

(RESEARCH ARTICLE)



EFFECT OF PREGNANCY SCHOOL PARTICIPATION ON MATERNAL AND NEWBORN HEALTH KNOWLEDGE AMONG PREGNANT WOMEN IN THE VOLTA AND SAVANNAH REGIONS OF GHANA: A CONTROLLED, NON-RANDOMISED QUASI-EXPERIMENTAL STUDY

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ABSTRACT

Antenatal care in Ghana reaches most pregnant women, but routine clinic talks are brief and may not produce the understanding needed for timely care-seeking. The Pregnancy School offers structured, interactive group education alongside routine antenatal care, yet its effect on knowledge has not been evaluated with a concurrent comparison group in Ghana. This study assessed the effect of Pregnancy School participation on maternal and newborn health knowledge. A controlled, non-randomised, longitudinal quasi-experimental study with an embedded qualitative component was conducted in four health facilities in the Volta and Savannah Regions. Two facilities delivering Pregnancy School supplied the intervention group and two facilities providing routine antenatal care supplied the comparison group; 225 pregnant women were recruited systematically into each group. Objective knowledge was measured with a 12-item test (score 0–12) and perceived knowledge with a self-rated scale (0–32) at enrolment and endline. The primary effect measure was the difference-in-differences (DiD) in mean objective knowledge, estimated from a linear model with a group-by-time interaction. Baseline objective knowledge was similar in the two groups (5.97 vs 5.66; $p = 0.114$). At endline, mean scores were 10.13 in the intervention group and 7.90 in the comparison group ($p < 0.001$). The DiD was +1.92 points (95% CI 1.39–2.45; $p < 0.001$; Cohen's $d = 0.94$), and every item improved by 16.4 to 18.2 percentage points more in the intervention group. Perceived knowledge showed a DiD of +2.70 points (95% CI 1.95–3.45; $p < 0.001$). Knowledge gain rose with session attendance, from +1.42 points among non-attenders to +5.12 points among women attending more than five sessions (p -trend < 0.001). Women attributed their learning to repetition, demonstrations, and the opportunity to ask questions. Pregnancy School was associated with a substantially greater gain in maternal and newborn health knowledge than routine antenatal care. Because programme status was determined by facility, the estimate should be confirmed in studies that randomise more facilities.

Keywords: Pregnancy School; Antenatal Education; Maternal Health Knowledge; Newborn Care; Difference-In-Differences; Quasi-Experimental Study; Ghana

1 INTRODUCTION

Maternal and newborn health remains a central concern for health systems in low- and middle-income countries. An estimated 260,000 women died from causes related to pregnancy and childbirth in 2023, and sub-Saharan Africa accounted for approximately 70% of these deaths [1]. Many of these deaths, and many newborn deaths, follow complications that can be recognised and managed when women understand warning signs, prepare for childbirth, and seek skilled care without delay [2,3]. The World Health Organization therefore positions antenatal care not only as a platform for screening and prevention but also for health promotion and for a positive pregnancy experience in which women understand and participate in their care [4].

High antenatal attendance does not, by itself, ensure this educational function. In busy clinics, health talks are often delivered to large waiting groups, leaving little time for questions or checking what women have understood [5,6]. Structured antenatal education programmes, often described as pregnancy schools, address this gap by providing planned, repeated, and interactive sessions on nutrition, danger signs, birth preparedness, breastfeeding, and newborn care alongside routine clinical care [7,8]. Such programmes have been associated with improved knowledge and related outcomes in Egypt, Tanzania, and Nigeria [9–11], and learning alongside other pregnant women may provide additional opportunities for reflection and mutual support [12,13].

In Ghana, a cluster-randomised trial of group antenatal care in the Eastern Region reported greater improvements in maternal health literacy, birth preparedness, and knowledge of newborn danger signs and care than individual care [14–16], and its process evaluation found that women valued learning together [17]. However, a Cochrane review of group versus conventional antenatal care found no statistically significant overall differences in preterm birth or low birth weight [18]. Group antenatal care may also differ from Pregnancy School: the former can reorganise clinical assessment, scheduling, and continuity of care, whereas the latter places greater emphasis on structured education within existing services [19]. Community-based Pregnancy School initiatives are being promoted in rural Ghana [20]; however, their effect on women's knowledge has not been assessed against a concurrent comparison group.

Knowledge is a necessary, though not sufficient, step towards preventive practices and timely care-seeking through which antenatal education is expected to improve outcomes [21]. Establishing whether Pregnancy School produces greater gains in knowledge than routine antenatal care is therefore the first test of its proposed pathway. This article reports the first objective of a larger evaluation: to assess the effect of Pregnancy School participation on pregnant women's knowledge of pregnancy, maternal health, and newborn health in selected facilities in the Volta and Savannah Regions of Ghana.

2 MATERIAL AND METHODS

2.1 Study design

We conducted a controlled, non-randomised, longitudinal quasi-experimental study with pre- and post-intervention measurements and an embedded qualitative component. Exposure was determined by the existing service arrangement at each facility: women attending facilities that delivered Pregnancy School formed the intervention group, and women attending facilities that provided routine antenatal care without a formal Pregnancy School programme formed the comparison group. The study integrated quantitative and qualitative findings at the interpretation stage [22].

