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BEYOND AVERAGE EFFECTS: FACILITY-LEVEL HETEROGENEITY IN FINANCIAL PREPAREDNESS FOR CHILDBIRTH AND OBSTETRIC EMERGENCIES FOLLOWING STRUCTURED PUBLIC HEALTH EDUCATION IN DELTA NORTH, NIGERIA

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Abstract

Background: Pooled intervention outcomes may conceal differences in financial preparedness across healthcare facilities. This study examined facility-level variations in financial preparation for childbirth and obstetric emergencies following structured public health education among antenatal clinic attendees in Delta North, Nigeria.

Methods: A cluster-based quasi-experimental pretest–posttest comparison-group design involved 168 antenatal clinic attendees across eight public health facilities in Oshimili North and Oshimili South Local Government Areas. Four facilities received structured public health education (n = 84), while four served as comparison facilities (n = 84). Assessments occurred at baseline, immediately post-intervention and eight-week follow-up. Ten participants were lost to follow-up, yielding 158 participants and a 94.05% retention rate. Facility-specific mean changes and statistical comparisons were examined alongside pooled baseline-adjusted ANCOVA.

Results: Childbirth financial preparedness improved across intervention facilities, with eight-week mean increases ranging from 2.98 to 3.66, compared with 0.09 to 0.73 in comparison facilities. Emergency financial readiness increased by 3.33–4.49 across intervention facilities, compared with 0.11–1.13 in comparison facilities. All intervention facilities demonstrated statistically significant within-facility improvements in both domains at eight weeks. Pooled ANCOVA indicated significant intervention-associated differences in childbirth financial preparedness ($F(1,155) = 66.16$, $p < .001$) and emergency financial readiness ($F(1,155) = 85.85$, $p < .001$).

Conclusion: Structured public health education was associated with improvements across intervention facilities, although the magnitude of observed gains varied. Facility-responsive antenatal education may strengthen financial preparedness, but between-facility heterogeneity requires formal statistical confirmation.

Keywords: Facility-level heterogeneity; financial preparedness; childbirth; obstetric emergencies; antenatal education; Delta North.

Introduction

Public health interventions are commonly evaluated through average outcomes, yet statistically significant overall improvements may conceal differences in how participants respond across healthcare facilities. Such differences are particularly important when interventions are implemented in settings with varying organisational conditions and population characteristics. Hawe et al. (2004) argued that complex interventions should be understood in relation to their implementation contexts rather than assuming uniform outcomes across settings. Greenhalgh et al. (2004) demonstrated that organisational arrangements influence the adoption and implementation of healthcare innovations. Damschroder et al. (2009) further identified contextual and implementation-related factors that may shape intervention outcomes. These perspectives suggest that evaluating structured maternal health education requires attention not only to overall effectiveness but also to the distribution of improvements across participating healthcare facilities.

Facility-level heterogeneity becomes particularly relevant when educational interventions seek to influence practical health behaviours. Although participants may receive similar information, their capacity to translate educational messages into action may differ according to available resources, opportunities and individual circumstances. Michie et al. (2011) identified capability, opportunity and motivation as interacting determinants of behaviour, demonstrating that information alone may be insufficient to produce behavioural change. Ajzen (1991) similarly recognised perceived behavioural control as an important influence on behavioural intentions and actions. Rosenstock et al. (1988) established that perceived benefits and barriers influence health-related decisions. These theoretical perspectives provide a basis for investigating why maternal financial preparedness may improve at different rates across healthcare facilities, although the underlying reasons for such differences require direct empirical investigation.

Financial preparedness is an important component of birth preparedness and complication readiness because accessing skilled obstetric care often requires advance arrangements for anticipated and unexpected expenses. Thaddeus and Maine (1994) identified financial constraints among the barriers contributing to delays in obtaining appropriate maternal healthcare. Anikwe et al. (2020) documented deficiencies in practical birth preparedness among antenatal clinic attendees in southeastern Nigeria, indicating that healthcare attendance does not automatically guarantee adequate preparation. Osaze et al. (2021) identified gaps in financial preparedness among women in Delta State, demonstrating the continuing relevance of financial planning to

maternal healthcare. These findings establish financial preparedness as a practical maternal health concern, while highlighting the need to understand whether educational interventions improve preparedness consistently across different healthcare settings.

An important distinction exists between financial preparation for routine childbirth and financial readiness for obstetric emergencies. Routine childbirth involves relatively predictable expenses, whereas obstetric emergencies may require additional resources for transportation, referral and specialised treatment. Osaze et al. (2021) reported that 36.7% of women had saved money for childbirth, compared with 26.6% who had saved for emergency complications. Thaddeus and Maine (1994) demonstrated how financial and logistical barriers may delay access to emergency obstetric services. Kukula et al. (2024) reported improvements in practical financial and transportation preparedness following structured antenatal care in Ghana. These findings suggest that routine childbirth financial preparation and emergency financial readiness should be examined separately because improvements in one domain may not necessarily correspond to equivalent improvements in the other.

