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Effect of cadre-based empowerment on antenatal care knowledge, attitudes, and antenatal care visit among pregnant women

Yuniarti Yuniarti[1], Epti Yorita[2], Desi Widiyanti[3], Elvi Destariyani[4]
[1]Midwifery Department, Poltekkes Kemenkes Bengkulu, Indonesia, yuniarti.yuni80@gmail.com
[2]Midwifery Department, Poltekkes Kemenkes Bengkulu, Indonesia, eptiyorita74@gmail.com
[3]Midwifery Department, Poltekkes Kemenkes Bengkulu, Indonesia, widiyanti.desi@gmail.com
[4]Midwifery Department, Poltekkes Kemenkes Bengkulu, Indonesia, destariyani@poltekkesbengkulu.ac.id

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ABSTRACT

Despite ongoing efforts to reduce maternal mortality in Indonesia, antenatal care (ANC) coverage particularly completion of >4 visits (K4) remains suboptimal in regions such as Bengkulu City. The involvement of community health cadres is recognized as a key strategy to improve maternal health outcomes; however, limited research has directly examined the effect of structured cadre-based empowerment on ANC knowledge, attitudes, and service utilization. This study aimed to examine the effect of ANC cadre empowerment on ANC knowledge, attitudes, and the frequency of ANC visits among pregnant women in Bengkulu City, Indonesia. This quasi-experimental study employed a pre-test and post-test control group design involving 40 pregnant women in Bengkulu City, Indonesia divided equally into intervention and control groups. The intervention group received structured cadre-based empowerment involving trained health cadres, while the control group received standard counseling. Data were analyzed using Wilcoxon and Mann-Whitney tests to assess differences in knowledge, attitudes, and ANC visit frequency. After the intervention, the knowledge scores in the intervention group significantly increased from 53.80 to 73.90 (p=0.020), while the control group showed no significant change. Attitude scores in the intervention group also increased significantly from 35.35 to 38.25 (p=0.014), unlike the control group (p=0.320). Regarding ANC visits, the intervention group had a higher mean number of visits (mean=4) compared to the control group (mean=3), with a statistically significant difference (p=0.001). Cadre-based empowerment through structured training significantly improved pregnant women's knowledge, attitudes, and ANC service utilization. This suggests the importance of integrating cadre empowerment models into routine maternal health programs to support improved ANC compliance.

Corresponding Author:

Yuniarti Yuniarti
Midwifery Department, Poltekkes Kemenkes Bengkulu
Indragiri Street No 4, Padang Harapan, Gading Cemp, Bengkulu, Indonesia 38225. Phone: (0736)344025
Email: yuniarti.yuni80@gmail.com

INTRODUCTION

Antenatal care (ANC) plays a pivotal role in reducing maternal and neonatal mortality globally and nationally. (1) According to the World Health Organization, ANC allows early

detection of pregnancy-related complications, supports maternal nutrition, and enhances uptake of critical interventions such as immunization and counselling.(2)(3) Globally, ANC remains a cornerstone in achieving Sustainable Development Goal 3: to reduce the global maternal mortality ratio below 70 per 100,000 live births by 2030.(4)

Indonesia's maternal mortality ratio (MMR) has fallen from approximately 311 per 100,000 live births in 2000 to 140 per 100,000 live births in 2023.(5) Despite this progress, the country continues to rank among the highest MMRs in Southeast Asia, with disparities persisting between urban and rural provinces. Simultaneously, the infant mortality rate (IMR) remains elevated at around 17 per 1,000 live births in 2023.(6) At the national level, service utilization statistics show that ANC coverage (minimum four visits, or ANC4+) hovers around 85–88% during the period 2019–2023, as reported by Indonesia Demographic and Health Surveys and programmatic reviews.(7) However, many provinces, including Bengkulu, report K1 (first visit) coverage below 82% and K4 (fourth visit) coverage under 78%, both falling short of the Ministry of Health target of 95%. In Bengkulu Province specifically, recent data from community health centers indicate that K1 coverage is approximately 81.3% and K4 around 77%, showing a persistent dropout between early and late ANC visits.(8)

