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Health Equity as a Peace Dividend? Antenatal Care in the Conflict-Affected North-East of Nigeria

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Research Article

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Abstract

Background.

Antenatal care (ANC) is the primary point of contact between pregnant women and the health system, and equitable access to basic services is a component of positive peace. Protracted insurgency has destroyed much of the health infrastructure of Nigeria's North-East, yet little is known about how far antenatal care has recovered relative to the rest of the country.

Objective.

To compare antenatal care in the North-East with that in the other zones, and to separate the difference into a part explained by women's characteristics and a part that remains.

Methods.

Cross-sectional analysis of the 2023-24 Nigeria Demographic and Health Survey (fieldwork December 2023 to May 2024). The sample was 13,968 women whose most recent live birth or stillbirth fell in the three years before the survey, of whom 2,972 lived in the North-East. Outcomes were four or more visits, eight or more visits, and skilled-provider care. We used survey-weighted estimates, Erreygers-corrected concentration indices, and a Blinder-Oaxaca decomposition with bootstrap confidence intervals, and tested the main result across 15 specifications and in a bounding analysis. All analyses were done in R.

Results.

Four or more visits were 51.9% nationally and 50.2% (95% CI 46.4 to 54.1) in the North-East, compared with 40.1% in the North-West. The other zones exceeded the North-East by only 2.1 percentage points (95% CI − 2.7 to 5.9), although women's education and wealth alone predicted a gap of 14.8 points. The North-East therefore did 12.7 points better than expected (95% CI: 8.8 to 16.5), a result that held across all specifications (9.5 to 13.6 points). For eight or more visits, the North-East had the lowest coverage of any zone (4.0% compared with 19.4% elsewhere), with a 6.0-point unexplained shortfall. The advantage was concentrated among the poorest women (38.0% of the poorest wealth quintile in the North-East made four or more visits, against 20.9% elsewhere), and counting community health extension workers raised North-East skilled-provider coverage from 59.5% to 74.6%.

Conclusions.

Basic antenatal contact in the North-East exceeds what its socioeconomic profile would predict, most strongly among the poorest women, whereas continuity of care, as measured by eight or more visits, lags behind. This is consistent with, but not evidence of, humanitarian and community-level provision. Zone is a proxy for conflict, and the findings are associations.

1. Introduction

1.1 Why antenatal care matters

Maternal survival remains one of the starkest measures of unequal life chances in the world, and Nigeria sits at the centre of the problem. In 2020, the country had the highest estimated number of maternal deaths of any nation, around 82,000, which is more than a quarter (28.5 per cent) of the global total (WHO et al., 2023). About 70 per cent of all maternal deaths that year occurred in sub-Saharan Africa (WHO et al., 2023). Behind these totals are women whose pregnancies went unmonitored, whose complications were detected late or not at all, and whose families had few places to turn.

Antenatal care (ANC) is the most common point of contact between pregnant women and the health system, and for many women, it is the only one before delivery. The World Health Organization describes ANC as a platform for health promotion, screening and diagnosis, and disease prevention, and stresses that timely, evidence-based practice during pregnancy can save lives (WHO, 2016). The 2016 guideline moved the international standard from a minimum of four visits to a model of at least eight contacts with a health provider, beginning early in pregnancy, and placed a woman's experience of care alongside clinical outcomes (Tunçalp et al., 2017; WHO, 2016). Coverage alone is not enough because what happens during a visit matters as much as whether one occurs at all (Arsenault et al., 2018; Benova et al., 2018).

The most recent Nigeria Demographic and Health Survey (NDHS 2023-24) shows both progress and fragility. About 63 per cent of women who recently gave birth saw a skilled provider during pregnancy, and 52 per cent made four or more visits. The skilled-provider figure rose from 57 per cent in 2008 to 67 per cent in 2018, then fell back to 63 per cent (NPC & ICF, 2025). A national average hides large differences between places and between groups of women. The question of *who* is reached, and who is left behind, is therefore as important as the question of how many.

1.2 A region shaped by protracted violence

The North-East geopolitical zone has lived with armed conflict since the Boko Haram insurgency began in 2009. Borno has been the epicentre, and in May 2013 a state of emergency was declared in Borno, Yobe and Adamawa (Olanrewaju et al., 2017; FEWS NET, 2013) More than fifteen years on, the humanitarian agencies still describe a crisis in these three states that "continues unabated", with an estimated 7.8 million people in need of assistance in 2025 and a conflict-driven displacement of about 2.3 million people across the north-east (UN OCHA, 2025). Borno alone hosts 1.7 million internally displaced people (UN OCHA, 2025).

The health system has taken heavy damage. A WHO assessment of 743 health facilities in Borno at the end of 2016 found that 35 per cent were completely destroyed, 29 per cent partially damaged and only 34 per cent intact, with more than half of all facilities not functioning, mostly because insecurity prevented access (WHO, 2017). In response, partners established about 100 temporary health facilities across the state, including 49 emergency clinics serving displaced people living in camps (WHO, 2017). These figures describe the situation several years ago, but they capture something important for this paper: in the North-East, much of the basic health infrastructure was destroyed and then partly rebuilt or replaced through humanitarian arrangements within the same decade.

The conference theme concerns post-conflict zones, and this paper contributes to it, but the North-East is not post-conflict in the strict sense. Violence continues, and recovery is uneven across and within states (UN OCHA, 2025). The more accurate description is *conflict-affected and recovering*, and that is the sense in which the term "post-conflict" is used here.

1.3 The problem and the gap

A growing body of research shows that exposure to armed violence reduces the use of maternal health care. Studies that link survey data to the locations of violent events find lower rates of facility delivery near conflict (Østby et al., 2018) and higher risks of maternal death (Kotsadam & Østby, 2019). For Nigeria, Chukwuma and Ekhator-Mobayode

(2019) found that the Boko Haram insurgency reduced the probability of any antenatal visit, of delivering in a health facility and of skilled assistance at birth, and that these effects extended beyond the North-East. Cross-national evidence adds that inequalities in coverage of maternal health services are wider in conflict-affected countries, with the poorest, least educated and rural families faring worst (Akseer et al., 2020).

This literature mostly asks the following causal question: *does exposure to violence reduce care?* It answers by comparing exposed and unexposed women, usually over time. It says little about a different, equally practical question that policymakers and peacebuilders face during recovery: *how far does a conflict-affected region now differ from the rest of the country, and how much of that difference is simply a reflection of who lives there?* A region that is poorer, less educated, and more rural will show lower service use even if its health system is as effective as any other. Conversely, a region that matches the national average despite a disadvantaged population may be getting something right, or may be measured in ways that flatter it. Telling these cases apart requires separating the *composition* of the population from the *residual* difference that composition does not explain.

Three further gaps motivate the study. First, the main Nigerian study of conflict and maternal care (A. Chukwuma & Ekhator-Mobayode, 2019) was published before the most recent survey round became available. Second, published figures are still commonly reported against the older four-visit standard, with less attention to the eight-contact standard now recommended or to the content of care. Third, regional comparisons rarely test whether the conclusions depend on how a "skilled provider" is defined, an important point in a setting where community-level health workers play a key role in service delivery.

1.4 Aim, research questions and contribution

The paper uses the NDHS 2023-24 to examine antenatal care in the North-East compared with the rest of Nigeria and treats equitable access to basic services as one component of positive peace. It asks four questions.

1. **Levels and gaps.** How do the North-East and the other geopolitical zones compare on skilled-provider ANC, four or more visits and eight or more contacts?
2. **Composition and residual.** How much of the North-East's gap with the rest of the country is explained by differences in women's education, household wealth, residence, age, parity and marital status, and how much remains unexplained?
3. **Heterogeneity.** Does the picture differ within the North-East, in particular between Borno, Adamawa and Yobe, the three states under the 2013 emergency declaration, and the other North-East states? How sensitive is it to the definition of a skilled provider and to the treatment of "don't know" answers?
4. **Inequality within the region.** Is wealth-related inequality in ANC use larger or smaller in the North-East than nationally?

The paper makes three contributions. Empirically, it provides an up-to-date, design-based account of the North-East's position in the first national survey of the recovery period. Analytically, it uses a decomposition of the regional gap to separate compositional from residual differences, rather than relying on raw regional comparisons. Conceptually, it connects the demographic evidence to debates in sociology and peace studies about services, structural inequality and the legitimacy of the state, and it sets out explicit competing explanations for what the data show.

1.5 Structure of the paper

Section 2 reviews the literature in six steps: the concepts that link health services to peace; what is known about health systems in conflict and recovery; the evidence on armed conflict and maternal health; the measurement and determinants of antenatal care, with a focus on Nigeria; the policy and humanitarian context of the North-East; and the methods used to measure and explain inequalities. It ends with a synthesis, a conceptual framework and a set of

propositions. Section 3 describes the data and methods; Section 4 presents the results; Section 5 discusses their meaning, implications, and limits; and Section 6 offers a conclusion.

2. Literature review

2.1 Positive peace, structural violence and horizontal inequality

The idea that health services can contribute to peace rests on a particular understanding of what peace is. Galtung (1969) distinguished *negative peace*, the absence of direct violence, from *positive peace*, which requires the absence of structural violence: avoidable harm built into social arrangements that distribute life chances unequally. On this view, a woman who dies in pregnancy because no skilled care was within reach has been harmed by a structure, even if no one raised a hand against her. Services that reach people equitably are then part of what makes peace durable, not simply a welcome by-product of it.

A second body of work explains why inequality matters for the *risk* of renewed violence. Stewart (2008) argued that inequalities between culturally defined groups, which she called horizontal inequalities, in political, economic and social outcomes (health and education among them), can fuel grievance and mobilisation, particularly when they coincide with group identity and are seen as unjust. A cross-national analysis by Cederman et al. (2011) found that horizontal inequalities were associated with a higher risk of ethnonationalist civil war. In a country such as Nigeria, where geopolitical zones overlap with ethnic and religious differences and where the north-south gap in human development is long-standing (Archibong, 2018), regional differences in basic services are not politically neutral. A region that is visibly left behind in maternal care can become a symbol of exclusion, and a region that visibly catches up can become evidence of an inclusive recovery.

Third, writers on state-building argue that services are one of the ways in which citizens encounter the state. Kruk et al. (2010) set out a logic model in which the early reconstruction of a functioning, equitable health system after conflict improves health and may also strengthen government capacity, accountability, and legitimacy, thereby contributing to the prospects for peace. They were careful to present this as a theoretical framework and a research agenda, noting that the empirical evidence is thin. Witter et al. (2015) reached a similar conclusion about the health workforce, observing that while state building does occur over time, the role of health staff in it warrants further investigation. This paper takes the theory seriously but does not test its causal claims. What it can do is describe the *distribution* of a basic service across regions, which is a precondition for any of the proposed pathways to operate.

“Peace dividend” is used here as a metaphor for tangible improvements in welfare that people can attribute to the end, or easing, of violence. It is not a technical term, and the title of this paper poses it as a question because one cannot assume that better service use in a region reflects peace rather than aid policy or other forces.

2.2 Health systems in conflict and recovery

Violent conflict damages health systems through several routes at once. Kruk et al. (2010) summarise the pattern: health professionals leave, infrastructure is destroyed, and the supply of drugs and equipment is interrupted. Longer-term effects follow. An early cross-national study of civil wars found that public health outcomes continued to suffer for years after the fighting ended (Ghobarah et al., 2004), a result that aligns with the idea that damaged systems and livelihoods recover slowly.

Recovery is not only a technical matter: Percival et al. (2014) reviewed the reconstruction of health systems in post-conflict settings through the lens of gender equity and found that reforms were largely gender-blind, even though reconstruction offers an opening to change social norms and institutions. They also noted that health information

systems in post-conflict settings are weak and rarely track the effect of reforms on gender equity. For a study such as this one, the implication is practical: household surveys may be the only source from which equity can be monitored, and their strengths and limitations should be stated plainly.

The evidence on health inequality in conflict settings points in a consistent direction. Akseer et al. (2020), studying 137 low- and middle-income countries between 1990 and 2017, found that inequalities in coverage of reproductive and maternal health services were significantly worse in conflict-affected countries, with access for poorer, less educated and rural families several times worse than in non-conflict countries. At the local level, Østby et al. (2018) found that the negative effect of nearby violence on institutional delivery was stronger for poor and less-educated mothers, which they interpret as evidence of the importance of household and individual resilience. Taken together, these studies lead to a clear expectation: where conflict has disrupted services, disadvantage should be concentrated among those who already have the fewest resources.