2.2 Study setting

This study was conducted in four health facilities. Peki Government Hospital (South Dayi District) and Ave-Dakpa Health Centre (Akatsi North District), both in the Volta Region, delivered Pregnancy School. The Ho Municipal Hospital in the Volta regional capital and East Gonja Municipal Hospital in Salaga, Savannah Region, provided routine antenatal care and served as comparison facilities. The comparison facilities were selected for broadly similar patient loads and maternity service arrangements, but were not formally matched to the intervention facilities.

2.3 Intervention and comparison condition

Pregnancy school consisted of planned group sessions delivered by midwives in addition to routine antenatal care. Sessions covered nutrition in pregnancy, the importance of antenatal care, danger signs, birth preparedness, breastfeeding, postnatal care, newborn care, and family planning, using discussion, practical demonstrations, and familiar local languages, with opportunities for male partners to attend. Among the intervention participants, the topics most frequently reported as covered were the importance of antenatal care (92.0%), nutrition (88.0%), and breastfeeding (86.7%), while family planning was the least frequently reported (64.0%). Women in the comparison group received the routine health education provided during antenatal visits, which was delivered during waiting periods or consultations. Therefore, the comparison was between structured education and routine counselling, not between education and no education.

2.4 Participants and sampling

Eligible participants were pregnant women aged 18–45 years in any trimester who attended antenatal care at a participating facility and gave written informed consent. We excluded women with severe conditions requiring specialised care or for whom we could not obtain essential baseline information. Within each facility, we selected women by systematic sampling from the antenatal register, using a facility-specific sampling interval and a random start. If a selected woman was ineligible or declined, we approached the next eligible attendee and resumed the sequence. Peki and Ho each contributed 113 women, and Ave-Dakpa and East Gonja contributed 112 each, for a total of 225 women per group.

2.5 Sample size

The sample size was calculated to compare two independent proportions, assuming that 50% of the comparison group and 65% of the intervention group would attain good knowledge, with a two-sided α of 0.05 and a power of 80%. This required 170 women per group, or 189 per group after a 10% allowance for attrition and incomplete data. The sample size of 225 per group exceeded this threshold. A retrospective sensitivity calculation using an intra-cluster correlation coefficient of 0.01 [14] and a mean of 112.5 women per facility gave a design effect of 2.12, indicating that the sample would have been insufficient if facility clustering had been fully considered.

2.6 Data collection and measures

A structured questionnaire was administered at enrolment (baseline) and again during antenatal follow-up (endline). The questionnaire recorded socio-demographic and obstetric characteristics and the two knowledge outcomes. Objective knowledge was measured using 12 items covering sources of iron, additional meals, the recommended number of antenatal visits, the importance of early antenatal care, danger signs, signs requiring immediate care, birth preparedness, the timing of the first postnatal check-up, the timing of breastfeeding initiation, the duration of exclusive breastfeeding, keeping a newborn warm, and the return of fertility after childbirth. Each correct answer scored one point, giving a total of 0 to 12; a score of 9 or more was classified as good knowledge. Perceived knowledge was measured using a self-rated scale scored from 0 to 32. Session attendance was recorded for intervention participants. The instruments were reviewed by maternal health and research experts and pretested among antenatal attendees at a non-study facility, and the internal consistency of the knowledge items was assessed using the Kuder–Richardson Formula 20.

Semi-structured interviews were conducted with 24 purposively selected women, six from each facility, chosen to vary in age, parity, gestational age, and schooling. Interviews explored women's understanding of antenatal information, their experience of the education they received, and the circumstances affecting the use of advice.

2.7 Statistical analysis

Participant characteristics were summarised by group as counts and percentages and compared using Pearson's chi-square test. The proportion of correct responses to each knowledge item was compared between groups at each wave using the chi-square test, and mean scores were compared using independent-samples t-tests; within-group change was assessed using paired t-tests. The primary effect measure was the difference-in-differences (DiD) in mean objective knowledge $(K_{I,T1} - K_{I,T0}) - (K_{C,T1} - K_{C,T0})$, where K is the mean score, I and C denote the intervention and comparison groups, and T₀ and T₁ denote baseline and endline. The DiD was estimated as the group-by-time interaction in a linear regression model, $\text{Knowledge} = \beta_0 + \beta_1\text{Group} + \beta_2\text{Time} + \beta_3(\text{Group} \times \text{Time})$, and the same approach was applied to perceived knowledge. A standardised effect size (Cohen's d) was calculated for each DiD estimate and interpreted as small (0.2), medium (0.5), or large (0.8). Among intervention participants, the association between the number of sessions attended (0, 1–2, 3–5, >5) and knowledge change was examined using one-way analysis of variance (p for trend). Analyses were performed in Stata 18, and all tests were two-sided at $\alpha = 0.05$. Interview transcripts were analysed thematically through repeated reading, coding, and the development of themes, and the themes relating to learning were compared with the quantitative findings.