Multiple factors contribute to these persistent gaps:healthcare system limitations such as staff shortages, inconsistent service quality, and irregular availability of midwives at Puskesmas; socio-cultural barriers including low health literacy, traditional beliefs, and gender norms discouraging facility-based care; logistical constraints such as long travel distances, transportation costs, and inflexible clinic schedules factors like travel time, education, insurance ownership significantly influence ANC completion.(9) These coverage gaps highlight unresolved barriers such as limited access, irregular service delivery, low community awareness, and insufficient engagement by health cadres.(10) Given this landscape, exploring cadre-based empowerment as a strategy to strengthen knowledge, attitudes, and ANC uptake is both timely and essential for addressing persisting gaps in Bengkulu City's maternal health services.

In Indonesia, health cadres/ community volunteers trained by primary health centers are expected to bridge gaps in maternal health services by providing education, motivation, and support to pregnant women.(11) While previous studies have evaluated the role of health cadres in improving ANC service uptake, the specific impact of cadre *empowerment* through structured training, supportive tools, and active accompaniment remains understudied. For instance, a cross-sectional study in Jombang reported that high-risk pregnant women guided by cadres had significantly higher ANC attendance (74%, $p < 0.05$) compared to controls. Another study in Indonesia's Bangka Belitung Province found that most cadres had low knowledge levels and lacked capacity, underscoring the potential of targeted empowerment to enhance performance.(12) Moreover, a qualitative study on mental health cadres in Java and Sumatra highlighted that cadres require structured training and support to optimize their community roles.(13)

Although multiple studies have confirmed that community health cadres in Indonesia serve as vital agents for promoting maternal health particularly by improving maternal knowledge and service-seeking behaviors through education and motivation,(14,15) no prior research has directly evaluated the effect of structured ANC cadre training on K1–K4 visit coverage in Bengkulu City. Existing studies either focus on general cadre roles or assess knowledge and attitude outcomes without explicitly measuring impact on complete ANC visit compliance. For example, Fauziah et al. (2022) reported that household-based ANC monitoring by cadres significantly improved early detection of high-risk pregnancies and ANC compliance but did not assess the contribution of structured empowerment programs.(14) A recent cluster RCT in Bantul, Indonesia emphasized the importance of maternal mentoring and education to promote timely and complete ANC attendance but this intervention was delivered directly to pregnant women, not via cadre training models.(16) Meanwhile, Nurmilawati et al. (2024) evaluated an interactive Posyandu cadre training

program using KIA Book materials, showing substantial improvements in cadre competency in Banjarbaru, yet did not assess downstream effects on ANC visit behavior among pregnant women.(17)

Thus, while cadre involvement is recognized as beneficial for maternal health promotion, the effect of systematic cadre empowerment on pregnant women's knowledge, attitudes, and ANC attendance has not been thoroughly evaluated especially in low-resource settings like Bengkulu City. This study aims to fill that gap by investigating whether cadre-based empowerment can significantly influence ANC utilization behaviors in this context.