That expectation is important for the present study, because it implies two things at once. If conflict mainly hurts the poor and the less educated, then a conflict-affected region with a disadvantaged population should show a clear compositional deficit. And if service use in that region is *not* correspondingly low, something other than composition must be at work.

2.3 Armed conflict and maternal health: global and Nigerian evidence

The problem is not only local, but global in scale. A Lancet series estimated that armed conflict affected at least 630 million women and children in 2017, and found that the mortality of women of reproductive age living near high-intensity conflict was about three times higher than in peaceful settings (Bendavid et al., 2021). The same review stressed that the evidence on how conflict affects survival *indirectly*, through nutrition, disease, and reproductive health, remains fragmentary, thereby limiting the design of interventions (Bendavid et al., 2021).

Micro-level studies have sharpened the picture for sub-Saharan Africa by linking georeferenced survey data to the locations of violent events. Østby et al. (2018) examined 569,201 births in 31 countries, using a mother fixed-effects design and a 50-kilometre radius, and found that closeness to organised violence reduced the likelihood of delivery in a health facility, with a stronger effect among poor and less-educated mothers and, notably, in urban areas. Kotsadam and Østby (2019) used the sisterhood method on more than 1.3 million sisters in 30 countries and found that local exposure to armed conflict increased the risk of maternal death, with larger differences in rural areas but also in richer and more educated areas. These studies establish that *exposure* is an important factor. They also show that the effects are not uniform and that groups with more resources are not always the least affected.

For Nigeria, the key study is that of Chukwuma and Ekhator-Mobayode (2019). Using difference-in-differences methods, they spatially matched 52,675 birth records from the NDHS with attack locations in the Armed Conflict Location and Event Dataset and found that the Boko Haram insurgency reduced the probability of any antenatal visit, facility delivery, and delivery by a skilled professional. Two features of their result are important here: first, the negative effects extended beyond the North-East, which is the region on which humanitarian programmes concentrate; second, their design identifies the effect of *exposure to violent events*, not of residence in a region. Ekhator-Mobayode and Abebe Asfaw (2019) extended this line of work to child health by comparing areas of high and low Boko Haram activity.

The distinction between exposure and region deserves emphasis because the two are easily confused. If violence has spilt into neighbouring zones, the North-East is an imperfect proxy for “conflict-affected”. Women in the North-East may live in relatively safe places, while women in other zones may live in places that are not. A regional comparison, such as the one in this paper, therefore answers a different question from an exposure-based design. It describes how the

region as a whole now stands relative to the rest of the country, which is the question of interest for regional recovery planning, but it should not be read as an estimate of the effect of violence.

Table 1 summarises the studies that bear most directly on this paper.

Table 1
Selected empirical studies informing this paper

Study	Setting and data	Design	Finding most relevant here
Østby et al. (2018).	569,201 births, 31 sub-Saharan African countries; DHS and UCDP	Mother fixed effects, 50 km radius	Nearby violence reduces facility delivery; stronger among poor and less-educated mothers, and in urban areas
Kotsadam & Østby (2019).	1,335,161 sisters, 30 countries; DHS and UCDP	Sister fixed effects, 50 km radius	Local conflict exposure raises risk of maternal death; larger differences in rural, but also richer and more educated, areas
Chukwuma & Ekhator-Mobayode (2019).	52,675 NDHS births; ACLED	Difference-in-differences, with births matched to attack locations	Boko Haram insurgency reduced any ANC, facility and skilled delivery; effects extended beyond the North-East
Akseer et al. (2020)	137 low- and middle-income countries, 1990 to 2017	Multi-country ecological time series	Coverage inequalities for maternal services are worse in conflict countries, especially for poor, less-educated and rural families
Bendavid et al. (2021).	Global review and geospatial analysis	Series paper	Heavy mortality burden near high-intensity conflict; evidence on indirect effects fragmentary

2.4 Antenatal care: standards, measurement and determinants

From four visits to eight contacts. For two decades, the shorthand for adequate ANC was four visits. The 2016 WHO guideline replaced it with a model of at least eight contacts, beginning in the first trimester, and defined a positive pregnancy experience as the goal (Tunçalp et al., 2017; WHO, 2016). Household surveys such as the DHS record the number of visits, the timing of the first visit, and the content of care, and can therefore describe each of these dimensions, though the indicator of four or more visits remains the figure most often quoted in headline reports (Benova et al., 2018; Croft et al., 2018). This paper reports both four-plus visits and eight-plus contacts, because the first reflects the standard against which most published figures are expressed, and the second reflects the current international standard.

Coverage and content are different things. Benova et al. (2018) examined 10 countries and found that even among women whose visit patterns complied with global recommendations, the quality of care was poor. Arsenault et al. (2018), in an analysis of 91 national household surveys, found that pooled coverage of at least one visit with a skilled provider was about 90 per cent, but that the share of women receiving blood pressure measurement and urine and blood testing was far lower, about 73 per cent overall and about 54 per cent in low-income countries, and that quality was markedly unequal by wealth. The implication is that a region can look adequate by the number of visits while falling short in what happens during those visits.

Nigerian evidence on determinants and quality. Studies of Nigerian survey data consistently find that ANC use and quality vary with women's education, household wealth, residence and region, and that determinants operate at several levels. Babalola and Fatusi (2009) examined individual-, household-, community-, and state-level factors and found that the relevant determinants differed by the indicator of maternal service use. Ononokpono and Odimegwu (2014) used a

multilevel approach and stressed that decisions to seek care depend on community conditions, such as social factors and the location of services, as well as on individual characteristics. On quality, Fagbamigbe and Idemudia (2015), analysing 13,410 women who used ANC in the 2013 NDHS, found that only about 11 per cent of attendees received the minimum acceptable package of care, and that receipt of good-quality care was higher among women who began early, made at least four visits, saw skilled workers, and were urban, better educated and wealthier. Education and wealth are therefore the natural candidates for the compositional component of any regional gap, and the quality evidence serves as a reminder that high visit counts do not guarantee adequate care.

Building on these paradigms, Oladosun and Etim (2026) offered a broader conceptual framework by analysing a sample of 28,888 married women from the 2018 NDHS. Their model explicitly integrates the Social Determinants of Health framework with psychological and critical perspectives, mapping structural inequities through the lenses of the Health Belief Model (HBM) and Intersectionality Theory. By using Intersectionality Theory, the authors acknowledge that a woman's overlapping identities create compounded barriers that a single-factor analysis misses. This critical lens grounds their investigation into how deeply entrenched demographic features and striking regional anomalies shape health-seeking actions. Under the HBM component, the uptake of maternal services relies on a woman's perceived health threats and her belief in the efficacy of the formal medical pathway, yet the study underscores that these psychological choices are heavily bound by a woman's socioeconomic position. Their design-weighted results revealed that overall compliance remains critically low across the nation, with only 25 per cent of married women completing six or more ANC visits, and just 28.7 per cent achieving a facility-based delivery.

Defining a skilled provider. Surveys classify providers into categories, and the grouping that counts as "skilled" is a convention that varies between reports and analyses. In Nigeria, community health extension workers are part of primary care delivery, and whether they are counted as skilled can considerably affect regional comparisons. This paper, therefore, reports skilled-provider ANC with and without them and treats the choice as an analytical decision to be stated openly.

2.5 The North-East context: damage, humanitarian substitution and policy

Three strands of context help explain why a conflict-affected region might perform better, or worse, than its composition would suggest.

Damage and disruption. The scale of destruction to health facilities in Borno, Adamawa and Yobe is well documented by WHO's Health Resources Availability Monitoring System (WHO, 2017). Disruption has been compounded by displacement, access constraints and workforce shortages (UN OCHA, 2025). These pressures would, in the absence of other forces, lead one to expect lower service use in the region.

Humanitarian substitution. Alongside destruction, the region has hosted a large humanitarian health response. WHO reported about 100 temporary health facilities in Borno by early 2017, including 49 emergency clinics for displaced people in camps (WHO, 2017), and the 2025 response plan covers a large share of the population of the three states (UN OCHA, 2025). Where humanitarian providers deliver antenatal services free of charge to displaced and host communities, service use among women who are poor and less educated could be higher than their circumstances would normally predict. This is a plausible mechanism, not a demonstrated one, and the household survey cannot observe it directly. It does, however, generate a testable pattern: if substitution is the case, the most heavily served states (Borno, Adamawa and Yobe) should look better than the other North-East states.

Workforce and national policy. Nigeria's response to the shortage of skilled maternal health workers has included the Midwives Service Scheme, launched in 2009, which posted newly graduated, unemployed and retired midwives to

primary care facilities in underserved areas. Abimbola et al. (2012) described uneven improvement across the six geopolitical zones and identified retention, training, and varying levels of commitment from states and local governments as major challenges. They also noted that efforts to reach underserved communities had relied on task shifting to community health workers, which supports the view that provider mix is part of the story in the north. Financing reforms under the National Health Act of 2014, including the Basic Health Care Provision Fund, were intended to expand primary care (J. N. Chukwuma, 2023; Uzochukwu et al., 2018). Whether such national measures reach conflict-affected areas differently from other areas is an empirical question that this paper touches only indirectly.

2.6 Measuring and explaining inequality

Two families of methods are standard in the analysis of health equity from household surveys, and this paper uses both.

Concentration-based measures. The concentration index summarises how a health indicator is distributed across the population ranked by socioeconomic status, and was introduced to the health literature by Wagstaff et al. (1991). For binary indicators such as "made four or more visits", the variable's bounds make the standard index depend on the mean, so Erreygers (2009) proposed a corrected index that is now widely used. O'Donnell et al. (2008) provide a standard, practical guide to these measures, using household survey data and addressing sampling weights and design considerations. This paper reports the corrected index within the North-East and nationally.

Decomposition of group differences. The Blinder-Oaxaca decomposition (Blinder, 1973; Oaxaca, 1973) splits the average difference in an outcome between two groups into a part explained by differences in observed characteristics and a part due to differences in how those characteristics are associated with the outcome, together with unmeasured factors. A well-known difficulty is that the result can depend on which group's coefficients are used as the reference, and Neumark (1988) proposed using pooled coefficients, a convention that has been implemented and discussed by Jann (2008). For binary outcomes, Fairlie (2005) extended the approach to logit and probit models. The unexplained component is often loosely referred to as "discrimination" in labour economics. In a health setting, it should not be given a causal label. It collects everything not measured, including facility availability, workforce, security, norms, reporting differences and chance, and the paper treats it as such.

Inference with complex surveys. The DHS uses stratified, clustered sampling with unequal weights, so naïve standard errors are misleading. Design-based estimation (Lumley, 2004) and resampling methods suited to stratified cluster designs, such as the rescaled bootstrap of Rao and Wu (1988), provide valid inference. A further practical point is that when a gap is small, expressing the explained component as a percentage share of the gap is unstable. This paper, therefore, reports components in percentage points with confidence intervals.

2.7 Synthesis, framework and propositions

What the literature establishes. Exposure to organised violence reduces the use of maternal care and raises maternal mortality, with effects that vary by place and by group (A. Chukwuma & Ekhator-Mobayode, 2019; Kotsadam & Østby, 2019; Østby et al., 2018). Inequalities in service coverage are wider in conflict-affected countries (Akseer et al., 2020). ANC coverage and quality are different things, and quality is both low and unequal (Oladosun & Etim, 2026; Arsenault et al., 2018; Benova et al., 2018; Fagbamigbe & Idemudia, 2015). Reconstruction of health systems is theorised to contribute to state-building and peace (Kruk et al., 2010), though empirical support is limited.

What it leaves open. The evidence on Nigeria is concentrated on exposure to violence and on survey rounds before 2023. Few studies compare regional gaps while explicitly separating composition from the residual. The eight-contact

standard and the content of care are less often examined than the four-visit indicator. And the role of provider definitions and humanitarian delivery in regional comparisons is rarely tested.

The framework used in this paper has three layers that together determine a region's observed level of ANC use.

1. **Composition.** Who lives in the region: women's education, household wealth, place of residence, age, parity and marital status. This layer is measured directly in the survey and is the source of the explained component of the gap.
2. **Service supply.** What care is physically and organisationally available: facilities, health workers, provider mix, and humanitarian or donor-funded substitutes. This layer is measured only indirectly, through the type of provider reported by women.
3. **Demand and context.** Insecurity, distance, trust, household decision-making, norms and the cost of care. This layer is partly measurable (the survey asks about barriers such as permission, money and distance) and partly not.

The unexplained component of a regional gap reflects layers 2 and 3, as well as reporting differences and chance. A conflict-affected region could show a negative unexplained component if supply is bolstered by humanitarian action, or a positive one if insecurity suppresses demand and supply beyond what composition predicts.

