BMJ Open

Effectiveness of education programme to increase competency of health cadres in Indonesia: a cluster non-randomised controlled trial

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To cite: Sulistyorini D, Huq KATME, Babaita AO, *et al*. Effectiveness of education programme to increase competency of health cadres in Indonesia: a cluster non-randomised controlled trial. *BMJ Open* 2025;**15**:e095428. doi:10.1136/bmjopen-2024-095428

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2024-095428).

Received 22 October 2024
Accepted 01 December 2025

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ABSTRACT

Objectives Health cadres, who assist midwives in supporting pregnant women in community settings, need to enhance their competencies in identifying risk factors and referring high-risk pregnant women to midwives for further care. Since the capabilities of these health cadres are influenced by maternal complications, an educational programme was implemented to strengthen their skills. Therefore, this study aimed to evaluate the competency of health cadres by providing a researcher-developed educational programme.

Design An open-label, cluster non-randomised controlled trial.

Setting and participants Health cadres with at least 1 year of work experience were recruited at six public health centres (PHCs) in Banjarnegara Regency, Indonesia.

Interventions Six PHCs were selected and allocated into intervention group (IG=3 PHCs) and control group (CG=3 PHCs) groups. A total of 133 female health cadres were enrolled across the selected PHCs. At each PHC, a systematic random sampling method was used to select the participants. The researchers and health professionals provided a 3-week period of theoretical and scenario-based simulations to the IG, while the CG received no education.

Outcome measures Researcher-developed questionnaires and checklists were used to assess the knowledge, skills (health assessment, communication, attitude) and confidence. The primary endpoint was competency, a total score of knowledge and skills. The outcome domains were compared between the two groups, and a linear mixed-effect model was used to account for cluster-level variation.

Results A total of 130 (97.7%) completed the study (IG:64, CG:66). The competency score showed significant improvement at endline (CG=49.5 and IG=52.5; p=0.002). The median scores for health assessment skills (CG=12 vs IG=14; p<0.001) and communication skills (CG=7 vs IG=8; p<0.001) were increased in the IG compared with the CG. Mixed-effect model indicated that groups (β (95% CI) 2.49 (0.57 to 4.41), p=0.012), baseline knowledge (β(95% CI) 0.73 (0.54 to 0.92), p<0.001) and midline health assessment skills (β (95% CI) 0.54 (0.25 to 0.82), p<0.001) were significant positive predictors, while age was negatively associated with competency (β (95% CI) −0.20 (−0.30 to −0.10), p<0.001)).

Conclusion Education effectively increased the competency of health cadres. A well-structured education programme is necessary for health cadres to improve and maintain their competencies in monitoring high-risk pregnant women.

Trial registration number NCT06134518.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The scenario-based educational programme grounded in ethnographic observation within the community provided practical training aligned with real-world situations.
⇒ To account for differences between the multiple study sites and minimise bias, a mixed-effects model was employed.
⇒ Since the observation period for the programme's effects was 3 months, long-term impacts could not be observed.

INTRODUCTION

The Sustainable Development Goal 3.1 sets out that the global maternal mortality ratio (MMR) should be less than 70 per 100 000 live births by 2030. Each country should have an MMR of not more than 140 per 100 000 live births.[1]

According to the 2020 Population Census in Indonesia, maternal deaths were 189 per 100 000 live births, which was a substantially higher MMR compared with other countries in Southeast Asia.[2] The Central Java province initiated the most effective efforts to reduce maternal mortality by increasing the number of human resources, such as health cadres who are community health volunteer workers. The MMR in Banjarnegara regency of Central Java province in 2021 was 287 per

100 000 live births, which indicates the top 10 in that province over the last 5 years.[3]

Geological description in this regency, which is mostly mountainous with undulating and steep relief, makes it difficult for community residents 'accessibility to the health facilities when referring to the patient'.[4] This condition prevents community residents from seeking timely emergency care, early recognition of danger signs, decision-making and receiving services from the healthcare facilities. In addition, financial constraint, lack of education, physical conditions such as malnutrition and early marriage (pregnancy <17 years old) make the pregnant women more vulnerable to accessing necessary care and treatment.[4]

The ratio of health workers to the total population is an important indicator to measure the achievement level of certain health development targets. In this area, the total number of midwives is 593 (69.5 per 100 000 population). This figure is still far from the targeted ratio in 2025, which is 130 per 100 000 population for the Banjarnegara regency.[4] Therefore, regional public health centres (PHCs) appointed non-professional health cadres as volunteers, who support pregnant women to prevent complications during their pregnancy. They are considered key human resources for reducing MMR not only in Banjarnegara regency but also nationwide in Indonesia.

Even though the central and regional governments have made efforts to reduce the MMR by utilising health cadres, this effort has not been a visible achievement in terms of a decrease in MMR. The obstacles experienced by health cadres are as follows: having a low level of education and not receiving training on maternal and child health.[5] In Indonesia, health cadres are female, recruited from the community who can read and write, and receive 2 days (14 hours) of training on communication, recording and reporting about the condition of pregnant women to midwives if they find any abnormal signs.[6 7] They also instructed on how to use the Indonesian Maternal and Child Health handbook.[8]

The inclusion of health cadres as community health volunteer workers in the health system has been found to be an effective alternative strategy; however, they need to manage pregnant women more competently.[3] They are members of the community and more familiar with the problems and health needs of pregnant women. Therefore, they should be the key contact person to identify the newly pregnant women in the community. In addition, health cadres are expected to be able to recognise the risk factors experienced by pregnant women and accompany them to visit the healthcare facilities. To enable those preventative volunteer activities, health cadres need to be equipped with knowledge and skills in how to handle these activities.[9]