3 RESULTS

3.1 Characteristics of participants

A total of 450 women were enrolled, 225 in each group (Table 1). Most were aged 25–34 years (61.7% in the intervention group and 59.6% in the comparison group), married (87.1% and 88.4%), and educated to at least the junior high school level (85.8% and 90.2%). The groups did not differ significantly in age, marital status, occupation, income, parity, or gestational age at enrolment. Educational attainment differed ($p = 0.017$): tertiary education was more common in the intervention group (16.0% vs 10.7%), whereas junior high school education was more common in the comparison group (42.7% vs 36.4%).

Table 1: Socio-demographic and obstetric characteristics of participants by study group

Characteristic	Intervention (n = 225) n (%)	Comparison (n = 225) n (%)	p-value
Age group (years)			0.244
<20	8 (3.6)	2 (0.9)	
20–24	42 (18.7)	38 (16.9)	
25–29	75 (33.3)	69 (30.7)	
30–34	64 (28.4)	65 (28.9)	
35–39	26 (11.6)	38 (16.9)	
40–45	10 (4.4)	13 (5.8)	
Education			0.017
None	8 (3.6)	0 (0.0)	
Primary	24 (10.7)	22 (9.8)	
Junior high/Middle	82 (36.4)	96 (42.7)	
Senior high/Secondary	75 (33.3)	83 (36.9)	
Tertiary	36 (16.0)	24 (10.7)	
Marital status			0.907
Single	18 (8.0)	15 (6.7)	
Married	196 (87.1)	199 (88.4)	
Cohabiting	9 (4.0)	8 (3.6)	

Widowed/Divorced	2 (0.9)	3 (1.3)	
Occupation			0.879
Unemployed	55 (24.4)	47 (20.9)	
Farmer	41 (18.2)	45 (20.0)	
Trader	72 (32.0)	78 (34.7)	
Formal employment	42 (18.7)	39 (17.3)	
Other	15 (6.7)	16 (7.1)	
Monthly income (GH¢)			0.967
No income	24 (10.7)	22 (9.8)	
<500	58 (25.8)	62 (27.6)	
500–999	71 (31.6)	74 (32.9)	
1,000–1,999	47 (20.9)	42 (18.7)	
≥2,000	25 (11.1)	25 (11.1)	
Parity			0.993
0	75 (33.3)	73 (32.4)	
1	62 (27.6)	63 (28.0)	
2	48 (21.3)	50 (22.2)	
≥3	40 (17.8)	39 (17.3)	
Gestational age at enrolment			0.886
First trimester (≤12 weeks)	48 (21.3)	51 (22.7)	
Second trimester (13–27 weeks)	104 (46.2)	99 (44.0)	
Third trimester (≥28 weeks)	73 (32.4)	75 (33.3)	

Note. p-values from Pearson's chi-square test. GH¢, Ghana cedi.

3.2 Objective knowledge at baseline and endline

At baseline, the proportion of women answering each item correctly ranged from 44.0% to 54.2% in the intervention group and from 42.2% to 52.0% in the comparison group, with no significant differences for any item (Table 2). The mean objective knowledge score was 5.97 (SD 2.14) in the intervention group and 5.66 (SD 2.03) in the comparison group ($p = 0.114$).

At endline, correct responses ranged from 80.0% to 88.0% in the intervention group and from 60.9% to 68.9% in the comparison group, and the intervention group scored significantly higher on all 12 items ($p < 0.001$). The intervention group showed larger improvements from baseline to endline across items (16.4 to 18.2 pp), with the largest additional gains in knowledge of additional meals in pregnancy (18.2 pp) and the smallest in keeping a newborn warm (16.4 pp). At endline, the mean score was 10.13 (SD 1.61) in the intervention group and 7.90 (SD 1.89) in the comparison group ($p < 0.001$).

Table 2: Correct responses to objective knowledge items at baseline and endline by study group

Knowledge item	Baseline Int. n (%)	Baseline Comp. n (%)	p	Endline Int. n (%)	Endline Comp. n (%)	p	DiD (pp)
K1. Source of iron during pregnancy	117 (52.0)	113 (50.2)	0.706	191 (84.9)	149 (66.2)	<0.001	+16.9
K2. Additional meals required during pregnancy	108 (48.0)	106 (47.1)	0.850	187 (83.1)	144 (64.0)	<0.001	+18.2
K3. Recommended number of antenatal care visits	99 (44.0)	95 (42.2)	0.703	180 (80.0)	137 (60.9)	<0.001	+17.3
K4. Importance of early antenatal care	115 (51.1)	110 (48.9)	0.637	194 (86.2)	151 (67.1)	<0.001	+16.9
K5. Danger signs during pregnancy	119 (52.9)	115 (51.1)	0.706	198 (88.0)	155 (68.9)	<0.001	+17.3
K6. Signs requiring immediate care during pregnancy	104 (46.2)	99 (44.0)	0.636	185 (82.2)	142 (63.1)	<0.001	+16.9
K7. Birth preparedness	122 (54.2)	117 (52.0)	0.637	196 (87.1)	153 (68.0)	<0.001	+16.9
K8. Timing of the first postnatal check-up	106 (47.1)	101 (44.9)	0.636	189 (84.0)	146 (64.9)	<0.001	+16.9
K9. Timing of breastfeeding initiation after birth	117 (52.0)	113 (50.2)	0.706	194 (86.2)	151 (67.1)	<0.001	+17.3
K10. Duration of exclusive breastfeeding	110 (48.9)	106 (47.1)	0.706	187 (83.1)	144 (64.0)	<0.001	+17.3
K11. Keeping a newborn warm	115 (51.1)	110 (48.9)	0.637	191 (84.9)	149 (66.2)	<0.001	+16.4
K12. Timing of return of fertility after childbirth	108 (48.0)	104 (46.2)	0.706	189 (84.0)	146 (64.9)	<0.001	+17.3
Total score (0–12), mean (SD)	5.97 (2.14)	5.66 (2.03)	0.114	10.13 (1.61)	7.90 (1.89)	<0.001	+1.92