The timing of educational responses introduces another dimension of potential facility-level variation. Immediate improvements may reflect increased awareness or intentions, while follow-up changes may indicate further development of reported financial arrangements. Ajzen (1991) explained that behavioural intentions are influenced by attitudes, subjective norms and perceived behavioural control. Rosenstock et al. (1988) demonstrated the relevance of perceived barriers and benefits in health-related decisions. Michie et al. (2011) further emphasised that behavioural outcomes depend on opportunities and capabilities alongside motivation. These perspectives justify examining financial preparedness at baseline, immediately after intervention and during follow-up. Nevertheless, improved preparedness scores should not automatically be interpreted as verified savings or sufficient financial resources for obstetric care.

Evidence from maternal health education interventions supports the potential for structured programmes to strengthen practical childbirth preparedness. Akinwaare and Oluwatosin (2023) demonstrated improvements in birth preparedness and complication readiness following goal-oriented prenatal education among Nigerian pregnant women. Kukula et al. (2024) reported that saving money for transportation increased from 19% to 73% among women receiving group antenatal care in Ghana, compared with 19% to 32% among women receiving individualised care. Hawe et al. (2004), however, emphasised that complex interventions must be understood within their implementation settings. Consequently, evidence of overall educational effectiveness does not necessarily establish whether comparable improvements occur across individual healthcare facilities.

This distinction has implications for programme evaluation and equitable maternal healthcare delivery. A favourable pooled intervention effect may obscure facilities where participants experience comparatively smaller improvements, thereby limiting the usefulness of aggregate findings for local planning. O'Neill et al. (2014) emphasised the importance of examining how intervention outcomes are distributed across populations rather than relying exclusively on average estimates. Greenhalgh et al. (2004) demonstrated that healthcare organisations differ in circumstances influencing intervention implementation. Damschroder et al. (2009) similarly identified organisational and contextual influences that may affect programme delivery. Facility-

specific evaluation can therefore reveal patterns requiring further investigation, although observed differences should not automatically be attributed to facility performance or organisational characteristics without supporting evidence.

Within Nigeria, existing studies demonstrate both deficiencies in maternal preparedness and the benefits of structured educational interventions. Anikwe et al. (2020) documented inadequate birth preparedness among antenatal clinic attendees in Abakaliki. Akinwaare and Oluwatosin (2023) established that structured prenatal education improved preparedness among pregnant women, supporting the importance of organised educational approaches. Osaze et al. (2021) identified deficiencies in childbirth and emergency financial preparation among women in Delta State. These findings demonstrate the relevance of financial preparedness within Nigerian maternal healthcare but provide limited evidence concerning the distribution of intervention-associated improvements across individual healthcare facilities. Addressing this limitation requires moving beyond pooled intervention effects to examine facility-specific patterns.

Evidence from Delta State further supports this analytical focus. Osaze et al. (2021) reported that 48.7% of women were prepared for childbirth, while 42.9% were prepared for complications, with preparedness associated with selected socioeconomic and community characteristics. Thaddeus and Maine (1994) established the broader relevance of financial and logistical circumstances to maternal healthcare access. Michie et al. (2011) demonstrated that behavioural opportunities interact with capability and motivation, suggesting that practical circumstances may influence preparedness responses. These findings justify examining facility-level differences within Delta North, although they do not establish that specific organisational or socioeconomic factors caused differences among the facilities participating in the present investigation.

The parent investigation across eight public health facilities in Oshimili North and Oshimili South Local Government Areas provides an opportunity to examine these differences. Four facilities received structured public health education, while four served as comparison facilities, with assessments conducted at baseline, immediate post-intervention and eight-week follow-up. Campbell et al. (2012) highlighted the importance of recognising clustering when interventions are allocated through groups or institutions. Damschroder et al. (2009) established the relevance of implementation context, while Hawe et al. (2004) emphasised the importance of understanding intervention responses across settings. These considerations support examining facility-specific changes alongside pooled outcomes. However, descriptive differences between facilities do not independently establish statistically significant heterogeneity, which requires appropriate between-facility analyses.

Despite growing evidence supporting antenatal educational interventions, important gaps remain concerning facility-level variation in financial preparedness outcomes. Akinwaare and Oluwatosin (2023) demonstrated improvements in maternal preparedness following structured education, but their findings do not establish differences across the facilities examined in the present study. Kukula et al. (2024) provided evidence of improvements in practical preparedness behaviours, while Osaze et al. (2021) documented financial preparedness deficiencies within Delta State. However, these studies do not adequately explain how improvements in routine

childbirth financial preparation and emergency financial readiness are distributed across participating facilities over time. This gap warrants an examination of facility-specific changes alongside overall intervention-associated differences.

Accordingly, this study examined facility-level heterogeneity in financial preparedness for childbirth and obstetric emergencies following structured public health education among antenatal clinic attendees in Delta North, Nigeria. The investigation assessed facility-specific changes from baseline to immediate post-intervention and eight-week follow-up across intervention and comparison facilities. Hawe et al. (2004) established the importance of implementation context, Damschroder et al. (2009) demonstrated the relevance of contextual variation, and O'Neill et al. (2014) emphasised examining the distribution of intervention outcomes. By moving beyond pooled estimates, the study seeks to identify patterns of observed improvement that may inform more responsive antenatal financial preparedness education and future investigations into facility-level differences.