Competing explanations for a better-than-expected result. Because the main empirical pattern reported later in this paper is that the North-East does better than its composition predicts on four or more visits, it is important to set out the explanations that must be considered and what each would predict. Table 2 lists them.

Table 2
Competing explanations and how the analysis addresses them

Explanation	What it would predict	What the NDHS 2023-24 can show	What it cannot show
Humanitarian substitution	Higher-than-expected use in the most heavily served states (Borno, Adamawa, Yobe) than in the rest of the North-East	State-level contrasts and adjusted odds ratios by state	Whether humanitarian services caused the pattern
Task shifting and provider mix	"Skilled" coverage in the North-East rises sharply when community health extension workers are counted	Skilled-provider coverage with and without these workers	Quality of care provided by each cadre
Selective survey coverage	The surveyed population is more accessible and better served than the full population	Number of clusters and eligible births by zone and state, compared with the survey design	Women in places the survey could not reach
Unmeasured demand-side factors	The unexplained component shrinks when barriers to care, insurance, religion and phone or internet use are added	Re-estimating the decomposition with added covariates	Factors not collected in the survey
Reporting and measurement	Results sensitive to how "don't know" answers and content items are handled	Sensitivity analyses on these choices	Systematic recall differences between regions
Region as an imperfect proxy	The North-West or other zones look worse than the North-East because violence and insecurity are not confined to it	Comparisons with the North-West and by state	Individual exposure to violent events (requires linkage to event data)

Propositions

The framework leads to five propositions that the empirical sections test descriptively.

- **P1.** The North-East's composition (lower education and wealth, more rural residence) predicts a substantial deficit in ANC use relative to the other zones.
- **P2.** Net of composition, the North-East does not have a residual deficit on four or more visits, and may have a residual advantage.
- **P3.** On the more demanding indicators, eight or more contacts and content of care, the North-East lags more, consistent with limited system capacity for continuity of care.
- **P4.** Within the North-East, outcomes are better in the states most heavily served by emergency and humanitarian health provision than in the others.
- **P5.** Conclusions about "skilled" care depend materially on whether community health extension workers are counted as skilled providers.

These propositions are stated so that they can be falsified. If the unexplained advantage disappears when demand-side covariates are added, or if the best-performing states do not coincide with those most served by humanitarian actors, the corresponding explanations lose force. The findings are associations between region and service use, and they should be read with the caution that region is a proxy for conflict exposure, not a measure of it.

3. Data and Methods

3.1 Data source and survey design

The analysis uses the women's individual recode of the Nigeria Demographic and Health Survey 2023-24 (NDHS 2023-24), a nationally representative household survey conducted by the National Population Commission with technical support from ICF through the Demographic and Health Surveys (DHS) Program. Fieldwork took place between December 2023 and May 2024. The survey used a stratified, two-stage cluster design. The sampling frame was divided into 74 strata. In the first stage, enumeration areas were selected within strata, and in the second stage, 30 households were selected within each enumeration area (NPC & ICF, 2025). A total of 39,050 women aged 15 to 49 were interviewed.

The data file contains 1,380 sampled clusters, against about 1,400 in the sampling design. The 20-cluster difference is consistent with insecurity or other access problems in some areas, although the file does not record the reason. Section 3.9 elaborates on this point further, and the robustness analyses report clusters and eligible births by zone and state.

Each woman carries a sampling weight (variable v005, divided by 1,000,000 to obtain the usual weight), a cluster identifier (v021), and a stratum identifier (v022). The weights sum to the number of women in the file, and the mean weight is 1. Every estimate reported in the paper uses these design variables (Section 3.6.1).

The women's file contains maternal care variables for the most recent pregnancy that ended in a live birth or a stillbirth within the survey's reference window (variables with the suffix _1). Women with a second pregnancy in the window have a second set of variables (suffix _2), but these are rare (344 women), and only the most recent pregnancy is analysed. In the SPSS version of the data (used for this study), indexed variables are named with a dollar sign (for example, m14$1); these were renamed to underscores on import into R (for example, m14_1) so that all variable names are consistent.

3.2 Study population

The analytic population is women whose most recent pregnancy in the reference window ended in a live birth or a stillbirth and who therefore have antenatal care data (a non-missing value for the number of antenatal visits, m14_1). There are 13,968 such women, of whom 13,754 had a live birth and 214 a stillbirth. This eligibility rule was chosen so that the denominator matches the one used for the published antenatal care indicators, which are reported for the most recent live birth or stillbirth (NPC & ICF, 2025).

The reference window is not fixed by the analyst; it is built into the data because the maternal care questions were asked only of women with a recent pregnancy outcome. For the eligible live births, the interval between the date of birth and the date of interview ranged from 0 to 36 months, with the births spread across months 0 to 35 and only a few at 36 months (the median was 14 months, and 22.9 per cent of eligible live births were more than 24 months before interview). The window is therefore about three years. The analytic population reproduces the published national indicators (Section 3.7). A sensitivity analysis restricted to live births within 24 months is reported in Section 4.9.

Table 3
Derivation of the analytic population

Step	Women
All women aged 15 to 49 interviewed	39,050
Without maternal care data (no live birth or stillbirth in the reference window, or a pregnancy outcome for which the questions were not asked)	25,082
Eligible women (non-missing number of antenatal visits)	**13,968**
of whom: most recent pregnancy ended in a live birth	13,754
of whom: most recent pregnancy ended in a stillbirth	214
Eligible women in the North-East	2,972
Eligible women in the other five zones	10,996
Complete cases for the main decomposition (all covariates observed)	13,968

No eligible woman had missing information on the main covariates, so the complete-case analysis loses no observations.

3.3 Outcomes

The primary outcomes are two indicators of antenatal contact counts. Secondary outcomes cover the provider seen, the timing of the first visit and the content of care. All outcomes refer to the most recent eligible pregnancy. Table 4 gives the definitions and the source variables.

Table 4
Outcome definitions

Outcome	Definition	Source variables
Four or more visits (primary)	1 if the woman made four or more antenatal visits, otherwise 0	m14_1
Eight or more contacts (primary)	1 if the woman made eight or more visits, otherwise 0	m14_1
Skilled-provider ANC	1 if care was received from a doctor, a nurse or midwife, or an auxiliary midwife	m2a_1, m2b_1, m2h_1
Skilled-provider ANC, broad definition	As above, plus community health extension workers	adds m2c_1
Early initiation	1 if the first visit took place in months 1 to 3 of pregnancy; women with no visit coded 0	m13_1, m14_1
Content of care	1 if the woman had her blood pressure measured and gave urine and blood samples; women with no visit coded 0	m42c_1, m42d_1, m42e_1

The following points need to be emphasised.

“Don’t know” answers. The number of visits was recorded as “don’t know” for 374 women (2.7 per cent of the eligible population). Following the DHS convention, these women stay in the denominator and are not counted as having reached four (or eight) visits. This convention reproduces the published national figure of 52 per cent for four or more visits. A sensitivity analysis drops these women instead (Section 3.6.5).

Eight or more contacts. The WHO guideline speaks of contacts, meaning any interaction between a pregnant woman and a health provider, whereas the survey counts visits. The indicator is therefore a close proxy for the guideline’s standard, and the paper describes it as eight or more visits when the distinction is important.

Who answers which question. The timing of the first visit and the content of care items were asked only of women who made at least one visit (10,153 women). The main versions of these two outcomes count women with no visit as 0, so that they describe coverage among all eligible births. Versions restricted to women with at least one visit are also computed and are labelled as such, because they answer a different question (quality among users). Women with “don’t know” for the number of visits have missing values for these two outcomes.

Defining a skilled provider. What counts as a skilled provider is a convention. The main definition uses the categories of doctor, nurse or midwife, and auxiliary midwife. Community health extension workers are listed separately in the survey, and the broad definition adds them. The main definition reproduces the published national figure of 63 per cent for skilled-provider antenatal care. Both definitions are reported throughout because the choice substantially changes regional comparisons (Section 3.6.5).

3.4 Regional classification

The main contrast is between the North-East geopolitical zone and the other five zones, using the survey’s region variable (v024). The North-East consists of six states: Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe, as confirmed by the state variable (sstate). Within the North-East, Borno, Adamawa and Yobe form a sub-group, the three states under the 2013 state of emergency, which in the analysis is called the BAY group. A secondary contrast compares the North-East with the North-West alone, to separate conflict-affected disadvantage from general northern disadvantage.

Zone is a proxy for conflict exposure and not a measure of it. The survey data used here are not linked to the locations of violent events, so the analysis compares the region as a whole with the rest of the country and does not estimate the effect of violence (Section 2.3).

Table 5 shows the eligible births by region.

Table 5
Eligible births by region (unweighted)

Region	Eligible births
North-West	4,344
North-East	2,972
North-Central	2,565
South-East	1,386
South-South	1,371
South-West	1,330
North-East: Yobe	614
North-East: Borno	460
North-East: Adamawa	462
North-East: Gombe	492
North-East: Bauchi	564
North-East: Taraba	380
North-East: BAY group (Borno, Adamawa, Yobe)	1,536

3.5 Explanatory variables

The main model uses six covariates chosen because they are the established correlates of antenatal care use in Nigeria (Section 2.4), are available for all eligible women, and apply to every woman regardless of marital status.

- **Education**: none, primary, secondary, higher. (The survey file includes a “don’t know” category, but no eligible woman falls in it.)
- **Household wealth**: the survey’s wealth quintile (poorest to richest). For ranking in the concentration index, the underlying continuous wealth score is used.
- **Place of residence**: urban or rural.
- **Age group**: seven five-year groups, 15 to 19, up to 45 to 49.
- **Parity**: number of children ever born, grouped as 0 to 1, 2 to 3, 4 to 5, and 6 or more. (Women with a stillbirth only are in the first group.)
- **Marital status**: never in union, married, living with a partner, widowed, divorced, and no longer living together or separated.

Husbands’ education and women’s decision-making autonomy were excluded from the main model because they were recorded only for women in a union (34 per cent of women had missing values), and including them would restrict the sample.

A second set of covariates is added, one block at a time, in the robustness analyses (Section 3.6.5): three barriers to care (getting permission, getting money, and distance to the health facility), health insurance, religion, mobile phone ownership, and internet use. Categories used by fewer than 1% of women were collapsed into “Other” to keep models stable.

3.6 Statistical analysis

3.6.1 Design-based estimation

All estimates use the survey weights, strata and clusters. The sampling design was declared to the survey package in R (Lumley, 2004) with clusters nested within strata. Estimates for subgroups (for example, the North-East) were obtained by subsetting the design, never by deleting cases, which would keep variance estimates valid for domains. A rule for strata with a single cluster (“adjust”) was specified in advance, though it was not triggered here, because every stratum contains at least two clusters.

Standard errors for percentages are obtained via Taylor linearisation. For the concentration indices and the decomposition, where no closed-form variance is available, standard errors and confidence intervals are obtained from the Rao-Wu rescaled bootstrap (Rao & Wu, 1988), implemented via bootstrap replicate weights that resample clusters within strata. The main analyses use 200 replications. Confidence intervals for the decomposition are percentile intervals from the replicate estimates.

3.6.2 Descriptive and inequality measures

Weighted percentages and 95 per cent confidence intervals are reported for each outcome by zone and for the North-East against the other zones. Each outcome is estimated separately, so its denominator is the set of women with a valid value for that outcome. The unweighted number of women is reported next to each estimate, and estimates based on fewer than 25 women are flagged.

Wealth-related inequality is measured by the concentration index (Wagstaff et al., 1991). Women are ranked by their wealth score, with a weighted fractional rank r running from 0 (poorest) to 1 (richest). For an outcome with mean μ, the index is

$$C = 2 \times \mathrm{cov}(y, r) / \mu$$

where the covariance is computed with the sampling weights. Because the outcomes are binary, the Erreygers correction (Erreygers, 2009) is applied, which makes the measure independent of the mean:

$$E = 4 \times \mu \times C$$

The index is computed nationally and within the North-East, with bootstrap standard errors, so that inequality within the North-East can be compared with inequality in the country as a whole (O’Donnell et al., 2008). A slope index of inequality, from a weighted regression of the outcome on wealth rank, is also reported.

3.6.3 Decomposition of the regional gap

The central analysis is a decomposition of the gap between the other zones (group A) and the North-East (group B) in the probability of each outcome. The gap is defined as the mean for the other zones minus the mean for the North-East, so a positive gap means the North-East is lower.