Note. Values are numbers (%) of participants who answered correctly; n = 225 per group at each wave. p-values from Pearson's chi-square test.

DiD, difference-in-differences in the percentage answering correctly, (intervention endline – baseline) – (comparison endline – baseline); pp, percentage points; SD, standard deviation; Int., intervention group; Comp., comparison group.

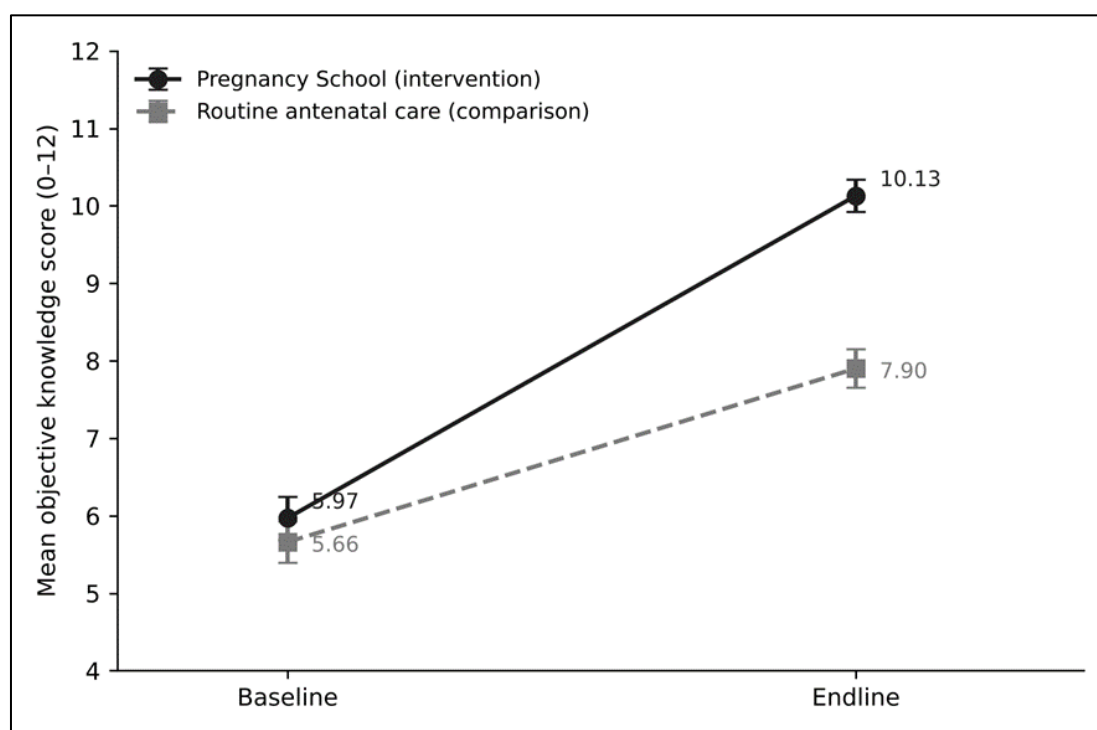
3.3 Effect of Pregnancy School on objective knowledge

Both groups improved significantly over the study period ($p < 0.001$), but the mean gain was 4.16 points (95% CI 3.89–4.43) in the intervention group and 2.24 points (1.98–2.50) in the comparison group, corresponding to relative increases of 69.7% and 39.6% over the baseline means (Table 3, Figure 1). In the regression model, the group-by-time interaction yielded a DiD of +1.92 points (95% CI 1.39–2.45; $p < 0.001$), equivalent to 16% of the 12-point scale range. A direct comparison of individual change scores gave the same estimate with a narrower interval (1.54–2.30), because it accounts for the pairing of each woman's baseline and endline scores. The standardised effect size was large (Cohen's $d = 0.94$).