Literature Review and Theoretical Framework

Facility-level variation in maternal financial preparedness requires an understanding of how educational interventions operate across healthcare settings and how pregnant women translate health information into practical arrangements. Although structured antenatal education can improve birth preparedness, the magnitude of improvement may differ across facilities and financial preparedness domains. This review examines empirical evidence on facility-level intervention responses, the distinction between routine and emergency financial preparedness, and theoretical explanations for variations in educational outcomes.

Facility-Level Heterogeneity in Maternal Health Interventions

Facility-level heterogeneity refers to differences in intervention outcomes across healthcare facilities participating in the same programme. Such variation may reflect differences in baseline preparedness, participant characteristics or implementation circumstances. Hawe et al. (2004) argued that complex interventions should be evaluated according to their functions and implementation contexts rather than assuming identical outcomes across settings. Greenhalgh et al. (2004) demonstrated that organisational structures and professional relationships influence the implementation of healthcare innovations. Damschroder et al. (2009) further identified organisational environments, individual characteristics and implementation processes as important considerations in intervention evaluation. These findings suggest that facility-specific analysis can complement pooled intervention estimates by identifying differences that require further investigation.

The methodological implications of facility-level variation are equally important. Campbell et al. (2012) emphasised that participants within intervention clusters may share characteristics, making it necessary to recognise clustering when analysing outcomes. O'Neill et al. (2014) highlighted the importance of examining how intervention benefits are distributed rather than relying exclusively on average estimates. Michie et al. (2011) demonstrated that behavioural outcomes depend on capability, opportunity and motivation. Consequently, facility-specific differences in preparedness scores may reveal uneven intervention responses, although

descriptive variation alone cannot establish statistically significant between-facility heterogeneity.

Financial Preparedness for Childbirth and Obstetric Emergencies

Financial preparedness encompasses arrangements for anticipated childbirth expenditure and resources required during unexpected obstetric complications. These dimensions differ because routine delivery expenses are relatively predictable, whereas emergencies may require immediate mobilisation of additional funds. Thaddeus and Maine (1994) identified financial constraints as important contributors to delays in obtaining obstetric care. Osaze et al. (2021) reported that 36.7% of women in Delta State had saved money for childbirth, compared with 26.6% who had saved for emergency complications. Anikwe et al. (2020) also documented deficiencies in practical birth preparedness among Nigerian antenatal clinic attendees. These findings demonstrate the importance of examining both financial domains independently.

Structured antenatal education may strengthen financial planning, although the extent of improvement can vary. Akinwaare and Oluwatosin (2023) demonstrated improvements in birth preparedness following goal-oriented prenatal education in Nigeria. Kukula et al. (2024) reported increased transportation savings following structured group antenatal care in Ghana. Michie et al. (2011), however, established that motivation and knowledge must be considered alongside practical opportunities. Accordingly, improvements in self-reported financial preparedness should not automatically be interpreted as verified savings or sufficient resources for emergency obstetric care.

Theoretical Framework: Integrating Behavioural and Implementation Perspectives

The present study draws on the Health Belief Model, the COM-B model and the Consolidated Framework for Implementation Research (CFIR) to explain potential differences in financial preparedness responses. The Health Belief Model proposes that health-related decisions are influenced by perceived susceptibility, severity, benefits and barriers. Rosenstock et al. (1988) established the relevance of these constructs to health behaviour, while Ajzen (1991) demonstrated the importance of perceived behavioural control in translating intentions into action. Applied to maternal financial preparedness, these perspectives suggest that recognising financial risks may encourage planning without necessarily overcoming resource constraints.

The COM-B model extends this explanation by recognising capability, opportunity and motivation as interacting determinants of behaviour (Michie et al., 2011). CFIR complements this individual-level perspective by identifying implementation characteristics and contextual influences that may shape intervention delivery (Damschroder et al., 2009). Greenhalgh et al. (2004) similarly established the relevance of organisational environments to healthcare innovation. Integrating these perspectives provides a basis for interpreting facility-specific preparedness patterns without assuming that the proposed mechanisms were directly measured.

This study presents a secondary, facility-level analysis of data obtained from a cluster-based quasi-experimental investigation of structured public health education and maternal birth

preparedness in Delta North Senatorial District, Nigeria. The analysis focused on differences in financial preparedness across participating healthcare facilities rather than exclusively on pooled intervention effects.

Method

Study Design, Setting and Participants

The parent study employed a pretest–posttest comparison-group design involving eight public health facilities in Oshimili North and Oshimili South Local Government Areas, Delta State. Four facilities were assigned to the intervention group and four to the comparison group. Systematic sampling from antenatal clinic registers yielded 168 pregnant women, comprising 21 participants per facility and 84 per study group. Ten participants were lost to follow-up, leaving 158 participants (94.05% retention) for the pooled follow-up analysis.

Intervention and Outcome Measures

Participants in intervention facilities received structured public health education over six weeks, comprising weekly sessions lasting approximately 45–60 minutes. Educational activities included lectures, discussions, demonstrations and illustrated materials addressing childbirth preparation, financial planning and obstetric emergencies. Comparison facilities continued routine antenatal services.

