioral outcomes in low-income communities. Int J Womens Health. 2024;16:477-489.