The Ministry of Health of the Republic of Indonesia developed a policy on maternal and child health to improve the knowledge and skills of health cadres by providing training throughout the country.[10] However, there is no standard guideline for their training management. The training is conventional, and there is still no evaluation procedure. Therefore, the training cannot serve the purpose of improving the knowledge and skills of the health cadres. They have inadequate qualities to be involved in planning and implementation in the health system.[11]

It is, therefore, necessary to increase competency by integrating and applying contextually appropriate knowledge, attitude and psychomotor skill domains to perform consistently and successfully to reduce maternal and infant mortality.[8] The competent health cadres identify pregnant women early and provide them with critical health education on prenatal care, nutrition and danger signs during pregnancy; screen pregnant women for high-risk conditions and make timely referrals to higher levels of care when needed; encourage and facilitate regular antenatal care visits, which are crucial for monitoring pregnancy progress and identifying potential complications early; offer vital social and emotional support to pregnant women; serve as an essential link between pregnant women and healthcare providers, helping to reduce disparities in access to maternal health services.[12]

It is imperative to integrate the clinical judgement with the observed condition and explain the risk to the pregnant woman and their family members for a better outcome professionally. Health cadres need self-reflection on their daily practice, gaining evidence-based knowledge, assessment skills and demonstrating the performance, including professional communication skills.[9] Therefore, this study aimed to evaluate the competency of health cadres by providing a researcher-developed educational programme. We hypothesised that health cadres who participate in the education programme acquire knowledge, skills and attitudes and integrate them into practice to identify pregnancy-related risk factors. These could increase their self-confidence in finding the risk factors of pregnant women to reduce the risks of maternal complications.

METHODS

Study framework

Competence is being able to perform successfully and consistently within a specified domain.[11] Consistency is an explicit feature of the description of competence within various qualifications and competence-based frameworks. The well-programmed education programme, which focuses on competency, facilitates acquiring knowledge, skills and attitude to perform tasks in each context. When we integrate them into practice confidence will increase. Then, health cadres can identify the risk factors of pregnant women. Ultimately, we can reduce the risks of maternal complications (online supplemental figure 1).

Study design

This was an open-label, cluster, non-randomised controlled trial. Out of the total 35 PHCs in Banjarnegara regency, Central Java Province of Indonesia, we