The Blinder-Oaxaca approach (Blinder, 1973; Oaxaca, 1973) splits the gap into a part explained by differences in the average characteristics of women in the two groups and a remainder:

Gap = mean(y_A) - mean(y_B)

= [mean(X_A) - mean(X_B)] × β* (explained) + remainder (unexplained)

Here X is the vector of covariates (Section 3.5) and β* is a vector of reference coefficients. The model is a weighted linear probability model, which makes the decomposition exactly additive and the coefficients directly interpretable as changes in probability. The reference coefficients are taken from a pooled model that includes both groups and a group indicator (Jann, 2008; Neumark, 1988). This choice avoids the arbitrary decision about which group's coefficients should serve as the benchmark. The explained component is reported by covariate. The contribution of a categorical variable, summed over its categories, does not depend on which category is omitted, so the explained contributions are reported by variable. Detailed contributions to the unexplained component depend on the omitted category and are not interpreted variable by variable. Instead, the unexplained part is reported in total.

Results are given in percentage points with confidence intervals. The explained part is not expressed as a percentage of the gap because that ratio becomes unstable when the gap is small, as is the case for four or more visits.

The unexplained component should not be read as an effect of conflict or discrimination. It collects everything that the covariates do not capture, including the availability of facilities and workers, the provider mix, security, norms, differences in reporting, and chance (Section 2.6).

As a robustness check, a non-linear counterfactual decomposition, in the manner of Fairlie (2005), is computed from a weighted logit model fitted to the other zones and applied to the characteristics of women in the North-East. The explained part is the difference between the observed mean in the other zones and the predicted mean for the North-East under the other zones' coefficients, and the unexplained part is the remainder. The two methods are compared in percentage points.

3.6.4 Adjusted models and multilevel check

To report adjusted differences in familiar terms, a survey-weighted logistic regression (quasi-binomial family) of four or more visits on the North-East indicator and the main covariates is used, and results are presented as adjusted odds ratios with design-based 95 per cent confidence intervals. Collinearity among covariates is screened with variance inflation factors, and models are checked for perfect prediction.

Because the survey is strongly clustered, a random-intercept logistic model with the enumeration area as the grouping level is fitted as a check, and the intraclass correlation is computed on the latent scale as the cluster variance divided by that variance plus $\pi^2/3$. A second version adds a random intercept for state. These multilevel models are not weighted by the survey weights and are used only to check that the regional difference survives clustering. They are not the primary estimates.

3.6.5 Sensitivity and robustness analyses

The analysis plan is organised so that each robustness check addresses one question raised by the main result. Table 6 maps the checks to the explanations and propositions of Section 2.7.

Table 6
Sensitivity and robustness analyses

Check	What changes	Question addressed
Alternative reference coefficients	Reference is the other zones or the North-East, instead of the pooled model	Does the split between explained and unexplained depend on the reference?
Eight or more contacts	Outcome changes to the stricter indicator	Does the pattern hold for the current international standard? (P3)
North-East against North-West only	The comparison group is the North-West	Is the North-East's position specific to the comparison group?
"Don't know" answers dropped	The 374 women are excluded instead of being kept as "not four or more"	Is the result sensitive to this convention?
Long-term residents	Only women resident in their place for five years or more (or always)	Does displacement or migration affect zone assignment?
BAY states against other North-East states	State-level estimates, with state-specific adjusted odds ratios	Are the most heavily served states different? (P4)
Skilled provider, with and without community health extension workers	Provider definition	Do conclusions about skilled care depend on the definition? (P5)
Added covariates, in blocks	Barriers to care, insurance, religion, mobile phone and internet use	Does the unexplained component shrink when more demand-side factors are controlled? (P2)
Coverage by zone and state	Clusters and eligible births compared with the survey design	Could the surveyed population differ from the full population?
Leave-one-state-out	Each North-East state removed in turn	Is the North-East result driven by one state?
Adjusted odds ratios by zone	North-Central as the reference zone	Where does the North-East sit among all six zones?
Multilevel models with state	Random intercepts for cluster and state	Does the result survive clustering by state?
Shorter reference window	Live births only, and live births within 24 months (stillbirths cannot be dated)	Does the result depend on the length of the window or on the stillbirths?
Missing-cluster bounds	Hypothetical missing North-East clusters with low coverage	How many missing clusters, and how poorly served, would remove the advantage?
Provider mix by state	Most qualified provider seen, by zone and North-East state	What lies behind the pattern in Adamawa and the BAY states? (P5)
Place of care	Type of facility where care was received, among women with at least one visit	Does care in the BAY states pass through different channels? (P4)
Test of the concentration index difference	Bootstrap difference between the North-East and the other zones, and coverage by wealth quintile	Is the lower inequality in the North-East real, and who benefits?

For the robustness blocks, bootstrap confidence intervals use 100 replications in the exploratory run and are re-run with 200 or more for the final tables.

Five further analyses address the main threats to the central result. First, because stillbirths have no birth date and the window reaches back 36 months, the decomposition was repeated for live births only and for live births within 24 months. Second, to examine the effect of clusters missing from the survey file, a bounding analysis assumes that a share *f* of the true North-East population is missing, that it has the same size and composition as the surveyed population (so that the explained component is unchanged), and that coverage in it is *c*. The unexplained component then becomes

new unexplained = observed unexplained + *f* × (observed North-East mean − *c*)

The analysis reports the number of missing clusters at which this reaches zero, for several values of *c*, using both the estimated component and its confidence limit nearest to zero. The assumption of unchanged composition is the least favourable to the result, because poorer composition in the missing clusters would raise the explained component and reduce the effect on the unexplained component. Third, because women can see several providers, each woman was classified by the most qualified provider she saw (doctor, nurse or midwife, or auxiliary midwife; then community health extension worker; then community health promoter; then traditional birth attendant or other; then none), and the classification was tabulated by zone and North-East state. Fourth, the place of care reported by women with at least one visit was grouped into the following categories: the woman's home; primary-level public facilities (primary health centres, clinics, and health posts); public hospitals; other public facilities; private facilities; drug shops (pharmacies and patent medicine vendors); and mobile clinics. The data file has no separate category for NGO or faith-based facilities in this question. Fifth, the difference between the Erreygers indices of the North-East and the other zones, and between the North-East and the country, was tested with the bootstrap, and coverage was compared by wealth quintile within each region.

3.6.6 Precision

With 2,972 eligible births in the North-East, a design effect of 4.5 and an intraclass correlation of 0.38, the smallest difference in a proportion near 50 per cent that the data can detect with 80 per cent power at the 5 per cent level is about 6 percentage points. Gaps smaller than this, such as the 2-point raw gap in four or more visits, cannot be distinguished from zero, and the paper interprets them accordingly. State-level estimates, which rest on between 380 and 614 births, are described as indicative.

3.7 Validation, reproducibility and software

Validation against published figures. Before any modelling, the analytic file was checked against the published national indicators. The weighted proportion with four or more visits was 51.9 per cent (published: 52 per cent), and the proportion receiving skilled-provider care was 62.9 per cent (published: 63 per cent), which reproduces the report within rounding.

Decisions made after inspecting the data. In the interest of transparency, the following choices were fixed after looking at the structure of the data, in order to align the analysis with the published indicators: the eligibility rule (non-missing number of visits), the treatment of "don't know" answers (kept in the denominator), and the definition of a skilled provider (the main version without community health extension workers). The outcomes, the covariates of the main model and the decomposition method were fixed before the regional results were examined. Sensitivity analyses test whether the substantive conclusions depend on the choices made afterwards.

Software and code. All data preparation and analysis were carried out in R version 4.6.1 under Windows 11, using the packages haven 2.5.5 (data import), dplyr 1.2.1 and tidyr 1.3.2 (data handling), survey 4.5 (design-based estimation and bootstrap replicate weights), lme4 2.0.6 (multilevel models) and car 3.1.5 (variance inflation factors). The analysis is organised as a sequence of numbered scripts. Each script writes its results to files and logs, and an automatic

verification log records every consistency check (for example, the number of women, the weight totals, the number of clusters and strata, and the reproduction of the published indicators). The scripts, logs and session information are retained so that every number in the paper can be traced to the code that produced it.

3.8 Ethical considerations and data access

This is a secondary analysis of anonymised data from a publicly available survey. Access to the NDHS 2023-24 data was approved by the DHS Program (ICF) on 19 October 2026 for the registered research project “Health Equity as Peace Dividend? Antenatal Care in the Post-Insurgency North-East of Nigeria”. The data were used only for this project and in accordance with the DHS terms of use, which prohibit the redistribution of respondent-level data and any attempt to identify households or respondents. No such attempt was made, and no geographic information finer than the state was used (the survey’s cluster numbers carry no location labels and were used only to describe the sampling design). The NDHS received ethical approval at the time of data collection, and respondents gave informed consent. Because the analysis uses de-identified secondary data, no additional ethical review was required. In line with the terms of use, a copy of this publication will be sent to the DHS Program.

3.9 Methodological limitations

Several limitations of the design shape how the results should be read, and the Discussion returns to them.

1. **Region is a proxy for conflict.** The analysis compares regions and does not measure individual or local exposure to violence, so it cannot estimate the effect of conflict. Violence has not been confined to the North-East (A. Chukwuma & Ekhator-Mobayode, 2019).
2. **Cross-sectional design.** A single survey round cannot show change over time or distinguish the effect of recovery from the effect of a stable regional characteristic.
3. **Coverage of the survey.** The file contains 1,380 of about 1,400 designed clusters. Where insecurity prevented fieldwork, the most affected populations may be missing, which would tend to flatter the North-East’s results. The analysis can describe the clusters that were surveyed, but not the ones that were not.
4. **Self-reported care.** The number of visits, the timing of the first visit and the content of care are reported from memory, and “don’t know” answers are handled by convention.
5. **The unexplained component.** It gathers all unmeasured influences, so it cannot by itself identify a mechanism.
6. **Complete-case and conditional inference.** The decomposition uses women with complete covariate data (here, all eligible women), and the bootstrap conditions on that sample.
7. **Unweighted multilevel models.** They check clustering but do not estimate population-level effects.
8. **Reference window.** The window of about three years limits the number of births per region, and its length differs from some published indicator definitions.

4. Results

4.1 The women and their regions

The analysis covers 13,968 women whose most recent live birth or stillbirth fell in the survey’s reference window, of whom 2,972 live in the North-East and 10,996 in the other five zones (Table 3). The two groups differ sharply in the characteristics identified in the literature as the main correlates of antenatal care (Table 7).

Table 7
Characteristics of eligible women, North-East and other zones (weighted per cent)

Characteristic	North-East	Other zones
Education		
No education	66.1	41.6
Primary	9.9	11.8
Secondary	19.3	35.3
Higher	4.7	11.3
Household wealth quintile		
Poorest	41.6	20.1
Poorer	27.4	21.6
Middle	17.6	20.6
Richer	10.0	19.6
Richest	3.4	18.2
Residence		
Rural	64.7	61.1
Parity (children ever born)		
0 to 1	15.4	20.3
6 or more	29.5	20.0
Marital status		
Married	94.5	90.9
Living with a partner	1.1	4.5
Unweighted number of women	2,972	10,996

Source: NDHS 2023-24, eligible women.

Two-thirds of eligible women in the North-East (66.1 per cent) had no formal education, compared with 41.6 per cent elsewhere. Almost seven in ten (69.0 per cent) belonged to the two poorest wealth quintiles, against 41.7 per cent in the other zones, and only 3.4 per cent were in the richest quintile, compared with 18.2 per cent elsewhere. By contrast, the shares living in rural areas were similar (64.7 and 61.1 per cent). The North-East profile is therefore one of marked educational and economic disadvantage that is not mainly a matter of rural residence, an important point for the decomposition below.

The survey reached 211 clusters in the North-East, of which 210 contained at least one eligible birth, with an average of 14.2 eligible births per cluster (Table 8). Across the entire file, there were 1,380 clusters, compared with about 1,400 in the sampling design.

Table 8
Clusters and eligible births by region (unweighted)

Region	Clusters in file	Clusters with eligible births	Eligible births	Births per cluster
North-West	259	259	4,344	16.8
North-East	211	210	2,972	14.2
North-Central	262	260	2,565	9.9
South-East	181	180	1,386	7.7
South-South	221	218	1,371	6.3
South-West	246	241	1,330	5.5
North-East states				
Yobe	33		614	
Borno	35		460	
Adamawa	36		462	
Gombe	31		492	
Bauchi	41		564	
Taraba	35		380	

4.2 Levels of antenatal care

Four or more visits. Nationally, 51.9 per cent of eligible women made four or more visits (95% CI 50.2 to 53.6), which reproduces the published figure of 52 per cent. In the North-East, the figure was 50.2 per cent (46.4 to 54.1), against 52.3 per cent (50.4 to 54.3) in the other zones. The raw difference of 2.1 percentage points is well within sampling error. The geography of coverage does not run from the conflict-affected region to the rest: the North-West was the lowest zone at 40.1 per cent (37.0 to 43.1), the North-East and North-Central were close together (50.2 and 49.2 per cent), and coverage rose steeply in the south, from 67.1 per cent in the South-South to 73.5 per cent in the South-East and 80.6 per cent in the South-West (Table 9, Fig. 1).