Table 3: Change in objective and perceived knowledge and difference-in-differences estimates

Outcome and group	Baseline mean (SD)	Endline mean (SD)	Change (95% CI)	DiD (95% CI)	p-value	Cohen's d
Objective knowledge (0–12)						
Intervention	5.97 (2.14)	10.13 (1.61)	+4.16 (3.89, 4.43)			
Comparison	5.66 (2.03)	7.90 (1.89)	+2.24 (1.98, 2.50)			
Between-group difference	0.31 (p = 0.114)	2.23 (p < 0.001)		+1.92 (1.39, 2.45)	<0.001	0.94
Perceived knowledge (0–32)						
Intervention	19.86 (3.42)	25.48 (3.21)	+5.62			
Comparison	18.21 (3.15)	21.13 (3.44)	+2.92			
Between-group difference	1.65 (p < 0.001)	4.35 (p < 0.001)		+2.70 (1.95, 3.45)	<0.001	0.85

Note. DiD, difference-in-differences, estimated as the group-by-time interaction in a linear regression model (objective knowledge: β_1 group = 0.31, β_2 time = 2.24, β_3 interaction = 1.92, SE 0.27, $R^2 = 0.412$). Within-group changes were tested with paired t-tests (p < 0.001 in both groups). Cohen's d is the standardised effect size for the DiD. CI, confidence interval; SD, standard deviation.

**Figure 1: Mean objective knowledge score at baseline and endline by study group**

Note. Error bars indicate the 95% confidence intervals. The difference-in-differences was +1.92 (95% CI 1.39–2.45; p < 0.001).

3.4 Perceived knowledge

Perceived knowledge was higher in the intervention group at baseline (19.86 vs. 18.21; p < 0.001). It increased by 5.62 points in the intervention group and by 2.92 points in the comparison group, giving a DiD of +2.70 points (95% CI 1.95–3.45; p < 0.001) and a large standardised effect (Cohen's d = 0.85) (Table 3). At endline, the mean perceived knowledge score was 25.48 in the intervention group and 21.13 in the comparison group.

3.5 Session attendance and knowledge gain

Among the 225 intervention participants, 18 (8.0%) attended no sessions, 42 (18.7%) attended one or two, 96 (42.7%) attended three to five, and 69 (30.7%) attended more than five; the mean number of sessions was 3.84 (SD 1.92). Knowledge gain increased steadily with attendance, from +1.42 points among women who attended no sessions to +5.12 points among those who attended more than five sessions (p -trend < 0.001), and perceived knowledge gain followed the same gradient (Table 4, Figure 2). The gain among intervention facility women who attended no sessions was smaller than that of the comparison group (+2.24 points).

Table 4: Knowledge gain by number of Pregnancy School sessions attended (intervention group)

Sessions attended	n (%)	Mean objective knowledge gain (points)	Mean perceived knowledge gain (points)
0	18 (8.0)	+1.42	+1.98
1–2	42 (18.7)	+2.87	+3.42
3–5	96 (42.7)	+4.31	+5.78
>5	69 (30.7)	+5.12	+6.54
p for trend		<0.001	<0.001

Note. The mean number of sessions attended was 3.84 (SD 1.92), with a median of 4. p for trend from one-way analysis of variance; SD, standard deviation.

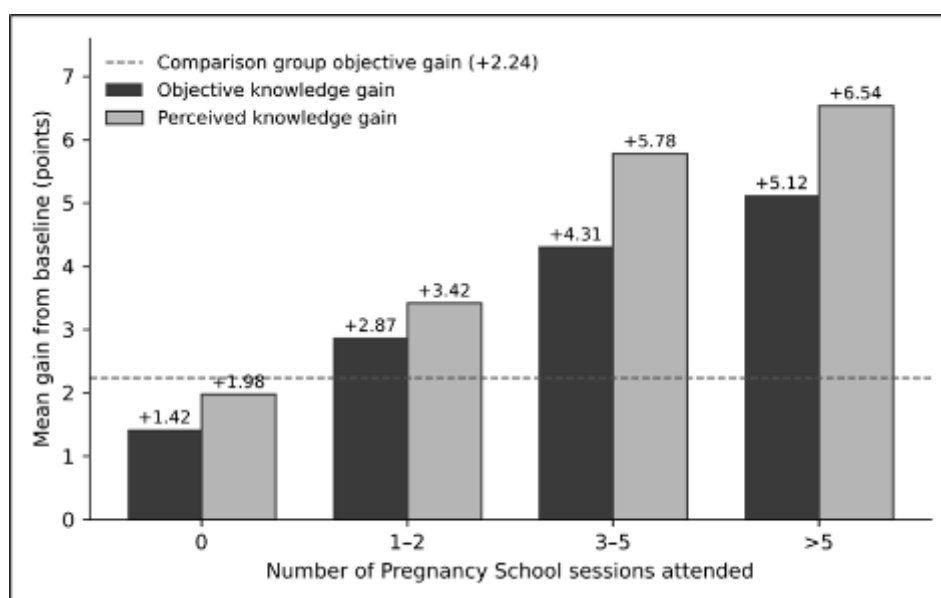


Figure 2: Mean knowledge gain by number of Pregnancy School sessions attended

Note. Intervention group ($n = 225$). The dashed line shows the mean objective knowledge gain in the comparison group (+2.24 points).