METHOD

This study employed a quasi-experimental design with a pretest-posttest approach and two intervention groups. The research was conducted over a period of two weeks in 2020 across selected public health centers (Puskesmas) in Bengkulu City, Indonesia. The study population consisted of pregnant women in their second or third trimester who were registered at participating health centers. Inclusion criteria included: (1) being in the second or third trimester of pregnancy, (2) able to communicate effectively, and (3) willing to participate. Exclusion criteria were: (1) presence of pregnancy complications, (2) cognitive impairments, and (3) prior participation in similar interventions. A purposive sampling method was used to select 40 participants. The minimum sample size was determined based on prior research (Sakinah & Fibriana, 2015), with an effect size estimate of 0.53. Participants were divided into two intervention groups: (1) Empowerment Group: Received structured empowerment sessions led by trained health cadres, including health education, motivational dialogue, and peer support strategies; (2) Counseling Group: Received conventional health counseling sessions from midwives, focusing on the importance of ANC visits. Both groups underwent an initial assessment of ANC-related knowledge and attitudes using a validated questionnaire. The interventions were delivered over two weeks, with sessions conducted twice per week (4 sessions total), each lasting approximately 30–45 minutes. Post-intervention assessments were conducted immediately after the intervention period using the same instruments. Data were collected using a structured questionnaire assessing participants' knowledge and attitudes toward ANC. The instrument consisted of 20 items on knowledge and 15 items on attitude, using a Likert-scale format. The questionnaire had been previously validated and showed acceptable internal consistency (Cronbach's alpha > 0.70). ANC visit compliance (K1–K4) was verified using maternal health records at the health centers. Descriptive statistics were used for univariate analysis to summarize participants' demographic characteristics and baseline variables. The Wilcoxon signed-rank and Mann-Whitney tests were used for bivariate analysis to assess changes in knowledge and attitudes before and after the intervention within each group. Statistical significance was set at $p < 0.05$.

RESULTS

Table 1 presents the sociodemographic comparison between groups. The intervention group had a slightly lower proportion of women in the high-risk age category (40% vs. 45%), a higher proportion with secondary or higher education (75% vs. 50%), fewer employed women (50% vs. 75%), fewer with high-risk parity (40% vs. 45%), and fewer with short interpregnancy intervals (20% vs. 70%).

Table 1. Sociodemographic comparison between empowerment and counseling group

Variable	Empowerment group		Counseling Group	
	f	%	f	%
Age				
High risk	8	40	9	45
Low risk	12	60	11	55

Variable	Empowerment group		Counseling Group	
	f	%	f	%
Education				
High	15	75	10	50
Low	5	25	10	50
Job				
Have a job	10	50	15	75
Don't have a job	10	50	5	25
Parity				
High risk	8	40	9	45
Low risk	12	60	11	55
Spacing				
High risk	8	20	14	70
Low risk	12	30	6	30

Table 2 shows changes in knowledge and attitudes before and after the intervention. In the empowerment group, mean knowledge scores increased from 53.80 to 73.90, and mean attitude scores improved from 35.35 to 38.25. In contrast, in the counseling group, mean knowledge increased only marginally (52.14 to 52.90), and attitudes rose from 33.14 to 35.19. The average number of ANC visits was higher in the empowerment group (mean = 4 visits) compared with the control group (mean = 3 visits).

Table 2. The changes in knowledge, attitudes and ANC visit before and after intervention

Variable	N	Mean	SD	Min-maks
Empowerment group				
Knowledge Before Intervention	20	53.80	17.353	31-92
Knowledge After Intervention	20	73.90	19.265	31-100
Attitude Before Intervention	20	35.35	4.356	28-43
Attitude after intervention	20	38.25	4.356	30-43
ANC visit	20	4	15.353	4-6
Counseling Group				
Knowledge Before Intervention	20	52.14	13.074	23-69
Knowledge After Intervention	20	52.90	13.074	38-69
Attitude Before Intervention	20	33.14	4.683	32-48
Attitude after intervention	20	35.19	4.654	32-48
ANC visit	20	3	3.356	

Table 3 demonstrates that in the empowerment group, improvements in knowledge and attitudes after cadre training were significantly associated with ANC visits ($p < 0.05$). In the control group, counseling did not yield a significant association ($p > 0.05$). Cadre empowerment significantly improved ANC visits in the intervention group ($p < 0.05$), while no significant effect was observed in the control group ($p > 0.05$).