Eight or more visits. The picture changes completely at the higher standard. Only 16.4 per cent of women nationally (15.4 to 17.3) made eight or more visits. In the North-East, the figure was 4.0 per cent (3.0 to 5.1), compared with 19.4 per cent (18.2 to 20.6) in the other zones. The North-East had the lowest coverage of any zone, below even the North-West (5.2 per cent), and far below the South-West (63.3 per cent).

Skilled provider. Skilled-provider care (doctor, nurse or midwife, and auxiliary midwife) reached 62.9 per cent nationally, reproducing the published 63 per cent. In the North-East, it was 59.5 per cent (54.3 to 64.6), and in the other zones, 63.8 per cent (61.5 to 66.0). When community health extension workers are included, the North-East figure rises to 74.6 per cent (70.2 to 79.1), above the 69.3 per cent (67.1 to 71.6) in the other zones. The addition lifts North-East coverage by 15.1 points, against 5.5 points elsewhere (Section 4.7).

Timing and content. Early initiation (first visit in the first three months of pregnancy) was similar in the North-East and elsewhere: 18.2 per cent (15.8 to 20.5) against 17.7 per cent (16.7 to 18.7). It was far lower in the North-West (6.8 per cent). Among women who made at least one visit, 23.2 per cent in the North-East started early, against 25.6 per cent elsewhere. Receipt of all three checks (blood pressure, urine sample, and blood sample) was 65.4 per cent in the North-East (61.5 to 69.3), compared with 58.1 per cent (55.8 to 60.5) elsewhere, when women with no visit are counted as not

receiving them. Among women who did attend, receipt was almost the same: 83.5 per cent (81.0 to 85.9) in the North-East and 82.2 per cent (80.5 to 84.0) elsewhere. In other words, the content of care delivered to attenders in the North-East was no worse than in the rest of the country.

Table 9
Antenatal care indicators by region (weighted per cent, 95% CI)

Indicator	National	North-East	Other zones	North-West	North-Central	South-East	South-South	South-West
Four or more visits	51.9 (50.2 to 53.6)	50.2 (46.4 to 54.1)	52.3 (50.4 to 54.3)	40.1 (37.0 to 43.1)	49.2 (45.1 to 53.2)	73.5 (69.1 to 77.8)	67.1 (63.9 to 70.3)	80.6 (77.7 to 83.4)
Eight or more visits	16.4 (15.4 to 17.3)	4.0 (3.0 to 5.1)	19.4 (18.2 to 20.6)	5.2 (4.0 to 6.3)	11.3 (9.7 to 13.0)	34.2 (30.5 to 37.9)	39.9 (36.3 to 43.4)	63.3 (60.0 to 66.6)
Skilled provider	62.9 (60.9 to 65.0)	59.5 (54.3 to 64.6)	63.8 (61.5 to 66.0)	50.4 (46.8 to 54.1)	60.7 (56.0 to 65.4)	90.8 (88.5 to 93.2)	82.4 (79.4 to 85.4)	89.4 (86.7 to 92.1)
Skilled provider, including CHEWs	70.4 (68.4 to 72.4)	74.6 (70.2 to 79.1)	69.3 (67.1 to 71.6)	60.0 (56.2 to 63.8)	63.2 (58.7 to 67.7)	90.8 (88.5 to 93.2)	85.5 (82.7 to 88.4)	89.7 (87.0 to 92.5)
First visit in first trimester	17.8 (16.9 to 18.7)	18.2 (15.8 to 20.5)	17.7 (16.7 to 18.7)	6.8 (5.7 to 8.0)	22.7 (20.1 to 25.2)	31.2 (27.7 to 34.7)	31.6 (28.5 to 34.7)	35.6 (32.3 to 38.9)
Blood pressure, urine and blood tests	59.6 (57.6 to 61.7)	65.4 (61.5 to 69.3)	58.1 (55.8 to 60.5)	50.4 (46.5 to 54.2)	52.7 (47.8 to 57.6)	72.2 (68.0 to 76.4)	71.8 (67.5 to 76.1)	81.2 (78.0 to 84.3)
Among women with at least one visit								
First visit in first trimester	25.1 (23.9 to 26.3)	23.2 (20.6 to 25.8)	25.6 (24.2 to 27.0)	10.9 (9.0 to 12.8)	36.0 (33.0 to 39.0)	34.8 (31.6 to 38.1)	36.9 (33.9 to 39.9)	39.6 (36.5 to 42.8)
All three tests	82.5 (81.0 to 84.0)	83.5 (81.0 to 85.9)	82.2 (80.5 to 84.0)	79.6 (76.2 to 83.0)	82.8 (79.4 to 86.3)	79.8 (76.4 to 83.1)	84.8 (81.8 to 87.9)	89.1 (87.2 to 91.0)

CHEWs: community health extension workers. Women with no visit are counted as 0 for the timing and test indicators in the upper block. Women with "don't know" for number of visits have missing values for these indicators.

4.3 How much of the regional gap does composition explain?

Four or more visits. The decomposition separates the 2.1-point gap into a component explained by the observed characteristics of women and a residual (Table 10, Fig. 2). The gap is defined as the other zones minus the North-East, so a positive gap means the North-East is lower.

The raw gap of 2.1 points (95% CI: −2.7 to 5.9) is small and not statistically distinguishable from zero. The characteristics of women in the North-East, however, would on their own predict a much larger deficit. The explained component is 14.8 points (12.1 to 17.3). Education accounts for 6.4 points (4.9 to 7.9) and household wealth for 7.8

points (6.2 to 9.1). Parity contributes 0.4 points (0.1 to 0.8), while residence (0.1), age (0.1) and marital status (0.0) contribute almost nothing. The unexplained component is therefore negative: −12.7 points (− 16.5 to − 8.8). Put differently, women in the North-East made 'four or more visits' about 13 points more often than women with their education, wealth, and other characteristics would be expected to if the relationship between those characteristics and care were the same as in the rest of the country.

The logit-based counterfactual decomposition gives the same answer: an explained component of 15.7 points (12.6 to 18.6) and an unexplained component of − 13.6 points (− 16.8 to − 10.3).

Eight or more visits. At the stricter standard, the sign of the unexplained component reverses. The gap is 15.4 points (14.0 to 17.1), of which 9.4 points (7.8 to 10.6) is explained by composition, and 6.0 points (4.6 to 7.7) is unexplained, pointing to lower coverage in the North-East.

Table 10
Decomposition of the regional gap (percentage points, 95% bootstrap CI)

Outcome and analysis	Gap (other zones minus North-East)	Explained	Unexplained
Four or more visits, main model	2.1 (− 2.7 to 5.9)	14.8 (12.1 to 17.3)	−12.7 (− 16.5 to − 8.8)
Four or more visits, logit counterfactual	2.1 (− 1.6 to 5.9)	15.7 (12.6 to 18.6)	−13.6 (− 16.8 to − 10.3)
Eight or more visits, main model	15.4 (14.0 to 17.1)	9.4 (7.8 to 10.6)	6.0 (4.6 to 7.7)

Contributions to the explained component for four or more visits: education 6.4 (4.9 to 7.9); wealth 7.8 (6.2 to 9.1); parity 0.4 (0.1 to 0.8); residence 0.1 (− 0.1 to 0.3); age 0.1 (− 0.2 to 0.2); marital status 0.0 (− 0.2 to 0.2).

4.4 Inequality within regions

Wealth-related inequality in four or more visits was substantial everywhere, but smaller in the North-East than elsewhere. The Erreygers-corrected concentration index was 0.302 in the North-East (95% CI: 0.229 to 0.387), compared with 0.542 in the other zones (0.505 to 0.569) and 0.486 nationally (0.456 to 0.513). The difference between the North-East and the other zones was − 0.240 (− 0.316 to − 0.151), and the difference from the national figure was − 0.184 (− 0.252 to − 0.118), so the lower inequality is clearly distinguishable from sampling error. The uncorrected indices show the same pattern (0.150 in the North-East and 0.259 in the other zones). The slope index of inequality within the North-East was 0.452 (standard error: 0.061), indicating that moving from the bottom to the top of the wealth distribution was associated with a 45-point difference in the probability of having four or more visits. Inequality within the region, therefore, remains large, even though it is less pronounced than elsewhere.

Coverage by wealth quintile shows where the difference comes from (Table 11). Among the poorest fifth of women nationally, 38.0 per cent of those in the North-East (95% CI 32.4 to 43.7) made four or more visits, compared with 20.9 per cent (18.4 to 23.4) of the poorest women in the other zones, a difference of 17.1 percentage points. The North-East advantage was 14.4 points in the second quintile and 7.9 points in the middle quintile, and it disappeared in the richer quintiles (0.8 points in the fourth quintile and − 2.4 points in the richest). The regional advantage is therefore concentrated among the poorest women.

Table 11
Four or more visits by household wealth quintile, North-East and other zones (weighted per cent, 95% CI)

National wealth quintile	North-East	n	Other zones	n	Difference (points)
Poorest	38.0 (32.4 to 43.7)	1,359	20.9 (18.4 to 23.4)	2,301	+ 17.1
Poorer	50.1 (43.6 to 56.6)	753	35.7 (32.6 to 38.7)	2,084	+ 14.4
Middle	59.9 (54.3 to 65.5)	479	52.0 (48.7 to 55.2)	2,213	+ 7.9
Richer	73.6 (67.3 to 79.9)	285	72.8 (70.3 to 75.2)	2,292	+ 0.8
Richest	82.7 (76.3 to 89.1)	96	85.1 (83.3 to 87.0)	2,106	−2.4

Quintiles are national. The difference is the North-East figure minus the figure for the other zones. n is the unweighted number of eligible women.

4.5 Adjusted differences between zones

In a survey-weighted logistic model with all six covariates, the North-East had the highest adjusted odds of four or more visits among the six zones when compared with North-Central (Table 12). The adjusted odds ratio was 2.04 (95% CI 1.61 to 2.58). The North-West, which had the lowest raw coverage, did not differ from North-Central after adjustment (odds ratio 1.11, 95% CI 0.91 to 1.34). The South-East (1.49, 1.21 to 1.84) and South-West (1.58, 1.25 to 1.98) were higher, and the South-South was lower (0.79, 0.64 to 0.98).

Education and wealth showed the expected strong gradients. Compared with no education, secondary education had an odds ratio of 2.94 (2.52 to 3.44) and higher education 4.40 (3.51 to 5.52). Compared with the poorest quintile, the richest had an odds ratio of 5.31 (4.17 to 6.78).

Table 12
Adjusted odds ratios for four or more visits (reference: North-Central zone)

Zone	Odds ratio	95% CI
North-West	1.11	0.91 to 1.34
North-East	**2.04**	**1.61 to 2.58**
South-East	1.49	1.21 to 1.84
South-South	0.79	0.64 to 0.98
South-West	1.58	1.25 to 1.98

Adjusted for education, household wealth, residence, age group, parity and marital status.

Clustering. In a random-intercept model with the enumeration area as the grouping level, the North-East odds ratio was 1.71 (log-odds 0.54, standard error 0.08; approximate 95% CI 1.45 to 2.01). The cluster variance was 0.62, corresponding to a latent-scale intraclass correlation of about 0.16 after adjusting for covariates, down from 0.38 in the model without covariates. When a state random intercept was added, the North-East odds ratio fell to 1.56, with a much wider interval (log-odds 0.44, standard error 0.27; approximate 95% CI 0.93 to 2.62). This widening is expected. A regional indicator is constant within each state, and the North-East has only six states, so once between-state variation is modelled, the region's advantage is estimated imprecisely. The direction remains the same, but this check does not give independent confirmation at the state level. These multilevel models are unweighted and serve only as checks.

4.6 Differences within the North-East

The three states under the 2013 emergency declaration (Borno, Adamawa and Yobe, the BAY group) had higher coverage of four or more visits than the other three North-East states: 55.0 per cent (50.6 to 59.3) against 45.7 per cent (39.6 to 51.8) (Table 13). After adjustment for the six covariates, the odds ratio for the BAY group was 1.43 (1.04 to 1.96). The BAY group also had a higher share starting care in the first trimester (21.5 per cent, 18.3 to 24.7, against 14.9 per cent, 11.8 to 18.1), but the same level of skilled-provider coverage (59.8 and 59.2 per cent).