3.6 Women's accounts of learning

The interviews helped explain the quantitative findings. Women in the intervention group described the Pregnancy School as a setting in which information was explained in more detail, repeated over several sessions, and linked to practical situations. Repetition helped them understand why advice mattered, not only what it was.

"Before I started attending classes, I knew some things about pregnancy, but I did not understand why they were important. During the school they explained them again and again, so now when the midwife talks about danger signs, I understand exactly what she means." (Pregnancy School participant, PS-P03)

Women contrasted the time available for questions with the brevity of routine clinic talks and described greater confidence in recognising danger signs.

“Normal antenatal education is helpful, but sometimes it is short because many women are waiting. At the pregnancy school, we had more time to prepare. You could ask a question and the midwife would explain until you understood.” (Pregnancy School participant, PS-P07)

“Previously, if I had swelling or headache, I might have thought it was just part of pregnancy. They taught us that severe headache, blurred vision and swelling can be dangerous, so now I know that I should report early.” (Pregnancy School participant, PS-P11)

Women in the comparison facilities valued the routine talks but found that the volume of information given at one time made it difficult to retain:

“They educate us when we come for antenatal, but sometimes many things are said together. When you get home, you may forget some of them.” (Comparison participant, COMP-P04)

Participants valued practical demonstrations, simple language, and local examples. In open-ended responses, the most frequent suggestions were more time for questions and discussion (21.3%), more demonstrations of newborn care (18.2%), and greater use of simple language and local examples (16.0%).

4 DISCUSSION

In this controlled evaluation in four Ghanaian health facilities, women who attended facilities offering pregnancy school gained substantially more maternal and newborn health knowledge than women receiving routine antenatal care. Starting from similar baseline scores, the intervention group gained an additional 1.92 points on the 12-point test beyond the improvement observed in the comparison group, a large standardised effect. The additional gain was remarkably uniform across all 12 knowledge domains, was mirrored by a greater gain in perceived knowledge, and increased with the number of sessions attended.

The direction of these findings is consistent with the Ghanaian cluster-randomised trial of group antenatal care, in which maternal health literacy improved more with group care than with individual care, while both arms improved [14], and in which recognition of danger signs and birth preparedness also improved [15]. Similar gains in knowledge have been reported after structured antenatal education in Egypt [9], after family-oriented group education in rural Tanzania [10], and after goal-oriented prenatal education in Nigeria [11]. The present study extends this evidence to a pregnancy school model that adds structured education to existing antenatal services rather than reorganising care, which is relevant to scale-up in settings where wholesale change to service delivery is impractical [19]. However, the instruments differ between studies, and a common score range does not make the measures equivalent; therefore, the magnitude of the effect should not be compared directly.

Qualitative accounts suggest how additional learning may have occurred. Women attributed their understanding to repetition across sessions, the time available for questions, practical demonstrations, and the use of familiar language, features that are difficult to provide in brief talks delivered to large waiting groups [5,6]. Similar experiences were reported in the process evaluation of group antenatal care in Ghana and Burkina Faso [17,23]. The breadth of the effect across all knowledge domains, rather than a gain concentrated in a few topics, is consistent with a programme that revisits a common curriculum over several contacts [7,8]. However, the study did not compare these teaching components separately; therefore, their individual contributions cannot be determined.

The comparison group also improved substantially by 2.24 points. Routine counselling, accumulating experience as pregnancy advances, and familiarity with the questions after the baseline assessment may all have contributed. The relevant estimate of the programme's contribution is therefore the additional improvement, not the whole within-group gain. Perceived knowledge was already higher in the intervention group at baseline, and self-assessed knowledge may be influenced by favourable views of the programme; the agreement between perceived and objectively tested knowledge is nevertheless reassuring.

The gradient between session attendance and knowledge gain strengthens the plausibility of a programme effect, and the small gain among intervention facility women who attended no sessions suggests that the difference between groups was not driven solely by facility characteristics. Attendance was self-selected; however, women who attended more sessions may have differed in motivation, time, transport, or family support. Therefore, the gradient is consistent with the benefit of repeated participation but does not isolate the causal effect of additional sessions.

These findings should be interpreted in light of several limitations. First, allocation was not random and programme status was determined by facility; therefore, differences between facilities in staffing, routine education, or patient populations cannot be separated from the effect of the Pregnancy School. Second, with only two facilities per group, the analysis treated women as independent observations; the retrospective design-effect calculation indicates that confidence intervals would be wider if facility clustering were fully accounted for. Third, both intervention facilities were in the Volta Region, whereas the comparison group included a facility in the Savannah Region, introducing regional differences between groups. Fourth, women were enrolled at different gestational ages; therefore, baseline scores reflect knowledge at enrolment rather than an unexposed state, and repeated administration of the same items may have contributed to learning in both groups. Fifth, knowledge was measured with a short test during pregnancy; therefore, retention after childbirth and the translation of knowledge into practice were not assessed in this analysis. Finally, education differed between groups at baseline, and the DiD removes only those differences that remained constant over time.