Table 3. Influence of knowledge and attitudes before and after the intervention with ANC Visits

Variable	N	Mean Rank	Z	P
Empowerment group				
Knowledge	20	5.00	2.333	0.020
Attitude	20	5.00	2.449	0.014
ANC Visit	20	6.00	2.559	0.001
Counseling Group				
Knowledge	20	1.00	1.000	0.317
Attitude	20	1.00	1.200	0.320
ANC Visit	20	1.00	1.000	0.120

Finally, Table 4 highlights that the between-group comparison revealed a significant difference in ANC visits ($Z = 3.44$, $p < 0.05$), confirming the positive effect of cadre-based empowerment on ANC utilization among pregnant women in Bengkulu City.

Table 4. Differences in Empowerment of ANC Cadres on ANC Visits

Variable	Mann Whitney	Z	P
ANC Visits	73,500	3.444	0.001

DISCUSSION

Sociodemographic Characteristics and ANC Visits

Understanding whether baseline differences in maternal age, education, employment status, parity, and pregnancy spacing influenced ANC visit compliance is critical. Clarifying these sociodemographic associations is essential to interpret whether cadre-based empowerment had differential impacts across subgroups and to assess the equity of intervention effects. In the present study, the intervention group and control group differed in certain characteristics: the intervention group had a lower proportion of high-risk age (>35) (40% vs 45%), higher education levels (75% vs 50%), fewer women working (50% vs 75%), fewer high-risk parities (40% vs 45%), and a greater proportion with short interpregnancy spacing (70% vs 20%). However, no statistically significant associations were found between these sociodemographic variables and the frequency of ANC visits in either group.

Previous national-level analyses, including the 2017 Indonesia Demographic and Health Survey (IDHS), demonstrated that women aged 30–34 years were the most likely to complete ≥4 ANC visits (AOR ≈2.93; 95% CI: 2.93–2.93), while women aged 35–39 also showed elevated odds (AOR ≈3.08) compared to adolescents aged 15–19 years.(18) More recent evidence from a 2022 continuum-of-care analysis similarly reported that mothers aged 25–34 years (AOR 1.12; 95% CI: 1.01–1.24) and those >34 years (AOR 1.28; 95% CI: 1.12–1.45) had higher ANC completion rates.(19) In contrast, our study did not find a statistically significant relationship between maternal age and ANC adherence, suggesting that cadre-led interventions may have reduced age-related disparities by promoting more uniform care-seeking behaviors across different age groups.

Educational attainment has consistently been identified as a strong determinant of ANC utilization. IDHS 2017 data indicate that women with higher education were 3.67 times more likely to complete ≥4 ANC visits compared with those without formal education, with secondary and primary education also conferring significant advantages (OR 3.88 and 2.53, respectively).(9) Similarly, continuum-of-care analyses revealed that women with secondary (AOR 2.21; 95% CI: 1.49–3.26) and tertiary education (AOR 2.07; 95% CI: 1.38–3.10) had significantly higher odds of ANC completion.(19) Contrary to these trends, our findings revealed no significant association between education level and ANC visit compliance. This divergence may reflect the capacity of cadre empowerment to standardize information and motivation across educational strata, thereby compensating for educational disadvantages.

Employment status has been reported as a modest predictor of ANC utilization. IDHS 2018 found maternal employment to be positively associated with ANC (AOR ≈1.075), and Andriani et al. (2022) similarly observed higher ANC compliance among employed mothers.(9,19) However, in our smaller-scale intervention, employment status did not significantly predict ANC attendance. It is plausible that structured cadre support minimized occupational barriers, enabling both employed and unemployed mothers to adhere equally to ANC recommendations.

Parity is another well-established predictor of ANC compliance. National survey data indicate an inverse association, where primiparous women are more likely to complete ≥4 visits compared to multiparous (AOR 0.646) and grand-multiparous women (AOR 0.249).(20) Other analyses confirm that lower parity (≤2 births) is associated with higher ANC completion (OR ≈3.58) compared to higher parity (>4 births).(18) Our study, however, did not find parity to be a significant predictor of ANC visits. This finding suggests that cadre-based empowerment may help mitigate the tendency of higher-parity women to underutilize services by providing targeted motivation and follow-up.