Data were collected at baseline, immediately after intervention and eight-week follow-up using the Birth Preparedness and Complication Readiness Questionnaire (BPCRQ), which had a reported reliability coefficient of 0.78. This analysis examined two four-item domains: financial preparation for routine childbirth and financial readiness for obstetric emergencies. Higher scores indicated greater measured preparedness.

Data Analysis

Facility-specific means, standard deviations and changes from baseline were examined to describe the magnitude and timing of preparedness improvements. Within-facility statistical comparisons were considered alongside pooled baseline-adjusted analysis of covariance (ANCOVA). Statistical significance was assessed at $p < .05$, and partial eta-squared was used to describe pooled effect sizes. Analyses were conducted using IBM SPSS Statistics, version 29. Facility-level differences were interpreted descriptively because formal facility-by-time interaction testing was not established in the available analyses.

Ethical Considerations

Ethical approval was obtained from the Delta State Ministry of Health Ethics Committee (HRC.10206/1/T/28) and the Federal Medical Centre, Asaba Health Research Ethics Committee (NHREC/TR/FMCASABA-HREC/31/7/24/250). Administrative permission and written

informed consent were obtained. Participation was voluntary, and confidentiality was maintained through coded questionnaires and restricted data access.

Result

This section presents financial preparation for routine childbirth and financial readiness for obstetric emergencies across eight public health facilities in Delta North, Nigeria. Facility-level means and within-facility comparisons are presented at baseline, immediately after the intervention and at eight-week follow-up, followed by pooled baseline-adjusted results and graphical comparisons. Facility-level patterns are descriptive; within-facility significance does not establish statistically significant between-facility heterogeneity.

Table 1: Facility-level Mean scores for routine childbirth financial preparation

Facility	Group	Baseline	Immediate post-test	Eight-week follow-up	Change to follow-up
FMC Asaba	Intervention	5.62	6.35	8.93	+3.31
PHC Okpanam Road	Intervention	5.71	7.25	9.37	+3.66
General Hospital, Ibusa	Intervention	5.67	7.90	8.65	+2.98
PHC Ibusa	Intervention	6.52	7.72	9.67	+3.15
PHC Cable Point	Comparison	5.48	6.01	6.07	+0.59
PHC Oko	Comparison	5.57	5.78	5.98	+0.41
General Hospital, Akwukwu-Igbo	Comparison	5.76	6.25	6.49	+0.73
CHC Illah	Comparison	6.62	6.77	6.71	+0.09

Source: Field Survey

Table 1 shows improvements in financial preparation for routine childbirth across all intervention facilities, although the magnitude varied. PHC Okpanam Road recorded the largest baseline-to-follow-up increase (3.66 points), followed by FMC Asaba (3.31), PHC Ibusa (3.15) and General Hospital, Ibusa (2.98). At eight-week follow-up, PHC Ibusa recorded the highest mean score (9.67), compared with 8.65 at General Hospital, Ibusa. In contrast, improvements across comparison facilities were smaller, ranging from 0.09 at CHC Illah to 0.73 at General

Hospital, Akwukwu-Igbo. These findings indicate greater improvements across intervention facilities, with differences in the magnitude of observed changes.

Table 2: Facility-level Mean scores for financial readiness for obstetric emergencies

Facility	Group	Baseline	Immediate post-test	Eight-week follow-up	Change to follow-up
FMC Asaba	Intervention	5.43	7.21	9.05	+3.62
PHC Okpanam Road	Intervention	5.38	7.85	8.71	+3.33
General Hospital, Ibusa	Intervention	5.71	7.03	10.20	+4.49
PHC Ibusa	Intervention	6.43	7.25	9.98	+3.55
PHC Cable Point	Comparison	5.57	6.10	6.70	+1.13
PHC Oko	Comparison	5.48	5.78	5.89	+0.41
General Hospital, Akwukwu-Igbo	Comparison	5.76	6.02	5.87	+0.11
CHC Illah	Comparison	5.00	6.07	6.01	+1.01

Source: Field Survey

Table 2 presents changes in financial readiness for obstetric emergencies across participating facilities. General Hospital, Ibusa demonstrated the largest baseline-to-follow-up improvement (4.49 points), followed by FMC Asaba (3.62), PHC Ibusa (3.55) and PHC Okpanam Road (3.33). General Hospital, Ibusa also recorded the highest eight-week mean score (10.20). Improvements among comparison facilities were smaller, ranging from 0.11 at General Hospital, Akwukwu-Igbo to 1.13 at PHC Cable Point. Unlike routine childbirth financial preparation, where PHC Okpanam Road demonstrated the largest improvement, emergency financial readiness improved most at General Hospital, Ibusa, indicating differences in observed responses across the two preparedness domains.