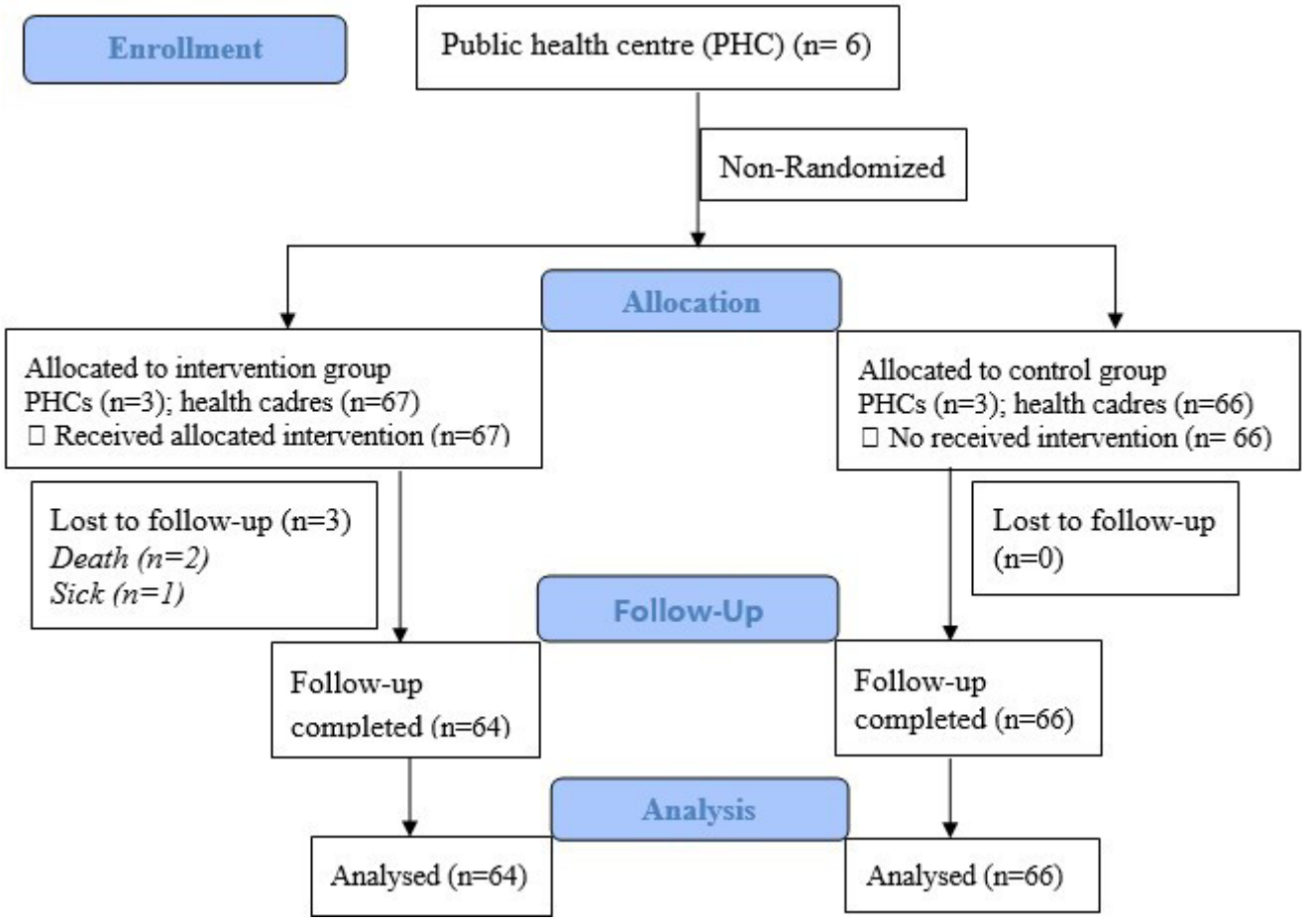

Figure 1 CONSORT flowchart. CONSORT, Consolidated Standards of Reporting Trials.

conveniently selected six PHCs for our study. Then we purposely divided three PHCs as the intervention group (IG) and three for the control group (CG), considering the distance among the PHCs and location to minimise the risk of contamination bias. We also chose one PHC from the urban area and two PHCs from the rural area for both groups to get representative samples.[13] Each PHC was notified of which group they were allocated. We enrolled in a total of 133 health cadres: 67 from the IG and 66 from the CG. In figure 1, the study was reported following the Consolidated Standards of Reporting Trials.[14] The study was conducted in accordance with the Declaration of Helsinki[15] and was registered at ClinicalTrial.gov.NCT06134518 on 15 November 2023.

Sample size

The sample size was 120 (n=60 in each group) estimated by G* power software (V.3.1.9.4, Psychonomic Society, Madison, Wisconsin) with tail (s)=two, effect size d=0.6, α error prob=0.05, power (1-β error prob)=0.9, and allocation ratio $N_2/N_1=1$.[16] We assumed this effect size as there was no previous reference found that estimated the competency; this moderate effect size could be achievable based on our study outcomes. Considering the 10% dropout, the total sample size was estimated to be 132 health cadres (n=66 per group and 132/6=22 per PHC).

Study participants and recruitment procedures

The participants who met the following criteria were included: (1) working as a health cadre at the selected PHCs for at least 1 year, (2) domiciled in the study area, (3) able to operate a telephone, (4) agreed to participate in this study and receive the whole education programme. The health cadre who was planning to move out to another city was excluded.

Prior to the commencement of the study, the principal investigator (PI, the first author) visited the heads of all the selected PHCs to get their approval to conduct this research. The PI asked the coordinator midwife to provide a list of health cadres who were eligible to participate in this study. At each PHC, 22 health cadres were selected. The way to get a sample in each PHC was by listing the entire health cadres by their years of experience from longest to shortest. Then the total number of health cadres in the PHC was divided by the desired sample size (n=22). By this, a health cadre was randomly selected between the first person on the list and the sampling interval.

After the selection, the PI contacted each participant and explained the purpose and methods of the study. They were ensured voluntary participation and free to withdraw without any penalty and obtained written

informed consent. All participants received appreciation gifts after completing the study. The researchers guaranteed their confidentiality and privacy using a unique ID number for each participant.

Training of the midwives as evaluators

The PI involved one midwife from each PHC as a coordinator. Each coordinating midwife selected 4–5 midwives from each PHC who had a minimum of 5 years of clinical experience and were capable and skilled in the clinical implementation of the midwifery profession and management of maternal and child health programmes.[17] The PI met directly with those midwives at their PHC and explained the schedule and procedure for assessing health cadres' skills and attitude at midline and endline using a skill checklist. In order to maintain consistency in the rating criteria and reduce bias introduced by multiple raters, the researchers established detailed evaluation criteria for the checklist and held discussions among evaluators.

Intervention group

The research team developed the study education programme based on a previous ethnographic observational study conducted before this trial. The study was conducted in the same community involving pregnant women, their husbands, mothers-in-law and health cadres. The study explored the barriers of unhealthy lifestyle culture influenced by family hierarchies that influenced decision-making related to reproductive health during pregnancy, which often leads to unplanned pregnancies and unsafe practices. They also described the role of health cadres in that situation and observed that health cadres handled those obstacles in an incorrect and unscientific way. These findings support that they had insufficient knowledge to identify the risk factors of pregnant women. They had insufficient communication skills to control family power balance, had less observation and health assessment skills to measure high-risk pregnancy for referral and were less respectful to pregnant women.[18] Therefore, the researcher developed a scenario-based education programme to integrate knowledge, skills and confidence besides conventional learning methods and evaluate the effectiveness of that education programme.

The duration of the education programme was 3 weeks, delivered by lectures (theory session) and scenario-based simulation training and the participants were evaluated on the fourth week. The programme is listed in table 1.

In the first week, the researchers conducted the lecture in the classroom at each PHC to give the theory session. In the second week, the health cadres received skill training from the researchers in the classroom. After receiving the skill material, every health cadre practised this skill with other health cadres. On the third week in the classroom, the researcher invited some pregnant women, and the health cadres conducted the skills with pregnant women through scenario-based simulation training. Health cadres learn clinical judgement of abnormal sign findings and how to effectively communicate with pregnant women and their surroundings. At the fourth week evaluation, use the scenario-based test to measure the competency (skills) of health cadres. The scenario is created by developing a case study in which a health cadre visits a pregnant woman's home who has risk factors for pregnancy complications. Health cadres must perform several skills to be assessed, including health assessment skills, communication skills and attitude. These skills include health cadres asking about the medical history for risk factors for maternal complications in pregnant women, physical examination and health education. Midwives as evaluators conducted health cadres' skills one by one and used the evaluation based on the skills checklist test.