Evidence on the influence of interpregnancy spacing on ANC attendance remains limited. Broader continuum-of-care studies suggest that short birth intervals may reduce ANC engagement due to maternal fatigue or competing childcare demands.(19) In our study, despite a higher proportion of women with short interpregnancy spacing in the intervention group, no significant association with ANC visits was observed. This indicates that intensive cadre accompaniment may help women overcome barriers typically associated with closely spaced pregnancies, ensuring adherence to recommended ANC schedules.

The absence of association between sociodemographic factors and ANC visit adherence suggests that cadre-based empowerment interventions may level the playing field, enabling pregnant women across different backgrounds to engage equally with ANC services. This finding supports the potential of community-driven interventions to improve equity in maternal health access, irrespective of education, parity, or age. It also underscores the importance of designing ANC promotion strategies that focus on behavioral support, rather than relying solely on demographic profiling.

Knowledge Improvement: Effect of Cadre-Based Empowerment

One of the central aims of this study was to evaluate the effect of cadre-based empowerment on improving antenatal care (ANC) knowledge among pregnant women. Knowledge is a foundational element influencing maternal behavior toward antenatal care adherence, and enhancing maternal understanding about pregnancy, danger signs, and ANC schedules is critical for improving maternal health outcomes. This study sought to test whether empowering health cadres through structured training could serve as an effective strategy to improve knowledge transfer to pregnant women.

The findings revealed a statistically significant increase in knowledge among pregnant women in the intervention group who were supported by empowered cadres. Specifically, the average knowledge score increased from 53.80 before intervention to 73.90 after intervention, with a Wilcoxon test result of $Z = -2.333$; $p = 0.020$, indicating significant improvement. In contrast, the control group which only received conventional counseling showed a negligible increase in knowledge from 52.14 to 52.90, and the change was not statistically significant ($Z = -1.000$; $p = 0.317$). These results demonstrate that cadre-based empowerment significantly outperformed routine health counseling in increasing pregnant women's knowledge about ANC.

The success of cadre-based empowerment in this study is attributed to its structured and participatory approach. Cadres received specific training on ANC content, communication techniques, problem-solving, and supportive supervision. Empowered cadres were then actively involved in disseminating ANC knowledge through home visits, small group discussions, and community-based educational activities. This model promotes horizontal learning, where information is delivered by trusted community members in familiar cultural and social contexts that making the messages more accessible and relatable. Compared to one-off counseling sessions by overburdened health workers, cadres were able to repeatedly reinforce knowledge, adjust messages to individual comprehension levels, and follow up on knowledge gaps. Furthermore, cadres acted not only as health educators but also as motivators and facilitators, using interactive tools such as flipcharts, pocketbooks, and storytelling—methods that are more likely to enhance long-

term knowledge retention.(3,11,21) The mechanism of knowledge transfer in cadre-based empowerment relies on three key dimensions: (1) Accessibility: Cadres live within the same community, making it easier to conduct regular visits and establish communication in local dialects; (2) Continuity: Cadres follow up multiple times, unlike health providers who may only interact with pregnant women during clinic visits; and (3) Trust-building: Due to social proximity, cadres can build strong interpersonal bonds, reducing resistance and enhancing acceptance of health messages.