Table 3: Within-facility comparisons for routine childbirth financial preparation

Healthcare facility	Immediate change	Immediate p	Eight-week change	Eight-week p
FMC Asaba	+0.73	.204	+3.31	<.001
PHC Okpanam Road	+1.54	.019	+3.66	<.001
General Hospital, Ibusa	+2.23	<.001	+2.98	<.001
PHC Ibusa	+1.20	.134	+3.15	.001
PHC Cable Point	+0.53	.449	+0.59	.402
PHC Oko	+0.21	.768	+0.41	.573
General Hospital, Akwukwu-Igbo	+0.49	.351	+0.73	.176
CHC Illah	+0.15	.738	+0.09	.841

Source: Field Survey

Table 3 indicates that statistically significant immediate improvements in routine childbirth financial preparation occurred at General Hospital, Ibusa (mean change = 2.23, $p < .001$) and PHC Okpanam Road (mean change = 1.54, $p = .019$). Immediate changes at FMC Asaba and PHC Ibusa were not statistically significant. At eight-week follow-up, all intervention facilities recorded significant improvements, with mean increases ranging from 2.98 to 3.66 points ($p \leq .001$). None of the comparison facilities demonstrated significant improvements at either assessment ($p > .05$). The findings indicate that significant within-facility improvements were more consistently observed at follow-up than immediately after intervention.

Table 4: Within-facility comparisons for emergency financial readiness

Healthcare facility	Immediate change	Immediate p	Eight-week change	Eight-week p
FMC Asaba	+1.78	.004	+3.62	<.001
PHC Okpanam Road	+2.47	<.001	+3.33	<.001
General Hospital, Ibusa	+1.32	.016	+4.49	<.001
PHC Ibusa	+0.82	.104	+3.55	<.001

PHC Cable Point	+0.53	.403	+1.13	.095
PHC Oko	+0.30	.558	+0.41	.429
General Hospital, Akwukwu-Igbo	+0.26	.657	+0.11	.849
CHC Illah	+1.07	.042	+1.01	.052

Source: Field Survey

Table 4 shows significant immediate improvements in emergency financial readiness at PHC Okpanam Road (mean change = 2.47, $p < .001$), FMC Asaba (1.78, $p = .004$) and General Hospital, Ibusa (1.32, $p = .016$). PHC Ibusa recorded a non-significant immediate increase (0.82, $p = .104$). At eight-week follow-up, all four intervention facilities demonstrated significant improvements, with mean changes ranging from 3.33 to 4.49 points ($p < .001$). Among comparison facilities, only CHC Illah recorded a significant immediate improvement (1.07, $p = .042$), which was no longer statistically significant at follow-up ($p = .052$). These results demonstrate differences in the timing and magnitude of within-facility changes.

Table 5: Pooled baseline-adjusted ANCOVA results for financial preparedness

Outcome	Assessment	F(1,155)	p-value	Partial η²
Routine childbirth preparation	Immediate post-test	37.22	<.001	.194
Routine childbirth preparation	Eight-week follow-up	66.16	<.001	.299
Emergency financial readiness	Immediate post-test	47.42	<.001	.234
Emergency financial readiness	Eight-week follow-up	85.85	<.001	.356

Note: pooled ANCOVA. Source: Filed Survey

Table 5 presents significant baseline-adjusted intervention-associated differences in both financial preparedness domains. For routine childbirth financial preparation, significant differences were observed immediately after intervention, $F(1, 155) = 37.22$, $p < .001$, partial $\eta^2 = .194$, and at eight-week follow-up, $F(1, 155) = 66.16$, $p < .001$, partial $\eta^2 = .299$. Similarly, emergency financial readiness demonstrated significant differences immediately after intervention, $F(1, 155) = 47.42$, $p < .001$, partial $\eta^2 = .234$, and at follow-up, $F(1, 155) = 85.85$, $p < .001$, partial $\eta^2 = .356$. The larger follow-up effect sizes indicate stronger adjusted group differences at eight weeks, particularly for emergency financial readiness.