Control group

Health cadres did not receive any education or intervention. We collected knowledge and confidence data at three time points (baseline, midline and endline) as well as skills and attitude data at two time points (midline and endline).

Patient and public involvement

Pregnant women, their family members and community people were involved by explaining their daily lifestyle activities from the initiation of the study. To develop the programme materials, we included those themes. However, participants/public were not involved in the study design, conduct, reporting or dissemination plan of this study. We did not disseminate the study results to participants.

Evaluation outcomes

The primary endpoint of this study was the competency level of health cadres, which comprised the total score of the knowledge questionnaire and skills checklist (health assessment, communication and attitude) (online supplemental file 1). The secondary endpoints were each domain of competency and confidence.

Measurement tools

All the questionnaires and checklists were developed by the research team and reviewed by consulting with three expert researchers (a university midwifery lecturer, a PHC head midwife and a midwife from the Regency Health Department in the field of midwifery) for checking face and content validity. To evaluate the skills of health cadres, midwives in each PHC assessed the health cadres when they conducted health assessment skills to pregnant women, using a scenario-based test skills checklist.[19]

Knowledge

The knowledge questionnaire consisted of 35 items with a score range of 0–35. Each item denotes a score of '1' as a correct answer and '0' as an incorrect answer. The contents about the role of health cadres, normal pregnancy and fetal growth process, nutrition and supplement blood tables for pregnant women, and risk factors for maternal mortality during pregnancy.

Table 1 Health cadres' overall competency improvement education programme

First week (1 day, 4 hours): classroom, theory session	
Objectives	1. Understand the definition and role of health cadres 2. Understand the normal pregnancy and fetal growth process 3. Understand misunderstandings and myths related to pregnancy care (understand the results of following unscientific behaviours) 4. Understand pregnant women's check-ups 5. Identify the danger signs of pregnant women 6. Identify the risk factors of postpartum haemorrhage 7. Understand the quality and quantity of nutritious food intake for pregnant women 8. Understand the importance of iron tablet intake for pregnant women
Materials	1. Regulation of the Ministry of Health of the Republic of Indonesia regarding health 2. Indonesian Maternal and Child Health handbooks 3. Qualitative research results (list of myths and theories according to the results of the first research) 4. Liu et al. BMC Pregnancy and Childbirth (2021) 21:332
Method	Lecture (face-to-face)
Second week (1 day, 4 hours): skills training	
Objectives	1. Understand how to monitor risk factors and signs in pregnancy (hypertension, fetal movement, anaemia, chronic energy deficiency, diabetes mellitus, other pregnancy-related diseases) 2. Learn medical history taking of pregnant women about the risk of maternal mortality 3. Acquire health assessment skills necessary for health cadres (blood pressure measurement, palpation of the abdomen, height, weight, BMI) 4. Learn effective communication skills for a pregnant woman and her surroundings
Materials	1. Height measuring machine, weight measuring machine, blood pressure measuring machine 2. Indonesian Maternal and Child Health Handbook 3. Checklist of skills for health cadres
Method	Lecture and skills training (face-to-face)
Third week (1 day, 4 hours): classroom, scenario-based simulation training	
Objectives	Learn clinical judgement of abnormal findings and how to effectively communicate with a pregnant woman, her surroundings and midwives
Materials	1. Pregnant woman as a simulated patient 2. Scenario 3. Checklist of skills for health cadres
Method	Scenario-based simulation
Fourth week (1 day, 2 hours): home visit, evaluation (scenario-based test)	
Objectives	Evaluate the improvement of competency (30 min per health cadre)
Materials	1. A simulated patient of a pregnant woman 2. Checklist of skills for health cadres
Method	Evaluation by scenario-based simulation (test 30 min per person) Knowledge and confidence test

BMI, body mass index.

Skills

The skills checklist for measuring the competency of health cadres was also developed based on guidelines from the Ministry of Health of the Republic of Indonesia and the Indonesian Maternal and Child Health handbook.[8 20] Health assessment skills consisted of 17 items, with scores ranging from 0 to 17; each item score of '1' denotes an accurate skill and '0' denotes an inaccurate skill. The content includes health cadres conducting interviews with pregnant women about risk factors for maternal death during pregnancy and see the results of examinations carried out by midwives in the maternal and child health book for pregnant women; health cadres conducted the physical examination and health education of pregnant women.

The communications skills had 8 items, ranging from 0 to 8; in each item, '1' denotes an accurate skill and '0' denotes an inaccurate skill. The attitude scale had 5 items with scores ranging from 0 to 5; in each item, '1' denotes an accurate attitude and '0' denotes an inaccurate attitude. Content of communication skills includes language that is easy to understand, paying attention to each answer, using the principles of effective communication, making the atmosphere fun and more intimate, making

the pregnant women talk and listen, engaging the target towards behaviour change and using the communication tools/educational media.

The attitude scale had 5 items, with scores ranging from 0 to 5; in each item, '1' denotes an accurate attitude and '0" denotes an inaccurate attitude. The content of attitude includes health cadres greeting pregnant women and families in a friendly manner, introducing pregnant women and family, explaining the purpose of the home visit to pregnant women, responding to the pregnant woman's reaction, patience and thoroughness.