The findings of this study are consistent with prior research that highlights the importance of community health workers or cadres in enhancing maternal health knowledge. A study in Eastern Uganda by Lee et al. (2025) found that maternal health education delivered by trained community health volunteers increased ANC knowledge scores by 19.6–80.3%(22), similar to the effect observed in our intervention group. In Nepal, Panday et al. (2024) demonstrated that structured training and empowerment of female community health volunteers resulted in a significant improvement in maternal knowledge and practice compared to control areas.(23) In Indonesia, research by Ayuni et al. (2023) also found that pregnant women who were regularly assisted by trained health cadres had significantly better knowledge about ANC schedules and danger signs of pregnancy than those without cadre assistance.(24) Additionally, a recent review by Scharff et al. (2022) emphasized that interventions involving cadres are more effective when cadres are trained using adult learning principles, equipped with job aids, and supported with performance monitoring mechanisms features that were embedded in our cadre empowerment model.(25) The findings of this study add to the growing body of evidence that cadre-based empowerment is a feasible and effective intervention to improve maternal health literacy in low-resource settings. The structured nature of cadre training in this study combined with the ongoing support and contextualized message delivery contributed to the substantial improvement in ANC-related knowledge. This suggests that integrating structured cadre empowerment into national maternal health strategies could be a low-cost, scalable solution to improve maternal outcomes, particularly in areas with health worker shortages or cultural barriers to institutional health services.

Attitude Change: Effects of Cadre-Based Empowerment

This study investigated whether cadre-based empowerment could significantly improve pregnant women's attitudes toward antenatal care (ANC), as attitudes play a vital role in shaping health-seeking behaviors and adherence to recommended maternal health services. The statistical results revealed a significant increase in attitudes among the intervention group following cadre-based empowerment. The mean attitude score in this group improved from 35.35 to 38.25 ($p = 0.014$). In contrast, the control group (who only received routine counseling) showed a smaller, statistically insignificant increase from 33.14 to 35.19 ($p = 0.320$). These findings suggest that structured engagement by empowered cadres had a more meaningful impact on shaping pregnant women’s positive perceptions toward ANC.

Cadre-based empowerment in this study involved intensive training, use of interactive communication tools, role-plays, and consistent follow-up support. This approach enabled cadres not only to transfer knowledge, but also to influence psychosocial aspects of maternal care, such as beliefs, motivation, and confidence in ANC services. The attitudinal change occurred through several pathways: (1) Peer-based communication: Cadres being part of the community were perceived as relatable and trustworthy, reducing psychological distance and resistance; (2) Repetition and reinforcement: Regular home visits allowed repeated exposure to positive messaging about ANC, which helped internalize favorable attitudes; (3) Cultural contextualization: Messages delivered by cadres were adapted to local norms and values, increasing their acceptability and relevance; and (4) Supportive environment: Cadres also encouraged family members, especially husbands

and in-laws, to support women's ANC participation, fostering a socially enabling environment for positive attitude formation.(26,27)

These mechanisms align with health behavior theories such as the Health Belief Model and the Theory of Planned Behavior, which recognize that interpersonal influence and perceived benefits/barriers shape attitude and ultimately health behavior.(28) Lee et al. found that Village Health Teams trained with a tailored MCH (Maternal, Newborn & Child Health) curriculum significantly improved pregnant women's attitudes toward ANC, aligning with our finding that structured cadre-led interventions enhance maternal perception and motivation.(22) A cluster randomized trial by Kassim et al. demonstrated that health education interventions significantly increased positive attitudes (AOR = 3.34) toward ANC and skilled delivery, resulting in a 6.5% net gain in ANC attendance.(29) This supports our findings that attitude change is pivotal to behavior uptake. A comprehensive review reported consistent improvements in knowledge and ANC utilization when community health workers were involved in delivering home-based visits with interpersonal communication highlighting that attitude shifts, not just knowledge, are essential for improving uptake.(25) A study on Integrated Service Post (Posyandu) cadres found that combined video and booklet education significantly increased both knowledge and attitudes toward high-risk pregnancy detection (p = 0.000), while standard methods had no significant effect on attitudes.(14) Our findings likewise show that structured, engaging training tools are superior to conventional counseling. Unlike standard health education interventions, our model featured cadre-led, peer-delivered sessions within communities, continuous follow-up, use of visual and interactive tools, and emphasis on motivational as well as informational components. These features align with the adult learning methods highlighted in global reviews, and likely explain the stronger attitudinal effects observed in our study compared to those relying on passive or clinician-delivered education.