Figure 1: Facility-level changes in routine childbirth financial preparation

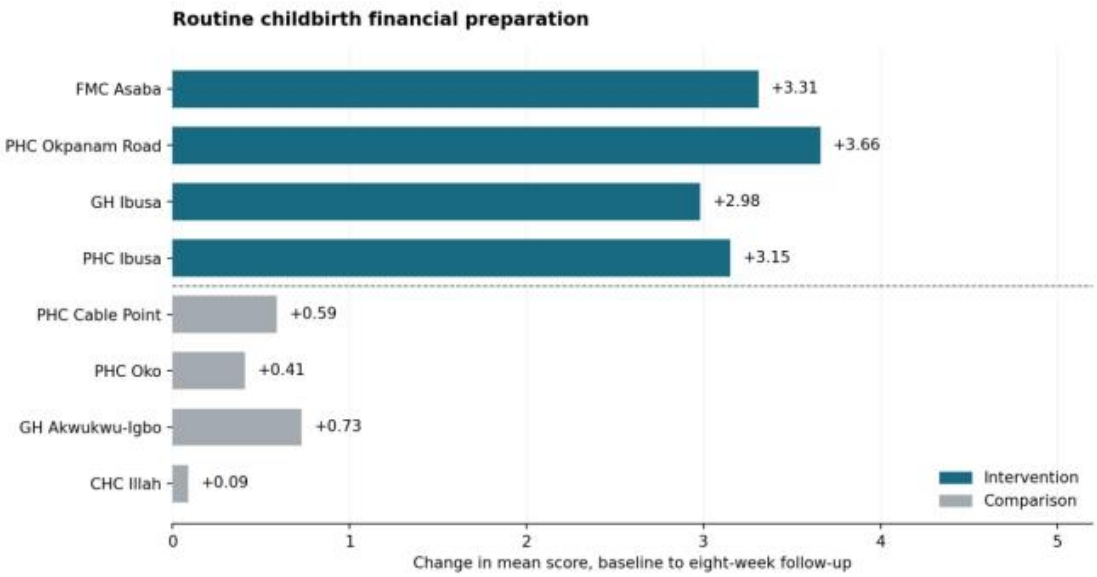


Figure 1 illustrates the distribution of baseline-to-follow-up changes in routine childbirth financial preparation across the eight facilities. Intervention facilities consistently demonstrated larger improvements than comparison facilities, with increases ranging from 2.98 to 3.66 points, compared with 0.09 to 0.73 points, respectively. PHC Okpanam Road recorded the greatest improvement, whereas CHC Illah demonstrated the smallest overall change. The figure highlights differences in the magnitude of observed improvements across facilities and the separation between intervention and comparison groups.

Figure 2: Facility-level changes in emergency financial readiness

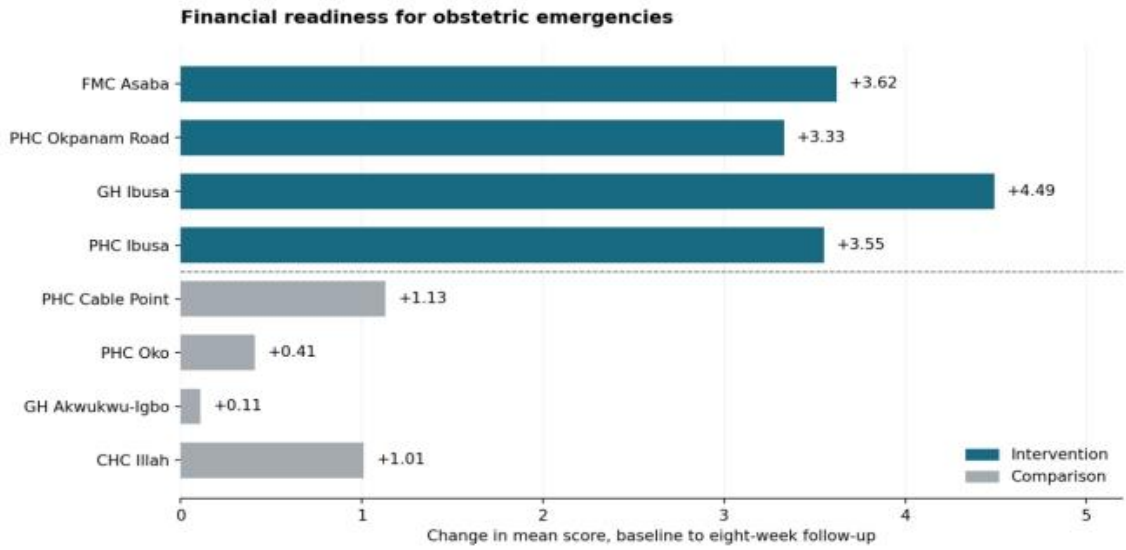


Figure 2 illustrates differences in emergency financial readiness across participating facilities. General Hospital, Ibusa recorded the largest baseline-to-follow-up improvement (4.49 points), followed by FMC Asaba (3.62), PHC Ibusa (3.55) and PHC Okpanam Road (3.33). Comparison facilities demonstrated smaller changes, ranging from 0.11 to 1.13 points. The graphical pattern indicates that emergency financial readiness improved more substantially across intervention facilities, although the magnitude differed between individual facilities.

Discussion

The most important finding of this study is that structured public health education was associated with improved financial preparedness across all four intervention facilities, but the magnitude and timing of improvement were not identical. This distinction challenges the assumption that a favourable overall intervention effect necessarily represents a uniform response across participating healthcare facilities. For routine childbirth financial preparation, eight-week improvements ranged from 2.98 to 3.66, while emergency financial readiness increased by 3.33 to 4.49. Although these differences were descriptive and were not confirmed through formal between-facility interaction testing, they reveal information that would be obscured by relying exclusively on pooled intervention estimates. Hawe et al. (2004) recognised that complex interventions operate within different implementation contexts, while Damschroder et al. (2009) demonstrated that contextual conditions may influence programme outcomes. The implication is that future maternal health education programmes should assess both overall effectiveness and the distribution of improvements across participating facilities.

A particularly important finding was that PHC Okpanam Road demonstrated the greatest improvement in routine childbirth financial preparation (+3.66), whereas General Hospital, Ibusa recorded the largest improvement in emergency financial readiness (+4.49). This difference indicates that the facility demonstrating the strongest response in one preparedness domain may not necessarily demonstrate the strongest response in another. It also suggests that financial preparation for anticipated delivery expenses and financial readiness for unexpected obstetric complications should not be treated as interchangeable outcomes. Osaze et al. (2021) previously identified differences between savings for childbirth and emergency complications among women in Delta State. Thaddeus and Maine (1994) established the importance of financial constraints in accessing emergency obstetric services, while Anikwe et al. (2020) documented persistent gaps in practical maternal preparedness in Nigeria. For future interventions, these findings support developing distinct educational activities for routine delivery budgeting and emergency financial arrangements, rather than assuming that general financial advice will address both adequately.