The BAY difference is not uniform across the three states. Borno (59.5 per cent) and Adamawa (58.1 per cent) had the highest coverage of four or more visits in the region, whereas Yobe (47.7 per cent) was close to Bauchi (45.0 per cent) and Taraba (51.9 per cent), and Gombe was lowest (40.3 per cent). Adjusted for covariates and compared with Bauchi, the odds ratios were 1.73 for Borno (1.01 to 2.96), 1.38 for Adamawa (0.86 to 2.23), 1.25 for Yobe (0.77 to 2.01), 1.20 for Taraba (0.70 to 2.07) and 0.67 for Gombe (0.42 to 1.07). Only the Borno estimate had an interval excluding 1, and only narrowly, so state-level comparisons are indicative.

Two further patterns stand out. First, skilled-provider coverage in Adamawa was only 33.5 per cent (20.5 to 46.6), far below its coverage of four or more visits. Section 4.8 shows that this reflects a high reliance on CHEWs and community health promoters. Second, coverage of eight or more visits was very low across all North-East states, ranging from 1.1 per cent in Gombe to 4.8 per cent in Bauchi.

Table 13
Antenatal care in the North-East by state (weighted per cent, 95% CI)

Group	Eligible births	Four or more visits	Skilled provider	Eight or more visits
BAY states (Borno, Adamawa, Yobe)	1,536	55.0 (50.6 to 59.3)	59.8 (53.7 to 65.8)	not estimated
Other North-East states	1,436	45.7 (39.6 to 51.8)	59.2 (51.0 to 67.4)	not estimated
Yobe	614	47.7 (41.6 to 53.8)	71.8 (62.3 to 81.3)	4.7 (1.9 to 7.5)
Borno	460	59.5 (52.1 to 67.0)	65.9 (57.8 to 74.0)	4.6 (1.5 to 7.7)
Adamawa	462	58.1 (48.7 to 67.5)	33.5 (20.5 to 46.6)	3.3 (0.7 to 6.0)
Gombe	492	40.3 (31.1 to 49.5)	61.1 (54.8 to 67.4)	1.1 (0.0 to 2.3)
Bauchi	564	45.0 (36.0 to 54.0)	56.8 (43.6 to 69.9)	4.8 (3.0 to 6.6)
Taraba	380	51.9 (41.2 to 62.6)	64.3 (53.8 to 74.8)	3.0 (1.1 to 4.9)

State estimates rest on 380 to 614 births and are indicative. The interval for Gombe, eight or more visits, is truncated at zero.

4.7 Sensitivity to the definition of a skilled provider

The definition of a skilled provider changes the regional story. Without community health extension workers (CHEWs), skilled-provider coverage in the North-East was 4.3 points below that of the other zones (gap 4.3, 95% CI − 1.4 to 8.4), with an explained component of 14.3 points (12.2 to 16.4) and an unexplained component of − 10.0 points (− 15.0 to − 6.4). With CHEWs counted, the North-East was 5.3 points *above* the other zones (gap − 5.3, − 10.2 to − 1.3), the explained component was 12.9 points (10.6 to 15.7), and the unexplained component was − 18.2 points (− 22.6 to − 14.2). Adding CHEWs raised North-East coverage by 15.1 points, but coverage elsewhere by only 5.5 points. Any statement about skilled care in the North-East, therefore, depends on how CHEWs are classified. This point is taken up further in the Discussion.

4.8 Who provides care, and where it is received

Provider mix. Women can see more than one type of provider, so each woman was classified by the most qualified provider she saw (Table 14). In the North-East, 59.5 per cent of eligible women (54.3 to 64.6) saw a doctor, nurse or midwife, or auxiliary midwife. For 15.2 per cent, the most qualified provider was a community health extension worker (CHEW); for 3.7 per cent, a community health promoter; and for 21.6 per cent, there was no antenatal care at all. Altogether, 21.3 per cent (95% CI 18.1 to 24.6) of North-East women saw a CHEW at some point, about twice the national figure of 10.5 per cent (95% CI 9.4 to 11.7). The share with no care at all was much lower in the North-East than in the other northern zones (36.6 per cent in the North-West and 36.1 per cent in North-Central), so a large part of the North-East's advantage over those zones comes from fewer women having no antenatal care at all.

The provider mix differs sharply by state. In Adamawa, only 33.5 per cent (20.5 to 46.6) of women had a skilled provider as the most qualified provider seen. A CHEW was the most qualified provider for 33.5 per cent (25.3 to 41.7), a community health promoter for 16.8 per cent (12.1 to 21.5), and 16.1 per cent (8.5 to 23.7) had no care. Half of Adamawa women (50.3 per cent) were therefore seen only by CHEWs or community promoters, and 19.9 per cent saw a community promoter at some point (Yobe 9.9 per cent; nationally 2.3 per cent). In Borno, 42.8 per cent saw a CHEW. Comparing the BAY states with the other North-East states, the share with no antenatal care was 15.9 per cent against 27.2 per cent, the share seen mainly by a skilled provider was the same (59.8 and 59.2 per cent), and community promoters were concentrated in the BAY states (6.9 against 0.6 per cent as the most qualified provider).

Table 14
Most qualified provider seen, by region and North-East state (weighted per cent of eligible births)

Most qualified provider seen	National	North-East	BAY states	Other NE states	Adamawa	Borno	Yobe	Bauchi	Gombe	Taraba
Doctor, nurse or midwife, or auxiliary midwife	62.9	59.5	59.8	59.2	33.5	65.9	71.8	56.8	61.1	64.3
Community health extension worker (CHEW) only	7.5	15.2	17.4	13.0	33.5	21.0	2.0	12.7	23.4	5.5
Community health promoter only	1.8	3.7	6.9	0.6	16.8	0.2	7.2	0.5	0.0	1.6
Traditional birth attendant or other only	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No antenatal care	27.1	21.6	15.9	27.2	16.1	12.8	19.0	30.1	15.5	28.6
Memo: saw a CHEW at any visit	10.5	21.3	27.6	15.3	34.8	42.8	5.8	14.4	26.1	9.1
Memo: saw a community health promoter at any visit	2.3	5.3	8.8	1.9	19.9	0.4	9.9	2.2	0.0	2.5

The first five rows are mutually exclusive and sum to 100 per cent (a negligible unclassified remainder is omitted). Women can see more than one provider, so the two memo rows overlap with the rows above. BAY: Borno, Adamawa and Yobe.

Place of care. Among women with at least one visit, care in the North-East was delivered almost entirely through public facilities (Table 15). A public facility was used by 95.2 per cent (93.4 to 97.1) of users, against 74.5 per cent (72.9 to 76.1) in the other zones. Primary-level public facilities (primary health centres, clinics and health posts) accounted for 78.4 per cent (74.5 to 82.3) of North-East users, against 47.5 per cent (45.5 to 49.6) elsewhere, whereas private facilities were used by 2.8 per cent (1.7 to 3.8), against 22.3 per cent (20.8 to 23.8). Care in the woman's own home or in another home was rare (0.9 per cent versus 3.0 per cent), and mobile clinics were reported by almost no one (0.0 per cent). The BAY states and the other North-East states did not differ: 78.8 and 78.0 per cent used primary-level public facilities, and 94.7 and 95.8 per cent used any public facility. Because the data file has no category for NGO or faith-based facilities in this question, humanitarian provision cannot be identified directly.

Table 15

Type of place where antenatal care was received, among women with at least one visit (weighted per cent, 95% CI)

Place of care	North-East	Other zones	BAY states	Other NE states
Woman's own home or another home	0.9 (0.4 to 1.4)	3.0 (2.4 to 3.6)	0.5 (0.2 to 0.8)	1.4 (0.3 to 2.4)
Public primary-level facility (health centre, clinic, health post)	78.4 (74.5 to 82.3)	47.5 (45.5 to 49.6)	78.8 (73.4 to 84.2)	78.0 (72.3 to 83.6)
Public hospital (teaching, federal medical centre, general)	17.8 (14.2 to 21.3)	27.6 (25.7 to 29.4)	16.6 (12.0 to 21.2)	19.0 (13.6 to 24.5)
Other public facility	0.0 (0.0 to 0.0)	0.2 (0.1 to 0.4)	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.0)
Any public facility	95.2 (93.4 to 97.1)	74.5 (72.9 to 76.1)	94.7 (91.6 to 97.9)	95.8 (94.0 to 97.6)
Private facility (hospital, clinic, doctor, maternity centre)	2.8 (1.7 to 3.8)	22.3 (20.8 to 23.8)	2.7 (1.3 to 4.1)	2.9 (1.3 to 4.4)
Pharmacy or patent medicine vendor	0.1 (0.0 to 0.2)	0.5 (0.2 to 0.7)	0.1 (-0.1 to 0.3)	0.0 (0.0 to 0.1)
Any private provider (including drug shops)	2.9 (1.8 to 3.9)	22.7 (21.2 to 24.2)	2.8 (1.4 to 4.2)	2.9 (1.3 to 4.4)
Mobile clinic	0.0 (0.0 to 0.0)	0.1 (0.0 to 0.2)	0.0 (0.0 to 0.0)	0.0 (0.0 to 0.0)
Other place	0.1 (0.0 to 0.2)	0.1 (0.0 to 0.1)	0.1 (-0.1 to 0.3)	0.0 (0.0 to 0.0)

Women can name several places, so the rows overlap. Unweighted numbers of women: North-East 2,279, other zones 7,874, BAY states 1,252, other North-East states 1,027. The data file has no category for NGO or faith-based facilities in this question.

4.9 Robustness of the main result

The main finding, that the North-East does better on four or more visits than its composition predicts, was tested against a series of alternative specifications. The unexplained component stayed negative, and its confidence interval stayed clear of zero, in every one (Table 16).

Table 16
Unexplained component for four or more visits under alternative specifications (percentage points, 95% CI)

Specification	Unexplained component
Main model (pooled reference coefficients)	−12.7 (− 16.5 to − 8.8)
Reference coefficients from the other zones	−13.6 (− 16.7 to − 10.3)
Reference coefficients from the North-East	−9.5 (− 12.8 to − 5.7)
Logit counterfactual decomposition	−13.6 (− 16.8 to − 10.3)
“Don’t know” answers dropped (instead of kept as not four or more)	−11.8 (− 15.4 to − 8.1)
Women resident five years or more (or always) in their place	−12.7 (− 16.8 to − 9.2)
Live births only (stillbirths excluded)	−12.6 (− 16.4 to − 8.9)
Live births within 24 months	−11.9 (− 16.3 to − 8.0)
North-East against North-West only	−12.1 (− 15.7 to − 7.7)
Baseline covariates, exploratory run	−12.7 (− 16.4 to − 8.1)
Plus barriers to care (permission, money, distance)	−13.0 (− 16.8 to − 8.9)
Plus health insurance	−12.7 (− 16.3 to − 8.9)
Plus religion	−12.9 (− 16.9 to − 9.0)
Plus mobile phone and internet use	−12.8 (− 16.3 to − 9.5)
All added covariates together	−13.2 (− 16.7 to − 9.5)

Across these specifications, the unexplained component ranged from − 9.5 to − 13.6 points. The added-covariate rows use 100 bootstrap replications.

Three features of these checks deserve more emphasis. First, adding barriers to care, insurance, religion and phone or internet use made almost no difference. The unexplained component did not shrink even after controlling for additional demand-side factors, so these measured factors do not account for it. Second, the result did not depend on a single state: dropping each North-East state in turn yielded unexplained components ranging from − 11.1 points (without Borno) to − 14.1 points (without Bauchi). Third, the result held in the comparison with the North-West alone, where the North-East had coverage 10.2 points higher (gap − 10.2, − 14.9 to − 5.9), and the composition explained only 1.9 points of that difference.

Two further checks address the length of the reference window and the survey’s missing clusters. First, the result held when stillbirths were excluded (13,754 live births; unexplained component: −12.6 points, − 16.4 to − 8.9) and when only live births within 24 months of the interview were included (10,287 women, of whom 2,226 lived in the North-East; −11.9 points, − 16.3 to − 8.0). In that sample, four or more visits were 50.3 per cent in the North-East against 52.6 per cent in the other zones, and the shortfall for eight or more visits also persisted (unexplained component + 6.1 points, 4.5 to 7.9).

Second, the bounding analysis shows how many unsurveyed North-East clusters would be required to eliminate the advantage (Table 17). With 211 surveyed clusters, about 72 missing clusters (25.3 per cent of the true North-East population) with no antenatal care at all would be needed if the estimated component is taken at face value, and about

45 (17.6 per cent) if the confidence limit nearest zero is used. If all 20 clusters missing from the national file had been North-East clusters with no care at all, the unexplained component would still be − 8.4 points.