Competency

Total scores for each domain of knowledge and skills (health assessment, communication and attitude) were calculated. Then, the competency score was obtained by summing up four domain scores (total=65). Higher scores indicate a high level of competency.

Confidence

To measure the level of confidence, which included 7 items, we used a 5-point Likert scale, and scores ranged from 7 to 35; a higher score indicated higher confidence. We found that our questionnaire and checklist were valid and reliable in this study (Cronbach's alpha 0.8).

In addition, sociodemographic information was collected at baseline: age, educational level, marital status, number of children and year of work experience.

Timing and procedure of data collection

Participants from both groups received a knowledge test, confidence questionnaires and sociodemographic data at baseline (T0). Then, IG joined the education programme; the CG received no education. Right after the completion of the education programme, both groups' knowledge, skills and confidence were assessed at midline (T1). Two months after T1, PI conducted the second assessment at endline (T2) for IG and CG (online supplemental figure 2). After collecting data, researchers input the data into a password-protected personal computer in an Excel file. Then, the data was cleaned, deidentified and coded with and unique ID number allocated for each participant. Only the research team has access to the data.

Data analysis

Data were analysed by JMP, Pro V.17 (SAS Institute, Cary, North Carolina, 1989~2023)[16] and SPSS for Windows V.27.0.1.0.[21] and R V.4.3.1 (lme4 package) and SPSS for Windows V.27.0.1.0.[22] Per protocol set analysis was used. Mean and SD or median (IQR) were used to describe the data. The normality of the data distribution was checked using Shapiro-Wilk's test for both the IG and CG. For normally distributed data (age and years of work experience), the descriptive statistic is presented in mean and SD; for the non-normally distributed data (educational level, marital status and number of children), descriptive statistic was presented in frequency and percentage. For baseline comparison, Student's t-test, χ^2 test and Fisher's exact test were performed. The Wilcoxon rank-sum test was used to compare competencies of the two groups at each time point, changes in knowledge (midline-baseline, endline-baseline and endline-midline) and skills and attitude (endline-midline) and confidence. The Kruskal-Wallis test was used to compare the differences among six PHCs.

To evaluate the effectiveness of the intervention, we applied a linear mixed-effects model with competency score at endline as the dependent variable. Fixed effects included group (IG vs CG), age, educational level, work experience, baseline knowledge and midline skills (health assessment, communication and attitude). PHC was included as a random intercept to account for potential clustering at the facility level. The model was fitted using maximum likelihood, and 95% CIs were obtained using the Wald method. Model performance was summarised using marginal and conditional R^2, representing the variance explained by fixed effects alone and by both fixed and random effects, respectively. The significance level was set at $p<0.05$.

RESULTS

Sociodemographic characteristics of the participants

Out of 133 enrolled, 3 participants from the IG dropped out (two had died and one was sick), and 130 (IG:64, CG:66) were used for final analysis (figure 1). All of the participants were female. The mean (SD) age of the participants was 41.3 (8.4) years, and the age was significantly younger in the CG 39.6 (7.8) than the IG 43.1 (8.8) (p=0.017). Moreover, their work experience was significantly longer in the IG 13.6 (9.3) compared with the CG 10.1 (7.4) (p=0.044). In both groups, more than 50% of participants had education levels in senior high school and above, and most of them were married (96.9%) and had children (96.2%) (table 2). Sociodemographic characteristics of the participants of six PHCs are compared in online supplemental table 1.

Students' t-test (age and years of work experience), χ^2 and Fisher's exact test (education level, marital status and number of children), SD.

Comparison of competencies of the intervention and CGs

The median competency score was significantly higher in the IG than the CG at midline (53.5 vs 45.5; p<0.001) and endline (52.5 vs 49.5; p=0.002). Analysing each component of competency, in the IG, the median knowledge score improved at midline and slightly decreased at endline (baseline: 23; midline: 27; endline: 25.5). On the other hand, in the CG, the median knowledge score improved consistently across the timepoints (baseline: 25; midline: 26; endline: 27). Between group comparisons, there was no significant difference in the IG and CG knowledge at midline (27 vs 26; p=0.106) and endline (25.5 vs 27; p=0.371). After the education programme, the scores for IG on health assessment skill, communication skill and attitude were significantly higher than the CG (14, 8, 5 vs 10, 6, 5, respectively; all p<0.05). While

Table 2 Sociodemographic characteristics of the participants (n=130)

Variables	Total, n=130	Control group, n=66	Intervention group, n=64	P value
Age, mean (SD) Range	41.3 (8.4) 23–63	39.6 (7.8) 23–54	43.1 (8.8) 26–63	0.017*
Education level, n (%)				0.789
Junior high school and below	56 (43.0)	30 (45.5)	26 (40.6)	
Senior high school	61 (47.0)	29 (43.9)	32 (50.0)	
Diploma and above	13 (10.0)	7 (10.6)	6 (9.4)	
Marital status, n (%)				0.975
Married	126 (96.9)	64 (97.0)	62 (96.9)	
Widow	4 (3.1)	2 (3.03)	2 (3.1)	
Number of children, n (%)				0.662
No children	5 (3.8)	2 (3.03)	3 (4.7)	
Have children	125 (96.2)	64 (97.0)	61 (95.3)	
Years of work experience, mean (SD)	11.9 (8.6)	10.13 (7.4)	13.64 (9.3)	0.044*

*Statistically significant at p<0.05.

the IG maintained health assessment skills, communication skills and attitude performance at endline (14, 8, 5, respectively), the CG maintained health assessment skills, communication skills and attitude (12, 7, 5, respectively) performance increased. Despite this unexpected trend in the CG performance, the group comparison showed that the IG group performed significantly better than the CG (table 3). We showed the changes in scores of each component of competency (knowledge, health assessment skill, communication skill and attitude) at each time point in online supplemental figure 3.