Improving maternal attitudes is a critical upstream determinant of ANC service utilization. The results of this study demonstrate that cadre-based empowerment can serve as a behavioral intervention tool, particularly effective in contexts where traditional health communication methods fall short. In public health practice, this indicates that training and empowering cadres should not only focus on increasing their knowledge but also equipping them with persuasive communication and behavior change techniques. The results support integrating structured cadre programs into maternal health strategies, particularly in underserved areas, to foster positive behavioral change and improve compliance with ANC protocols.

Antenatal Care (ANC) Visits – Effects of Cadre-Based Empowerment

This study examined whether cadre-based empowerment through structured training and community-based support can increase the frequency of ANC visits (K1–K4) among pregnant women in Bengkulu City. Adequate ANC visit coverage remains a national and global priority, as insufficient contact with skilled providers contributes to preventable maternal and neonatal morbidity. Our results indicate that pregnant women in the intervention group (who received support from empowered cadres) achieved a significantly higher mean ANC visit count (4 visits; SD = 15.353) compared to the control group (3 visits; SD = 3.356). The Wilcoxon test confirmed a significant improvement in ANC visits in the intervention group ($Z = -2.559$; $p = 0.001$), but not in the control group ($p = 0.120$). The Mann-Whitney test also found a significant difference between groups ($U = 73.500$; $Z = 3.444$; $p = 0.001$). These findings highlight that cadre-based empowerment significantly enhances adherence to the recommended ANC schedule compared to conventional counseling alone.

The findings of this study are consistent with several international and national studies that emphasize the positive impact of community-based empowerment programs particularly cadre or lay health worker models on maternal health service utilization, including ANC visits. A quasi-experimental study by Wafula et al. (2022) in Eastern Uganda

demonstrated that pregnant women who received structured home visits and reminders from trained community health workers were 2.4 times more likely to complete ≥4 ANC visits compared to those without such support.(30) Similar to our cadre-based empowerment intervention, their program emphasized regular follow-up, personalized counseling, and barrier reduction through localized solutions. Likewise, a cluster-randomized controlled survey in Ghana by Kassim et al. (2023) found that community health volunteer engagement increased ANC visit adherence 2.38 times.(29) These volunteers were trained similarly to our cadres and maintained frequent contact with mothers, paralleling the mechanism of empowerment employed in this study. In the Indonesian context, Ayuni and Sjaat (2023) evaluated the role of community health cadres (*kader posyandu*) and found a significant association between cadre engagement and ANC compliance, especially in highrisk pregnant women up to 82%.(24) However, unlike our study, theirs did not include structured empowerment training for cadres, highlighting the novel contribution of our findings in evaluating formalized cadre capacity-building. On the other hand, a study by Gupta and Khan (2024) in South Asian developing country reported mixed effects of community interventions, attributing this to inconsistencies in training quality, supervision, and logistical support.(31) This contrast reinforces the importance of structured empowerment and monitoring elements that were central to our cadre-based intervention model. Therefore, our study contributes to the growing evidence that well-trained, supervised, and empowered cadres can act as effective extensions of the health system to boost ANC service coverage, particularly in decentralized or underserved regions such as Bengkulu City.

Empowered cadres in this study were trained not only to convey essential maternal health knowledge but also to actively monitor ANC schedules of pregnant women within their community, remind and motivate mothers through interpersonal communication and regular home visits, identify and help overcome common barriers to ANC visits, such as lack of awareness, transport issues, or fear, and collaborate with health facilities for referral and coordination of services. This community-based support system bridges the gap between formal health services and pregnant women's daily environments, enabling more personalized, consistent, and culturally sensitive support. Cadres also served as trusted peers, reducing the psychological distance that often exists between pregnant women and health workers, especially in under-resourced settings. This approach aligns with health behavior theories such as the Health Belief Model and Theory of Planned Behavior which emphasize that social support, perceived benefit, and reduced barriers are key drivers of preventive health service uptake.