Table 17
Missing North-East clusters needed to remove the unexplained advantage for four or more visits

Coverage in the missing clusters (per cent)	Clusters needed, using the estimated component (share of true North-East population)	Clusters needed, using the confidence limit nearest zero (share)
0	72 (25.3%)	45 (17.6%)
10	98 (31.6%)	59 (22.0%)
20	153 (42.1%)	87 (29.2%)
30	358 (62.9%)	164 (43.7%)

Assumes that the missing clusters resemble the 211 surveyed North-East clusters in size and composition. The estimated component is − 12.7 points, and the confidence limit nearest zero is − 8.8 points.

4.10 Summary against the propositions

Table 18 sets the results against the five propositions of Section 2.7.

Table 18
Results against the propositions

Proposition	Result	Assessment
P1. The North-East's composition predicts a substantial deficit	Explained component 14.8 points, mostly education (6.4) and wealth (7.8)	Supported
P2. Net of composition, no residual deficit, possibly an advantage, on four or more visits	Unexplained component − 12.7 points; adjusted odds ratio 2.04; stable across all fifteen specifications; concentrated among the poorest quintiles (38.0 per cent against 20.9 in the poorest quintile)	Supported (an advantage)
P3. The North-East lags more on the demanding indicators	Eight or more visits: 4.0 per cent against 19.4; unexplained + 6.0 points. Early initiation and content of care among attenders were similar to elsewhere	Supported for eight or more visits, not for timing or content
P4. Better outcomes in the states most heavily served by humanitarian provision	BAY 55.0 per cent against 45.7; adjusted odds ratio 1.43; fewer women with no care (15.9 per cent against 27.2); community promoters concentrated in BAY; but Yobe resembles the non-BAY states and place of care is the same in both groups	Partly supported
P5. Conclusions on skilled care depend on counting CHEWs	North-East 4.3 points below others without CHEWs, 5.3 points above with them; 21.3 per cent of North-East women saw a CHEW (10.5 per cent nationally); half of Adamawa women were seen only by CHEWs or community promoters	Supported

These findings are associations between region and service use. They are consistent with several explanations, and the data do not allow them to be distinguished (Section 2.7). The Discussion considers them in turn.

5. Discussion

5.1 Principal findings

The paper set out to ask whether antenatal care in the conflict-affected North-East has recovered relative to the rest of Nigeria, and how much of any difference reflects the composition of its population. The answer has two parts that point in opposite directions.

On the basic standard of four or more visits, the North-East is not behind. Its coverage (50.2 per cent) is close to the national figure (51.9 per cent), above the North-West (40.1 per cent), and only 2.1 percentage points below the other zones combined. This is remarkable given who lives there. Two-thirds of eligible women in the region have no formal education, and almost seven in ten belong to the two poorest wealth quintiles. Composition alone predicts a deficit of about 15 points against the other zones. The observed gap is small because the North-East performs about 13 points better than its profile would suggest (unexplained component: −12.7 points; 95% CI: −16.5 to − 8.8). This result held in all fifteen specifications reported in Section 4 (Table 16), with the unexplained component never smaller in absolute size than 9.5 points and its interval never including zero. The advantage is also concentrated among the poorest women: 38.0 per cent of North-East women in the poorest wealth quintile made four or more visits, against 20.9 per cent of the poorest women in the other zones (Table 11).

Under the stricter standard of eight or more visits, the North-East is last among the six zones: 4.0 per cent compared with 19.4 per cent elsewhere. Here, the composition accounts for only part of the 15.4-point gap, and the unexplained remainder of 6.0 points runs against the region. The region that overperforms at the entry level of care underperforms in continuity.

Within the region, the three states under the 2013 emergency declaration did better than the others on four or more visits (55.0 per cent versus 45.7 per cent), but not uniformly: Borno and Adamawa stood out, while Yobe resembled the states outside the group. The definition of a skilled provider altered the regional comparison substantially, because community health extension workers (CHEWs) account for a much larger share of care in the North-East than elsewhere.

The paper’s title asks whether health equity is a peace dividend. On these results, the honest answer is conditional. There is no evidence of a regional deficit at the level of basic antenatal contact, and that is a notable outcome for a region that has endured protracted violence. But the data cannot show that this reflects peace, as opposed to aid, policy or measurement. And at the standard that now defines good antenatal care, the region has not caught up.

5.2 Interpreting a better-than-expected result

A finding that a conflict-affected region does better than expected should be treated with suspicion before it is explained. Section 2.7 sets out six candidate explanations, and each can now be weighed against the evidence in Section 4 (Table 19).

Table 19
Evidence for and against each explanation of the unexplained advantage

Explanation	Evidence for	Evidence against or limits	Assessment
Humanitarian substitution	BAY states outperform the other North-East states on four or more visits (adjusted odds ratio 1.43) and have fewer women with no care (15.9 per cent against 27.2); community promoters are concentrated in BAY; the advantage is concentrated among the poorest women, as free or targeted provision would produce; heavy humanitarian presence in these states (UN OCHA, 2025; WHO Regional Office for Africa, 2017)	Yobe resembles the non-BAY states; place of care is the same in BAY and other states, mobile clinics are almost absent, and there is no NGO category, so humanitarian provision is not directly visible; the survey does not record who funds or delivers the care; state estimates are imprecise	Plausible, partly supported, not demonstrated
Task shifting and provider mix	Counting CHEWs lifts North-East skilled coverage by 15.1 points against 5.5 elsewhere; 21.3 per cent of North-East women saw a CHEW (10.5 per cent nationally); half of Adamawa women were seen only by CHEWs or community promoters	Does not explain by itself why four or more visits are high; says nothing about quality by cadre	Supported for the provider mix; indirect for the main result
Selective survey coverage	1,380 of about 1,400 designed clusters are in the file; the advantage could reflect a more accessible surveyed population	Bounding analysis: about 72 missing North-East clusters with no care at all (45 at the confidence limit) would be needed to remove the advantage; even if all 20 missing national clusters were North-East and had no care, the component would be − 8.4 points; the location of the missing clusters is unknown	Unlikely to remove the advantage entirely, but may inflate it
Unmeasured demand-side factors	Several relevant factors (husband's education, autonomy, trust, norms) are not in the model	Adding barriers to care, insurance, religion, phone and internet use left the unexplained component unchanged (− 12.7 to − 13.2 points)	Measured factors do not account for it; unmeasured ones remain open
Reporting and measurement	Self-reported visits are subject to recall error and "don't know" answers	Dropping "don't know" answers gave − 11.8 points; content of care among attenders was no worse in the North-East	Unlikely to explain the result on its own
Region as an imperfect proxy	The North-West, not the North-East, has the lowest raw coverage; violence has not been confined to one zone (Chukwuma & Ekhator-Mobayode, 2019)	Adjusted odds ratio for the North-East (2.04) exceeds that of every other zone against the North-Central	Affects the interpretation of "conflict-affected", not the size of the advantage

Four observations help to narrow the field, though none settle it.

First, the advantage is concentrated at the entry level of care. It appears for four or more visits, not for eight or more, and not for the timing of the first visit. An explanation has to account for a region that gets women into care but struggles to keep them in it. Supply-side explanations (substitution and task shifting) fit this shape well because emergency clinics, outreach, and community health workers are good at providing first and second contact but are less well suited to scheduled, continuous follow-up. Demand-side explanations fit it less well because stronger demand would be expected to raise the more demanding indicators as well.

Second, the failure of measured demand-side factors to dent the advantage is informative. Barriers to care (permission, money, distance), insurance, religion and phone or internet use are the kinds of things that might make North-East women more or less able to seek care. Controlling for them changed the unexplained component by less than a point. This does not rule out unmeasured demand factors, but it weakens the case that the advantage reflects something simple about women's circumstances that the survey happened to omit from the main model.

Third, the advantage is not the product of a single state, a single definition or a single reference group. Leaving out any one North-East state shifted the unexplained component only between − 11.1 and − 14.1 points, and switching the reference coefficients shifted it between − 9.5 and − 13.6 points. The result is a property of the region, not of a single state or of the method.

Fourth, the evidence regarding who is served and where further narrows the field. The advantage is concentrated among the poorest women (a 17-point difference in the poorest quintile, disappearing among the richest), and it arises largely because fewer women have no antenatal care at all (21.6 per cent in the North-East, compared with 36.6 per cent in the North-West and 36.1 per cent in the North-Central). Care in the region is delivered almost entirely through public facilities (95.2 per cent of users), mainly at the primary level (78.4 per cent), with very little private care (2.8 per cent, against 22.3 per cent elsewhere). Together, these features point to publicly provided, primary-level care that reaches poor women, rather than to private or hospital-based explanations. They are what free or targeted provision would produce, but they are also what a public system in a poorer region would produce anyway, so they do not identify the source of the support.

Taken together, the evidence is most consistent with a supply-side account in which humanitarian and community-level provision has brought basic antenatal contact in the North-East up to, and somewhat beyond, what the population's socioeconomic position would otherwise predict. The word "consistent" is deliberate. The survey records the type of facility and the type of provider, but not who funds or delivers the services within them, and several rival explanations remain open. The selection explanation cannot be tested directly, but the bounding analysis shows that it would take a large number of missing and entirely unserved clusters to remove the advantage (Section 4.9), although it could still inflate it. It deserves particular attention in any follow-up (Section 5.10).

It is also worth noting what the result does *not* contradict. The literature shows that exposure to violence reduces the use of maternal care (A. Chukwuma & Ekhator-Mobayode, 2019; Østby et al., 2018) and raises maternal mortality (Kotsadam & Østby, 2019). The present finding concerns a different quantity: the 2023-24 level of use in a region, compared with other regions and adjusted for its population. A region can have suffered a negative shock to maternal care, and still show levels of use close to the national average if its starting point was lower and if substantial compensating provision has since been put in place. The two findings are compatible.

5.3 Why the advantage ends at eight visits

The reversal at eight visits is arguably the most policy-relevant result in the paper. The North-East has the lowest coverage of eight or more visits of any zone (4.0 per cent), below even the North-West (5.2 per cent), and it falls short of what its composition would predict by about 6 points. The eight-contact standard was introduced to improve the experience and effectiveness of care, with contacts spread through pregnancy and starting early (Tunçalp et al., 2017; WHO, 2016). Reaching it requires a health system that can schedule appointments, remember them, and follow up with women, and that remains reachable throughout pregnancy.

The data cannot say why the North-East falls short, but the context suggests several candidates that future work could test. Displacement and insecurity make repeated travel difficult and unpredictable, and humanitarian services are often organised around episodes of need and project cycles, rather than around continuous follow-up of individual women

(UN OCHA, 2025). Where care depends on emergency or temporary facilities (WHO, 2017), continuity is likely to be harder to guarantee than first contact. The pattern could also reflect a facility-level constraint: the workforce and records needed to track women through eight contacts may simply be thinner. None of these is tested here, and they should be read as hypotheses.

Two details in the results qualify this picture: among women who attended at least once, the share who received all three basic checks (blood pressure, urine and blood tests) was as high in the North-East as elsewhere (83.5 and 82.2 per cent), so the quality of what is delivered at each contact does not appear to be the problem. And the first visit takes place at a similar stage of pregnancy to elsewhere (23.2 per cent versus 25.6 per cent, starting in the first trimester, among attenders). The shortfall, therefore, lies in the number of contacts and not in what happens during them or in the timing of the first.

This distinction is important for how the findings are framed. The four-visit standard that dominated international monitoring for years is one that the North-East meets, as well as the rest of the country. The eight-contact standard, which is the current international benchmark, exposes a gap that the older indicator conceals. A reader who looked only at the traditional figure would conclude that the region had no problem.

5.4 Inequality within a disadvantaged region

Wealth-related inequality in four or more visits was lower in the North-East (Erreygers index 0.30) than in the other zones (0.54) and in the country as a whole (0.49), and the difference is statistically clear. This could reflect two different things, and the new results help to tell them apart.

First, the lower index is not simply an artefact of a compressed wealth distribution. It is true that the North-East's distribution is compressed at the bottom (69 per cent of eligible women are in the two poorest national quintiles, and only 3.4 per cent are in the richest), and ranking women within such a region produces a narrower spread in relative position. But coverage by quintile shows a real difference (Table 11): 38.0 per cent of the poorest fifth of North-East women made four or more visits, against 20.9 per cent of the poorest fifth elsewhere, and the advantage shrinks steadily with wealth and disappears among the richest. The lower index therefore reflects better coverage of poorer women, and not only a different shape of the wealth distribution. Second, inequality within the region remains large in absolute terms. The slope index of 0.45 implies a difference of about 45 points in the probability of four or more visits between the bottom and the top of the wealth distribution within the North-East.