Comparison of changes in participants' competencies

Since the CG (25) baseline knowledge was significantly higher than the IG (23) (p=0.001), we further analysed the change in score from each timepoint. For competency, comparing the change in performance from endline to midline, the CG (3) significantly improved over the IG (0) (p<0.001). Regarding knowledge, the gain in performance from endline to baseline was significantly higher for the IG (3) than the CG (1) (p=0.005).

As we did not collect data at the baseline for health assessment skill, communication skill and attitude, we compared endline–midline of all scales. We found significant score elevation in competency in CG (0 vs 3) (p<0.001), and all of the subscales significantly improved (p<0.05) in the CG (online supplemental table 2).

Analysis of reverse results

Due to unexpected consistent improvement in the CG performance and this is a non-randomised cluster design, we analysed each component of competency at the PHC. The knowledge score for each (PHC: 1, 2 and 3) of the IG clusters improved from baseline (23, 23 and 20) to midline (28, 26 and 27) and decreased at endline (27, 24 and 27). However, the knowledge score at the clusters of CG (PHC: 4, 5 and 6) improved from baseline (26, 25 and 25.5) to midline (25, 26 and 26.5) and endline (26.5, 26 and 28) (online supplemental figure 4A). Likewise, the health assessment skill and communication skill improved from midline to endline at PHC 5 (9.5 to 13 and 4 to 7) and PHC 6 (7 to 9 and 6 to 8) (online supplemental figure 4B,C). While the IG PHCs maintained their attitude from midline (5, 5 and 5) to endline (5, 5 and 5), PHC 5 demonstrated improved attitude at endline (3 to 5) (online supplemental figure 4D). These isolated events at some clusters contributed to the non-significant effect of the sustainability of the programme; hence, the significant gain in competency from midline to endline (online supplemental table 2). The distribution of endline competency scores by PHC and group is presented in online supplemental table 1. Age, experience, knowledge at baseline, knowledge differences (endline-baseline and endline-midline), competency at midline and endline and competency differences (endline-baseline) were significantly improved. Moreover, median scores were consistently higher in the intervention PHCs compared with control PHCs.

Effectiveness of the intervention

We evaluated the effectiveness of the intervention using a linear mixed-effects model, with competency at the endline as the outcome (table 4). Independent variables included group, age, educational level, work experience, baseline knowledge and midline skills (health assessment, communication and attitude). The IG showed significantly higher competency than the CG (β (95% CI) 2.49, (0.57 to 4.41), p=0.012). In addition, baseline knowledge (β(95% CI) 0.73 (0.54 to 0.92), p<0.001) and midline health assessment skills (β (95% CI) 0.54 (0.25 to 0.82), p<0.001) were significant positive predictors, while age was negatively associated with competency (β (95% CI) −0.20 (−0.30 to −0.10), p<0.001). Both marginal and

Table 3 Knowledge, health assessment skill, communication skill, attitude and competency scores of the participants (n=130)

Variable	Group	Baseline		Midline		Endline	
		Median (25th–75th percentile) (min–max)	P value	Median (25th–75th percentile) (min–max)	P value	Median (25th–75th percentile) (min–max)	P value
Knowledge	Control (n=66)	25 (23–27) (11–30)	0.001*	26 (23–28) (16–32)	0.106	27 (22.8–29) (15–32)	0.371
	Intervention (n=64)	23 (19.3–25) (10–29)		27 (24.3–29) (14–33)		25.5 (23–28) (10–33)	
Health assessment skill	Control (n=66)			10 (7–13) (2–15)	<0.001*	12 (9.8–13) (3–15)	<0.001*
	Intervention (n=64)			14 (13–15) (9–16)		14 (13–15) (10–16)	
Communication skill	Control (n=66)			6 (4–8) (0–8)	<0.001*	7 (6–8) (6–8)	<0.001*
	Intervention (n=64)			8 (8–8) (6–8)		8 (8–8) (7–8)	
Attitude	Control (n=66)			5 (3–5) (0–5)	<0.001*	5 (5–5) (3–5)	0.034*
	Intervention (n=64)			5 (5–5) (3–5)		5 (5–5) (4–5)	
Competency†	Control (n=66)			45.5 (41–50) (29–56)	<0.001*	49.5 (45–53) (32–57)	0.002*
	Intervention (n=64)			53.5 (50–55) (43–60)		52.5 (49–55) (37–62)	

Wilcoxon rank-sum test.
*Statistically significant at p<0.05.
†Competency score was calculated by summing up knowledge, health assessment skill, communication skill and attitude score.

conditional R^2 were 0.52, indicating that approximately half of the variance in endline competency was explained by the fixed effects (eg, group allocation, baseline knowledge and midline skills). The intraclass correlation coefficient for PHC was 0, showing that random effects (ie, clustering by PHCs) contributed minimally.

Comparison of participants' confidence

The confidence scores of the participants between the CG and IG at the baseline were not significant (p=0.846). However, after intervention, the scores of the IG improved than the CG at the midline and endline (p<0.05) (table 5).