The results underscore the critical role of community-level health actors in increasing ANC coverage. By integrating cadre-based strategies into maternal health programs particularly in areas with poor ANC compliance health systems can extend service reach beyond facility walls, provide targeted follow-up to at-risk mothers, and promote equity in access and utilization of services. This evidence supports national efforts such as Indonesia's "Program Indonesia Sehat" through the family approach (*PIS-PK*) and WHO's 2016 ANC model, which promotes 8 ANC contacts requiring innovative community-based strategies to achieve. In conclusion, cadre-based empowerment significantly improved ANC visit frequency among pregnant women, confirming the effectiveness of community-level interventions in promoting timely and adequate maternal health service utilization. Strengthening and scaling such interventions may offer a cost-effective solution to increase ANC coverage, particularly in decentralized or hard-to-reach areas like Bengkulu.

This study provides valuable insights into the impact of cadre-based empowerment on antenatal care (ANC) knowledge, attitudes, and service utilization. However, several limitations must be acknowledged. First, the sample size was relatively small (n=40) and selected through purposive sampling, which may limit the generalizability of the findings. The homogeneity within groups may have also reduced the variability of sociodemographic

characteristics, potentially obscuring associations between such factors and ANC utilization. Future research should employ larger, randomized samples to enhance representativeness and statistical power. Second, the study was conducted in a single urban setting (Bengkulu City), which may not reflect the conditions in more rural or geographically isolated areas where cadre outreach faces different logistical and cultural challenges. Subsequent studies should explore the applicability of cadre-based empowerment interventions across diverse geographical and socio-cultural contexts. Third, the duration of follow-up was limited, focusing only on short-term changes in knowledge, attitudes, and ANC visits. It remains unclear whether the observed improvements are sustained throughout pregnancy or translate into better maternal and neonatal outcomes. Longitudinal studies are needed to assess the long-term effectiveness and sustainability of cadre empowerment models. Fourth, while this study evaluated the outcome effects of cadre empowerment, it did not explore the process components, such as cadre competency development, motivation, fidelity to training protocols, or barriers encountered during implementation. Future research should incorporate mixed-methods or implementation science frameworks to evaluate these factors in depth. Lastly, the control group received only standard counseling without an enhanced educational component, which may have introduced a difference in intervention intensity. Future studies could include a more active comparator (e.g., facility-based health education) to isolate the specific contribution of the cadre empowerment model.

CONCLUSION

This study demonstrated that cadre-based empowerment significantly improved pregnant women's knowledge, attitudes, and antenatal care (ANC) service utilization in Bengkulu City. Pregnant women who received support from trained ANC cadres showed greater increases in knowledge and positive attitudes toward pregnancy care, and were more likely to complete at least four ANC visits compared to those in the standard counselling group. These findings highlight the practical implication that empowering community health cadres through structured training and supervision can serve as an effective strategy to bridge the gap in maternal health education and service access, particularly in resource-constrained urban settings. The intervention model reinforces the role of community-based health promotion in supporting national efforts to reduce maternal mortality and improve ANC coverage. Given the observed impact, it is recommended that policymakers and local health authorities integrate cadre empowerment programs into routine maternal health services, ensuring adequate training, supervision, and monitoring mechanisms. For future research, larger-scale and longer-term studies are needed to validate these findings, assess the sustainability of behaviour changes, and evaluate downstream effects on maternal and neonatal health outcomes.

AUTHOR CREDIT STATEMENT

YY: Conceptualization, Methodology, Data Collection, Formal Analysis, Writing Original Draft; **EY**: Supervision, Validation, Writing, Review & Editing, Visualization; **DW**: Investigation, Resources, Project Administration, Writing, Review & Editing; **ED**: Writing, Review & Editing.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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