The study also has strengths. It used a concurrent comparison group and repeated measurements in the same women, which allowed the DiD to remove stable baseline differences between groups. Participants were selected systematically within facilities, the knowledge test covered pregnancy, childbirth, and newborn care, objective and perceived knowledge were measured separately, and the quantitative estimates were interpreted alongside the women's own accounts of learning.

For policy and practice, the results support the inclusion of structured, interactive education within routine antenatal care in Ghana, with attention to the number of sessions women can attend. Programmes should protect time for questions and demonstrations, use local language and examples, and monitor attendance and content coverage, particularly for topics less often covered, such as family planning and newborn care. Future evaluations should randomise a larger number of facilities, account for clustering, measure knowledge retention after childbirth, and examine whether knowledge gains translate into preventive practices and care-seeking.

5 CONCLUSION

Pregnancy school participation was associated with a substantially greater improvement in maternal and newborn health knowledge than routine antenatal care. Objective knowledge improved by an additional 1.92 points on a 12-point scale, the gain was consistent across all knowledge domains, perceived knowledge improved in parallel, and the gain increased with the number of sessions attended. Women attributed their learning to repeated, interactive, and practical teaching. Structured antenatal education is a promising addition to routine antenatal care in Ghana, but because exposure was determined by facility, its effect should be confirmed in studies that randomise more facilities and assess whether knowledge gains are sustained and translated into practice.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no conflicts of interest with respect to this manuscript.

Statement of ethical approval

The Ghana Health Service Ethics Review Committee approved the study prior to data collection (GHS-ERC:008/10/25). Administrative permission was obtained from the management of the Peki Government Hospital, Ave-Dakpa Health Centre, Ho Municipal Hospital, and East Gonja Municipal Hospital. This study was conducted in accordance with the Declaration of Helsinki.

Statement of informed consent

Written informed consent was obtained from all participants before enrolment. Women were informed that participation was voluntary and that declining or withdrawing would not affect their access to antenatal, delivery, or postnatal care. Study identifiers replaced names in the analytical dataset.

Authors' contributions

JKA conceptualised the study, developed the research methodology, coordinated the research process, contributed to data interpretation, and led the preparation and revision of the manuscript. MOY contributed to the study design, methodology, data collection, interpretation of findings, and critical revision of the manuscript. SMS contributed to developing the research methodology, literature review, data collection, interpretation of findings, and manuscript revision. JBN contributed to the study design, methodological development, data collection, interpretation of results, and critical review of the manuscript. OV contributed to the research methodology, data collection, data interpretation, and manuscript review. RTM contributed to the literature review, methodological refinement, interpretation of findings, and critical revision of the manuscript. BA contributed to the study design, research methodology, data analysis, interpretation of findings, and critical review of the manuscript. BKA contributed to data collection, field coordination, data validation, interpretation of findings, and manuscript revision. AA contributed to the research methodology, data management, interpretation of results, and critical review of the manuscript. PEOA contributed to the literature review, research methodology, interpretation of findings, and substantive revision of the manuscript. RKE contributed to field coordination, data collection, data validation, interpretation of findings, and manuscript review. EAO contributed to the study design, methodological review, interpretation of findings, and critical revision of the manuscript. BO contributed to the study's conceptual development, methodological review, interpretation of findings, and critical revision of the manuscript. All authors reviewed the manuscript, provided intellectual input, approved the final version for submission, and agreed to be accountable for the accuracy and integrity of their respective contributions to the work.