The findings also demonstrate why baseline preparedness must be considered when evaluating facility performance. PHC Ibusa recorded the highest baseline and follow-up mean scores for routine childbirth financial preparation, yet PHC Okpanam Road achieved the greatest absolute improvement. Consequently, ranking facilities solely by their final preparedness scores could produce misleading conclusions about their responses to the intervention. A facility beginning with relatively high preparedness may have less opportunity for substantial numerical improvement, while another with lower initial scores may demonstrate larger gains. Campbell et al. (2012) emphasised the importance of accounting for baseline differences in clustered

intervention studies. O'Neill et al. (2014) also demonstrated the value of examining how intervention outcomes are distributed rather than relying on aggregate estimates. Greenhalgh et al. (2004) highlighted the importance of organisational context when interpreting programme implementation. These findings indicate that future programme evaluations should report baseline scores, absolute changes and adjusted outcomes together before making comparisons between facilities.

Another significant observation concerns the timing of preparedness improvements. Immediately after intervention, only two facilities demonstrated statistically significant improvements in routine childbirth financial preparation, compared with three facilities for emergency financial readiness. By eight-week follow-up, however, all four intervention facilities recorded significant within-facility improvements in both domains. This pattern indicates that the educational programme was followed by improvements that became more consistently detectable across facilities during follow-up. One possible explanation is that participants required additional time to discuss financial arrangements with household members, identify available resources or develop practical plans. However, these activities were not independently measured and cannot be established as the mechanisms responsible for the observed changes. Ajzen (1991) recognised that intentions and actual behaviour are not necessarily simultaneous, while Michie et al. (2011) demonstrated that behavioural change depends on opportunities and capabilities alongside motivation. The practical implication is that antenatal financial preparedness education should not end with information delivery. Follow-up assessments and reinforcement activities may be necessary to support the development of practical arrangements.

The larger improvement in emergency financial readiness at General Hospital, Ibusa deserves further consideration. Although the facility recorded an immediate increase of 1.32, its eight-week improvement reached 4.49, exceeding the corresponding changes in the other intervention facilities. This indicates that its greatest observed improvement occurred between the immediate assessment and follow-up. In contrast, PHC Okpanam Road demonstrated a comparatively strong immediate response in emergency readiness, increasing by 2.47, but its total follow-up improvement was smaller at 3.33. These differences suggest that facilities may exhibit distinct response trajectories even when their eventual outcomes are favourable. Hawe et al. (2004) argued that intervention processes should be understood in relation to their contexts, while Damschroder et al. (2009) identified implementation characteristics that may influence outcomes. Future studies should therefore investigate whether differences in educational participation, reinforcement, household circumstances or service delivery contribute to these trajectories, rather than assuming that the same mechanisms operate equally across facilities.

The comparison facilities provide an important perspective on the intervention findings. Although positive changes occurred in all comparison facilities, their eight-week improvements were substantially smaller than those recorded in intervention facilities. For routine childbirth financial preparation, comparison-group increases ranged from 0.09 to 0.73, while emergency financial readiness increased by 0.11 to 1.13. CHC Illah demonstrated a statistically significant immediate improvement in emergency financial readiness, but this finding was not sustained at the conventional significance threshold during follow-up. These results suggest that some preparedness improvements may occur through routine antenatal services or influences outside

the additional educational programme. Campbell et al. (2012) emphasised the importance of comparison groups when interpreting intervention effects, while Greenhalgh et al. (2004) recognised that healthcare outcomes emerge within broader organisational and social environments. The consistently larger improvements among intervention facilities nevertheless strengthen the evidence of an intervention-associated benefit, although the quasi-experimental design limits definitive causal attribution.

The pooled ANCOVA findings reinforce the overall effectiveness signal observed in the facility-specific results. At eight-week follow-up, the adjusted intervention-associated differences were statistically significant for routine childbirth financial preparation, $F(1, 155) = 66.16$, $p < .001$, partial $\eta^2 = .299$, and emergency financial readiness, $F(1, 155) = 85.85$, $p < .001$, partial $\eta^2 = .356$. The larger partial eta-squared value for emergency readiness indicates a stronger adjusted group association within that outcome's model, although the two effect sizes should not be treated as a formal test of differences between domains. These findings are consistent with Akinwaare and Oluwatosin (2023), who demonstrated improved maternal preparedness following structured prenatal education, and Kukula et al. (2024), who reported improvements in practical preparedness following organised antenatal care. The present findings extend their relevance by showing that favourable pooled outcomes can coexist with differences in facility-specific improvement. However, the ANCOVA results do not establish that the intervention effect differed significantly between facilities.