DISCUSSION

We developed the education programme, which integrated knowledge, health assessment skills, communication skills and attitude into a scenario-based simulation test for experienced health cadres to improve overall competency. In addition, increasing the competency of health cadres could maintain their confidence while they were dealing with patients with complications. Our results supported this hypothesis that health cadres who complete the education programme acquired and maintained higher levels of competency compared with those who received no education programme within the health system of PHCs.

Competency of the participants

Competency significantly improved in the IG (53.5) compared with the CG (45.5) after receiving educational intervention (at midline). In the IG, the competency was slightly decreased (53.5 to 52.5) after a 2-month follow-up from right after implementing the education programme. This can be considered as a fadeout process.

Table 4 Factors associated with competency at endline (linear mixed-effects model)

Predictor	Coefficient (B)	95% CL lower	95% CL upper	P value
Group (intervention vs control)	2.49	0.57	4.41	0.012*
Age (year)	−0.2	−0.3	−0.1	<0.001*
Education (senior high vs junior or below)	1.53	0.09	2.97	0.039*
Education (diploma and above vs junior or below)	−1.15	−3.56	1.25	0.35
Work experience (years)	0.03	−0.07	0.14	0.525
Knowledge (baseline)	0.73	0.54	0.92	<0.001*
Skill				
Attitude (midline)	0.45	−0.68	1.58	0.437
Health assessment skill (midline)	0.54	0.25	0.82	<0.001*
Communication skill (midline)	−0.01	−0.58	0.57	0.985
Random/model fit				
Var (PHC intercept)	0	–	–	–
Residual variance	14.09			
ICC_PHC	0	–	–	–
Marginal R^2	0.52	–	–	–
Condition R^2	0.52	–	–	–

Group ref=control group.
Education ref=junior high school or below.
Marginal R^2 = variance explained by fixed effects.
Conditional R^2 = variance explained by both fixed and random effects.
Model fitted using linear mixed-effects model with PHC as a random intercept, maximum likelihood estimation (ML).
*Statistically significant at p<0.05.
ICC, intraclass correlation coefficient; PHC, public health centres.

On the contrary, the competency of the CG significantly increased (45.5 to 49.5) until the endline. We analysed the component of competency of each PHC and found that, from midline to endline, communication skills (4 to 7, and 6 to 8) and health assessment skills (9.5 to 13 and 7 to 9) increased in two PHCs in CG, while attitude increased (3 to 5) in one PHC in the same group. The increase in scores in the CG could be due to the John Henry effect[23] as they were aware of being observed and graded. However, the scores were increased to some extent, but not up to the level of IG.

In contrast, the IG, after receiving the education at baseline, the scores of all 3 PHCs for communication and attitude were found to be highest (8 out of 8 and 5 out of 5) and health assessment 14, 15 and 14 out of 17. It could be assumed that, as the health cadres are considered professionals in their practice, to redeem their image, they tried to consciously practise and perform better than in the previous assessment time points. This indicates that integration of knowledge, health assessment skills, communication skills and attitude through scenario-based training

Table 5 The confidence of the participants (n=130)

		Baseline		Midline		Endline	
Variables	Group	Median (25th–75th percentile) (min–max)	P value	Median (25th–75th percentile) (min–max)	P value	Median (25th–75th percentile) (min–max)	P value
Confidence	Control (66)	22 (19.8–26) (10–29)	0.846	24 (21–26.3) (12–30)	0.043*	24 (21–27) (14–33)	0.031*
	Intervention (64)	23.5 (19–26) (7–30)		26 (23.3–28) (13–35)		27 (22.3–28) (8–35)	

Confidence minimum score 7 and maximum score 35, Wilcoxon rank-sum test.
*Statistically significant at p<0.05.

is effective in improving health cadres' competency and conscious practice.

We evaluated the improvement of knowledge in the IG and found that it was improved at the midline (right after the intervention) and decreased slightly at the endline (2 months after the education programme) but remained higher than that of the CG. This indicates that periodical learning sessions are necessary to keep their knowledge accurate and updated. One study conducted among the health cadres in Indonesia found a significant positive impact on knowledge for health education.[24]

We found that baseline knowledge, younger age, group and health assessment skills acquired in the programme were the influencing factors for sustaining the level of competency. CG originally held higher levels of knowledge at the baseline (25 vs 23), which affects the competency till the end. As we had more younger participants in the CG, they might have acquired more knowledge. This finding is supported by one study that older participants had the capacity to acquire significantly less knowledge.[25] More than half of our health cadres (57%) completed high school and above and there was no difference between the IG and CG. One study found significant improvement in knowledge among the health cadres after providing education. However, they had more participants who completed high school and above in the IG compared with the CG.[26] Contrary to the significant older age and longer work experience in the IG, this study shows that younger age predicts the competency at endline. This finding is in concert with another study that explained that younger health professionals consistently practise competencies and work more efficiently as interdisciplinary team members compared with their older counterparts. Moreover, more experienced health professionals showed less consistent application of quality improvement methods than their less experienced counterparts.[27]

The Maternal and Child Health Handbook was introduced in 1994 in Indonesia. This book has become a common tool for development partners and medical professional organisations to support the government's efforts to increase the coverage of various components of essential maternal and child health services.[28] The younger generation might be more enthusiastic to gain knowledge regarding maternal health. Also, their flexibility in sensing what they were evaluated made their attitude and communication skills at the endline.