REFERENCES

- [1] World Health Organization, UNICEF, UNFPA, World Bank Group, UNDESA/Population Division. Trends in maternal mortality estimates 2000 to 2023: estimates by WHO, UNICEF, UNFPA, World Bank Group, and UNDESA/Population Division. Geneva: World Health Organization; 2025.
- [2] Mesele TT, Syuom AT, Molla EA. Knowledge of danger signs in pregnancy and their associated factors among pregnant women in Hosanna Town, Hadiya Zone, southern Ethiopia. *Front Reprod Health*. 2023;5:1097727. doi: 10.3389/frph.2023.1097727
- [3] Nyirenda M, Jacobs C, Makasa M, Hazemba AN. Knowledge and practices of birth preparedness and complication readiness among pregnant women in Eastern Province, Zambia: a qualitative study. *PLOS Glob Public Health*. 2025;5(7):e0004975. doi: 10.1371/journal.pgph.0004975
- [4] World Health Organization (WHO). WHO recommendations for antenatal care for a positive pregnancy experience. Geneva: World Health Organization; 2016.
- [5] Escañuela Sánchez T, Linehan L, O'Donoghue K, Byrne M, Meaney S. Facilitators and barriers to seeking and engaging with antenatal care in high-income countries: a meta-synthesis of qualitative research. *Health Soc Care Community*. 2022;30(6):e3810–e3828. doi: 10.1111/hsc.14072
- [6] Afulani PA, Buback L, Kelly AM, Kirumbi L, Cohen CR, Lyndon A. Providers' perceptions of communication and women's autonomy during childbirth: a mixed methods study in Kenya. *Reprod Health*. 2020;17(1). doi: 10.1186/s12978-020-0909-0
- [7] Ayraller A, Tosun ŞA, Özkök S. Pregnancy school education program in mother friendly training and research hospital impact on stress and anxiety. *Rev Assoc Med Bras*. 2023;69(8):e20230279. doi: 10.1590/1806-9282.20230279
- [8] AlSomali Z, Bajamal E, Esheaba O. The effect of structured antenatal education on childbirth self-efficacy. *Cureus*. 2023;15(5):e39285. doi: 10.7759/cureus.39285
- [9] El-shrqawy EH, Elnemer A, Mohamed Elsayed H. Effect of antenatal education on pregnant women's knowledge, attitude and preferences of delivery mode. *BMC Pregnancy Childbirth*. 2024;24(1). doi: 10.1186/s12884-024-06922-0
- [10] Shimpuku Y, Madeni FE, Horiuchi S, Kubota K, Leshabari SC. Evaluation of a family-oriented antenatal group educational program in rural Tanzania: a pre-test/post-test study. *Reprod Health*. 2018;15(1). doi: 10.1186/s12978-018-0562-z
- [11] Akinwaare MO, Oluwatosin OA. Effect of goal-oriented prenatal education on birth preparedness, complication readiness and institutional delivery among semi-urban pregnant women in Nigeria: a quasi-experimental study. *PLoS One*. 2023;18(7):e0289414. doi: 10.1371/journal.pone.0289414
- [12] Mlotshwa L, Manderson L, Merten S. Personal support and expressions of care for pregnant women in Soweto, South Africa. *Glob Health Action*. 2017;10(1):1363454. doi: 10.1080/16549716.2017.1363454

- [13] McLeish J, Redshaw M. Peer support during pregnancy and early parenthood: a qualitative study of models and perceptions. *BMC Pregnancy Childbirth*. 2015;15(1). doi: 10.1186/s12884-015-0685-y
- [14] Lori JR, Kukula VA, Liu L, Apetorgbor VEA, Ghosh B, Awini E, et al. Improving health literacy through group antenatal care: results from a cluster randomized controlled trial in Ghana. *BMC Pregnancy Childbirth*. 2024;24(1). doi: 10.1186/s12884-023-06224-x
- [15] Kukula VA, Awini E, Ghosh B, Apetorgbor V, Zielinski R, Amankwah G, et al. Effect of group antenatal care versus individualized antenatal care on birth preparedness and complication readiness: a cluster randomized controlled study among pregnant women in Eastern Region of Ghana. *BMC Pregnancy Childbirth*. 2024;24(1). doi: 10.1186/s12884-024-06743-1
- [16] Apetorgbor V, Awini E, Ghosh B, Zielinski R, Amankwah G, Kukula VA, et al. The impact of group antenatal care on newborns: results of a cluster randomized control trial in Eastern Region, Ghana. *BMC Pediatr*. 2024;24(1). doi: 10.1186/s12887-024-05225-9
- [17] Zielinski R, Kukula V, Apetorgbor V, Awini E, Moyer C, Badu-Gyan G, et al. "With group antenatal care, pregnant women know they are not alone": the process evaluation of a group antenatal care intervention in Ghana. *PLoS One*. 2023;18(11):e0291855. doi: 10.1371/journal.pone.0291855
- [18] Catling CJ, Medley N, Foureur M, Ryan C, Leap N, Teate A, et al. Group versus conventional antenatal care for women. *Cochrane Database Syst Rev*. 2015;(2):CD007622. doi: 10.1002/14651858.CD007622.pub3
- [19] Wiseman O, Emmett L, Hickford G, Knight M, Lazar J, Yuill C, et al. The challenges and opportunities for implementing group antenatal care ('Pregnancy Circles') as part of standard NHS maternity care: a co-designed qualitative study. *Midwifery*. 2022;109:103333. doi: 10.1016/j.midw.2022.103333
- [20] UNICEF Ghana. Empowering mothers: the community pregnancy school transforming health in rural Ghana [Internet]. Accra: UNICEF Ghana; 2026 [cited 2026 16 Oct]. Available from: <https://www.unicef.org/ghana/stories/empowering-mothers-community-pregnancy-school-transforming-health-rural-ghana>
- [21] Hansen A, Bayes J, Schloss J. Empowering women through knowledge: a systematic review of literature on menstrual and reproductive health literacy. *Health Equity*. 2025;9(1):357–374. doi: 10.1177/24731242251363080
- [22] Fetters, MD, Curry, LA, & Creswell, JW W. Achieving integration in mixed methods designs: Principles and practices. *Health Serv Res*. 2013;48(6 Pt 2):2134–2156. doi: 10.1111/1475-6773.12117
- [23] Dao B, Ouedraogo Y, Mhlanga M, Kone A. Exploring the acceptability and impact of group antenatal care: a qualitative study among women in selected health facilities in Burkina Faso. *Reprod Health*. 2025;22(1). doi: 10.1186/s12978-025-02085-z