Beyond statistical significance, the findings raise important questions about the practical meaning of financial preparedness. Improved questionnaire scores indicate greater reported preparedness, but they do not establish whether participants accumulated sufficient money to meet actual childbirth expenses or unexpected emergency costs. This distinction matters because financial planning may improve without eliminating the economic barriers that prevent timely access to obstetric care. Thaddeus and Maine (1994) demonstrated that financial constraints can contribute to delays in obtaining emergency maternal healthcare. Osaze et al. (2021) documented gaps in actual savings arrangements among women in Delta State, while Michie et al. (2011) established that opportunities and resources influence the translation of intentions into behaviour. Consequently, future maternal health programmes should complement educational activities with practical assessment of available funds, transportation costs, emergency financial support and affordability of referral services. Educational success should ultimately be assessed not only through preparedness scores but also through evidence that women can mobilise resources when care is required.

The findings also have implications for how maternal health education is organised and supervised within public healthcare facilities. Rather than implementing a standard programme and evaluating only its average outcome, healthcare administrators could monitor preparedness changes separately across facilities and identify settings where additional support may be required. Facilities demonstrating smaller improvements should not automatically be considered ineffective, since differences in baseline preparedness, participant characteristics and implementation circumstances may contribute to their results. Damschroder et al. (2009) identified contextual assessment as an important component of implementation research, while Greenhalgh et al. (2004) demonstrated the influence of organisational conditions on healthcare innovation. O'Neill et al. (2014) further emphasised examining the distribution of intervention

benefits. For Delta North, these findings support integrating financial preparedness assessments into routine antenatal education, providing additional counselling where needed and examining facility-specific barriers before introducing corrective measures.

The study contributes to maternal health research by demonstrating that examining facility-level patterns can provide insights beyond those obtained from pooled intervention analyses. Nevertheless, several limitations require consideration. The facility-specific results were primarily descriptive, and statistically significant changes within facilities do not establish statistically significant differences between facilities. Furthermore, only eight facilities participated, limiting the precision of cluster-level comparisons. Campbell et al. (2012) highlighted the importance of appropriate analysis in studies involving clustered participants, while Hawe et al. (2004) emphasised the difficulty of separating intervention outcomes from contextual influences. Damschroder et al. (2009) similarly demonstrated that explanations of implementation variation require direct assessment of relevant processes. The facility-level results also require reconciliation with participant attrition, and the pooled analyses require confirmation of appropriate clustering adjustments. These limitations should guide future studies towards larger facility samples, formal facility-by-time analyses, implementation assessments and objective measures of financial preparedness.

The broader implication of these findings is that maternal financial preparedness education should be evaluated according to both the improvements achieved and the consistency with which those improvements reach women across healthcare settings. The observed gains suggest that structured education can contribute to stronger reported financial preparation, but differences in the magnitude and timing of change indicate that programme evaluation should not stop at average effects. Akinwaare and Oluwatosin (2023) demonstrated the potential of structured prenatal education in Nigeria, while Kukula et al. (2024) provided supporting evidence from Ghana. O'Neill et al. (2014) established the importance of examining the distribution of health intervention benefits. Future research should determine whether the facility-level patterns observed in Delta North persist in larger studies and identify the organisational, household and economic conditions associated with stronger preparedness outcomes. Such evidence would help move antenatal financial education from a uniform information-delivery approach towards more responsive programmes capable of supporting women with different preparedness needs.

Conclusion

This study established that structured public health education was associated with improvements in financial preparedness for routine childbirth and obstetric emergencies across intervention facilities in Delta North, Nigeria. However, the magnitude and timing of these improvements differed across healthcare facilities and preparedness domains. PHC Okpanam Road demonstrated the greatest improvement in routine childbirth financial preparation, whereas General Hospital, Ibusa recorded the largest increase in emergency financial readiness. Although pooled analyses revealed significant intervention-associated differences, facility-specific findings provided additional insights into patterns concealed by aggregate estimates. These findings demonstrate the importance of evaluating maternal health interventions beyond overall effectiveness to understand how improvements are distributed across healthcare settings.

Nevertheless, the observed facility-level variations remain descriptive and require formal statistical confirmation. Strengthening antenatal education through facility-responsive monitoring, practical financial planning and sustained follow-up may improve maternal preparedness and support more equitable access to timely obstetric healthcare services across participating communities

Recommendations

Based on the findings of this study, the following recommendations are proposed to strengthen financial preparedness for childbirth and obstetric emergencies across public health facilities in Delta North, Nigeria;

Healthcare providers should incorporate separate educational activities addressing routine childbirth expenses and obstetric emergency costs, as the magnitude of improvement differed between these preparedness domains.

Health facility managers should introduce facility-specific monitoring of financial preparedness outcomes, considering baseline scores and subsequent improvements to identify facilities requiring additional educational support.

Antenatal care programmes should provide follow-up financial preparedness counselling beyond initial educational sessions, given that significant improvements became more consistent across intervention facilities at eight-week follow-up.

Health policymakers should complement antenatal education with practical financial support arrangements and accessible emergency referral services to address barriers that education alone may not overcome.

Future researchers should investigate the factors associated with facility-level differences using larger samples, appropriate cluster-adjusted analyses and verified measures of financial preparedness.

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