Importantly, we observed that the health assessment skill acquired in the education programme was another strong influencing factor for competency. Regarding health assessment skills, scores of IG (14 to 14) were significantly higher than those of CG (10 to 12) at the midline and endline. This indicated that the acquisition of skills is effective and necessary for this programme. This skill was not acquired without training, and the most important ability was to detect abnormality.

The findings of our ethnographical observation showed that, although health cadres had knowledge following the maternal and child health handbook, they could not appropriately leverage it in the detection of risk factors and understand the right timing to refer pregnant women to healthcare facilities. Moreover, they did not have the accurate skills to assess pregnant women.

It is essential to have a professional attitude among the health cadres to get trust from pregnant women and their family members. In improving communication skills to persuade the right action in the existing strong family power balance, our scenario-based training showed cases to perform their roles. The majority (96.2%) of our participants had children and experience of having a pregnancy and childbirth. In Indonesia, this scenario-based training is not yet well practised. Therefore, using health cadres' experience, comprehensive learning and focusing on their competency is rather more effective. This education programme could be an opportunity to integrate health cadres' knowledge, skills and attitude into their practice.

We set up communication skills training for the health cadres to make a rapport and educate pregnant women and their family members, observing power balance within the family. We found the average communication skill score among the participants in the IG at endline was 8 out of 8 compared with CG (7.3 out of 8), which suggests the education programme worked. The communication skills are crucial for healthcare providers as they directly impact their ability to effectively listen, convey information and build trust with clients and community members.[29] Health cadres need to have good problem-solving skills to monitor the health of pregnant women, especially to find out risk factors for maternal deaths related to pregnancy.

The attitude scores of IG (5) were not found to have significantly improved compared with CG (5) at the endline. One study was conducted among the nurses to evaluate the effects of attitudes and found significant improvement in a 3-month follow-up period.[30] As we intervene with health cadres only for a short period, this time would not be sufficient for the improvement of attitude among our participants. One study conducted by S. Utami showed positive findings that the attitude of health volunteers of the community health centre in Indonesia was improved after health education intervention.[31]

Confidence of the participants

After intervention, the confidence scores of the IG improved, with the IG (27) scores higher than the CG (24) scores at the endline. The confidence can directly affect how individuals apply their competencies in the management of monitoring pregnant women. Those with higher confidence are more likely to utilise their skills effectively and take calculated risks to perform better under pressure.[32] The results of this study show that there was an increase in confidence of the health cadres at midline and endline. Similar results from Ruiz *et al* demonstrated that a core competency-based training programme can successfully influence community health

workers' perceived confidence, affect intention and provide a larger social justice context for their work and role.[33]

Study strengths and limitations

We selected the PHCs non-randomly to avoid research contamination. We used six PHCs from urban and rural areas to increase the generalisability of the study findings.

This study has some limitations. First, as the study was cluster non-randomised, it might introduce sampling bias, potentially leading to overrepresentation of certain groups and limiting the generalisability of the findings. This design also caused notable differences in sociodemographic characteristics between groups, which may have influenced the primary outcome. However, we adjusted those differences using a mixed-effect model. Second, the open-label nature of the trial meant that participants were aware of their group allocation, introducing the possibility of performance bias. Moreover, the outcomes evaluated relied on self-completed questionnaires and the use of a subjective outcome may have biased the results in favour of the IG. Third, the educational intervention was delivered over a brief period of 3 weeks, which may not have been sufficient to produce sustained improvements in competency. Finally, skill was evaluated by different evaluators in each of the PHCs; therefore, there might be differences in the rating of the participants. To minimise this bias, we ensured a detailed checklist and trained the evaluators in groups.

CONCLUSION

This research shows that the education programme is effective in increasing the competency of health cadres. The knowledge that they originally possessed had an impact on their competencies. However, after receiving the education programme, IG achieved improved scores in knowledge, health assessment skills, communication skills and attitude compared with the CG and was able to maintain the sustainability of improvement throughout the study period, which increased the total competency scores. Therefore, our intervention was considered successful as we hypothesised. We recommend continuing educational programmes regularly for the health cadres, especially for the young people, so that the competency can always be well maintained in carrying out monitoring to find risks to pregnant women. Therefore, their competency can possibly support the effort of reducing the risk of maternal complications.

Acknowledgements The authors would like to thank all the health cadres who agreed to participate in this study, as well as the research team members (lecturers at Polytechnic Banjarnegara, midwives, nutritionists and communication trainers professional in IG PHCs) who collected data and gave the education programme, the head of PHC and midwives in PHC Banjarnegara 1, Rakit 2, Pejawaran, Mandiraja 1, Punggelan 1 and Pagentan 2.

Contributors DS, MK and MM developed concept, design and educational content. DS did implementation and data collection. AOB, SAA, KK, YF did data analysis, and DS, KATMEH, AOB, GH, MM did interpretation of data. DS, EH, AOB and MM did manuscript drafting. All authors read and approved of the final manuscript. MM is responsible for the overall content as guarantor.

Funding The study was funded by the Center for Higher Education Funding and Fund Management Organization (reference number 1770/J5/KM.01.00/2021), Ministry of Education, Culture, Research and Technology, the Republic of Indonesia.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Consent obtained directly from patients.

Ethics approval This study was approved by the Institutional Review Board (number:550/EA/KEPK~FKM/2023) of Diponegoro University in Indonesia on 30 October 2023. Email: ecfkmundip18@gmail.com. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer-reviewed.

Data availability statement Data are available upon reasonable request. The data used and analysed in this study are available from the corresponding author on reasonable request.

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