The comparison with the literature is instructive here: cross-national work finds that inequalities in coverage of maternal services are wider in conflict-affected countries and that poorer, less educated and rural families are worst affected (Akseer et al., 2020). Micro-level work finds that the negative effect of nearby violence on institutional delivery is stronger for poor and less-educated mothers (Østby et al., 2018). The present results do not reproduce this pattern at the regional level for four or more visits: the region with the poorest population is not an outlier on the basic standard, relative wealth inequality within it is smaller than in the country overall, and its poorest women are better covered than the poorest women elsewhere. The finding is a reminder that regional patterns need not mirror the exposure-based patterns observed in studies that compare exposed and unexposed women.

5.5 Differences within the North-East

The within-region results are suggestive but should not be over-read. The BAY states combined did better than the rest of the North-East on four or more visits, but the difference was carried by two states. Borno (59.5 per cent) and Adamawa (58.1 per cent) were the highest, while Yobe (47.7 per cent), Bauchi (45.0 per cent) and Gombe (40.3 per cent) were the lowest of the six, with Taraba in between (51.9 per cent). Only the Borno comparison with Bauchi

reached conventional significance in adjusted models, and only just. With between 380 and 614 births per state, the estimates are imprecise, and the 95 per cent intervals overlap widely.

The substitution hypothesis predicts that states most heavily served by humanitarian actors do better, and the finding weakly supports it. But it is equally what several other explanations would produce, and the place-of-care data add a caution: women in the BAY states and in the other North-East states received care in the same types of facility (78.8 and 78.0 per cent in primary-level public facilities), and mobile clinics were essentially absent from the responses. Borno and Adamawa may differ from Yobe in the density of emergency clinics, the composition of displaced populations, the quality of state health management, or the proportion of the state surveyed. The data cannot choose among these.

The most intriguing detail is Adamawa. Its coverage of four or more visits is among the highest in the region, yet only a third of women (33.5 per cent) saw a provider in the skilled categories used here. The provider data confirm that a large share of antenatal care in Adamawa is delivered by providers outside those categories. A CHEW was the most qualified provider for 33.5 per cent of women (25.3 to 41.7 per cent), a community health promoter for 16.8 per cent (12.1 to 21.5 per cent), and 16.1 per cent had no care, so half of the Adamawa women were seen only by CHEWs or community promoters. Community promoters were also prominent in Yobe (9.9 per cent saw one) and rare nationally (2.3 per cent). This illustrates how much the regional comparison depends on classification. This point is elaborated further below.

5.6 Skilled care, definitions and what counts as “skilled”

The sensitivity of regional conclusions to the treatment of CHEWs is a finding in its own right. Without CHEWs, North-East skilled coverage (59.5 per cent) is about 4 points below that of the other zones. With them, it is about 5 points higher (74.6 per cent against 69.3 per cent). Adding CHEWs raises North-East coverage by 15 points and coverage elsewhere by 5. The provider data show how large the difference in mix is: 21.3 per cent of North-East women saw a CHEW at some point, against 10.5 per cent nationally, and in Borno the figure was 42.8 per cent. A researcher or a policymaker who uses one convention will describe a lagging region, and one who uses the other will describe a leading one.

The definitional choice is not only technical. Task shifting to community-level health workers has been a strategy for reaching underserved communities in Nigeria (Abimbola et al., 2012). If CHEWs are a primary channel of antenatal care in the North-East, excluding them from the “skilled” category understates the health system’s reach there, while including them may overstate its clinical quality. Evidence on the quality of care by cadre is needed to settle the question, and the data used here cannot supply it. The reasonable approach for monitoring is to report both, as this paper does, and to be explicit about the choice.

5.7 Relationship to previous research

The findings add to and, in places, qualify the literature reviewed in Section 2.

Exposure and region. Chukwuma and Ekhator-Mobayode (2019) showed that the Boko Haram insurgency reduced the probability of any antenatal visit, facility delivery, and skilled birth attendance, with effects extending beyond the North-East. The present paper cannot assess exposure because it does not link survey records to the locations of violent events. What it adds is a view of the region’s standing in the most recent survey. The two results are reconcilable. An adverse shock can coexist with a regional level close to the national average if the region started lower, if compensating provisions have been mobilised, and if the comparison is between levels in 2023-24 rather than changes around attacks. The existence of effects outside the North-East in their study also supports the caution that region is an imperfect proxy for conflict.

Inequality and resilience. The results are consistent with the observation that effects of violence on maternal care vary by group and place (Kotsadam & Østby, 2019; Østby et al., 2018). They also resonate with the emphasis on resilience in studies of how health systems cope with shocks. Here, the closest the data come to evidence of resilience is the combination of near-average coverage of basic care, no deficit in the content of care among attenders, and a state-level pattern favouring the most heavily served states. This is evidence of outcomes, not of system processes, and it should be described as such.

Quality and coverage. The paper's distinction between the number of contacts and the content of care echoes the argument that coverage and quality are different things (Arsenault et al., 2018; Benova et al., 2018). In the North-East, the content of care among attenders was no worse than elsewhere, but the content measure is narrow (three basic checks) and says nothing about counselling, referral, or the management of complications. Earlier Nigerian work found that few women received a full package of care (Fagbamigbe & Idemudia, 2015), and the present results should not be taken to imply that quality in the region is adequate.

State building and positive peace. Kruk et al. (2010) proposed that equitable reconstruction of the health system can strengthen the state and contribute to peace, while recognising that evidence was limited. The present study contributes a distributional description of one service in one region. It shows that, at the basic level, the region is not visibly excluded, which is a condition for the legitimacy argument. It does not show that the state, rather than humanitarian actors, is the source of this coverage, and that distinction is important for the argument. If the coverage is sustained mainly by external actors, the state-building pathway is weak, and the transition from humanitarian to state-led provision becomes the critical issue. Percival et al. (2014) caution that reconstruction tends to be gender-blind, and Witter et al. (2015) note that the link between the health workforce and state-building requires further investigation. Both remind us that the quality and sustainability of the arrangements behind the coverage figures cannot be read from a household survey, such as the NDHS, alone.

5.8 Implications for policy and peacebuilding

The following implications arise from the results, with the caveat that they rest on associations and a single cross-sectional survey.

1. **Set the eight-contact standard as the monitoring target in the North-East.** The older four-visit indicator conceals the region's shortfall. Reporting both indicators, by region and state, would show where continuity of care is failing.
2. **Invest in continuity, not only in access.** The evidence points to a region that is reasonably good at getting women into care but poor at keeping them there. Measures that support follow-up, such as appointment tracking, community outreach to women who miss visits, and integration of emergency services with routine primary care, address the gap identified in the data.
3. **Plan the transition from humanitarian to routine provision.** If part of the advantage reflects humanitarian delivery, as the supply-side hypothesis suggests, the gains depend on arrangements that humanitarian funding cycles do not guarantee. UN OCHA (2025) describes a continuing crisis with significant needs and a 2025 funding plan, so the question is how to sustain and integrate services during a recovery that is still underway.
4. **Treat CHEW-delivered care as part of the system, and measure its quality.** CHEWs appear to carry a substantial share of antenatal care in the region. Supervision, training, referral links and quality assessment for this cadre are therefore central to the quality of care in the North-East, and national monitoring should state how they are classified.

5. **Look within the region.** Gombe, Bauchi and Yobe had the lowest coverage of four or more visits, and Adamawa had a distinctive provider pattern. Regional averages conceal this variation, and state-level planning should draw on it, using larger samples or administrative data where the survey is too thin.
6. **Use decomposition routinely in equity monitoring.** Separating the composition of the population from the residual difference prevents misleading conclusions in both directions: a raw gap can hide a favourable residual, as here, and a raw parity can hide a deficit.

For peacebuilding practice, the results suggest a measured approach to messaging; the region is not visibly left behind on the basic indicator, which counts for something in terms of horizontal inequality (Stewart, 2008). But it is visibly behind on the indicator that represents good practice, and the arrangements that produce its basic coverage may be fragile. Framing "recovery achieved" would go beyond the evidence. A framing of "recovery underway, with a clear gap to close" is closer to it.

5.9 Strengths and limitations

Strengths. The analysis uses the most recent nationally representative survey, covering the recovery period, with a large sample and design-based inference. The central finding was stress-tested through 15 specifications and a bounding analysis, covering the reference group, outcome definition, treatment of "don't know" answers, residence history, comparison group, additional covariates, provider definition, state composition, and clustering. The analytic file reproduces the published national indicators, and the entire analysis is scripted and logged, allowing every number to be traced. The results are reported as components in percentage points with bootstrap intervals, which avoids the instability of percentage shares when the gap is small.

Limitations. Several apply and have been flagged in earlier sections; the main ones are these.

- **Region is a proxy for conflict.** The study compares regions and does not measure individual or local exposure to violence. Violence has not been confined to the North-East, so some of the comparison group is also affected.
- **Survey coverage.** The file has about 20 fewer clusters than designed. If the missing clusters were in the least accessible areas, the surveyed North-East population is probably the better served, and the advantage is overstated. This is the limitation that would most threaten the central result, but the bounding analysis (Section 4.9) shows that it would take about 72 missing North-East clusters with no antenatal care at all (45 using the confidence limit) to remove the advantage.
- **Provider and place categories.** Women can see several providers, so provider shares overlap, and the place-of-care question has no category for NGO or faith-based facilities, so humanitarian provision can only be proxied.
- **The unexplained component is a residual.** It collects everything that the model omits, including facility supply, workforce, security, norms, reporting differences and chance. It cannot by itself identify a mechanism, and the supply-side interpretation offered here is an inference.
- **Cross-sectional design.** One survey round cannot distinguish recovery from a stable regional characteristic. It cannot say whether the region's position has improved, worsened or stayed the same.
- **Self-reported care and its measurement.** Visits, timing and content rely on recall. The eight-contact indicator is approximated by the number of visits, and the content measure covers only three basic checks.
- **Precision at the state level.** State estimates rest on a few hundred births and are indicative. The multilevel model that adds state random effects shows that, once between-state variation is modelled, the regional odds ratio is estimated imprecisely (1.56, with an interval of about 0.93 to 2.62).
- **Eligibility and window.** The analysis covers women with a live birth or stillbirth in a window of about three years, and excludes pregnancies that ended before the stage at which antenatal questions were asked. Women who died,

migrated or were not interviewed are not represented.

- **Skilled-provider definition.** Results for skilled care depend on a classification choice, as shown.

5.10 Recommendations for further research

Five lines of further work follow directly.

1. **Link survey clusters to conflict events and facility data.** Using survey cluster locations (which are displaced to protect respondents) and event records, an exposure-based analysis within the North-East would show whether the advantage holds for women living near violence, and whether it differs from the regional average. Linking facility and humanitarian service data would directly test the substitution hypothesis.
2. **Extend the analysis of place and provider.** This paper shows that North-East antenatal care is delivered mainly through public primary-level facilities, with a large part played by CHEWs and community health promoters. The survey cannot show who funds or staffs these services. Linking survey clusters to facility registers and humanitarian service data would directly test the substitution and task-shifting explanations.
3. **Compare survey rounds.** Repeating the analysis for the 2018 survey would show whether the North-East's position has changed over the recovery period. This requires careful harmonisation of definitions across rounds.
4. **Complete the bounding of missing clusters.** The bounding analysis in Section 4.9 assumes that the missing clusters resemble the surveyed ones. Obtaining the designed number of North-East clusters and information on the locations of the missing clusters would enable a tighter, scenario-based assessment.
5. **Study continuity of care directly.** Qualitative work with women, community health workers and health managers in the North-East could explain why women stop short of eight contacts, and which interventions would help.

6. Conclusion

This paper asked whether antenatal care in the conflict-affected North-East of Nigeria has recovered relative to the rest of the country, and how far the answer depends on who lives there. Using the 2023-24 Nigeria Demographic and Health Survey, it found that coverage of four or more visits in the North-East (50.2 per cent) is close to the national average and well above that of the North-West, despite a population whose education and wealth would predict a deficit of about 15 percentage points. The region performs about 13 points better than its profile would suggest, and the result is stable across a wide range of checks. At the stricter standard of eight or more visits, however, the North-East has the lowest coverage of any zone (4.0 per cent) and falls short even of what its composition would predict. The advantage of basic coverage is concentrated among the poorest women, and care in the region is delivered mainly through public primary-level facilities, with a large part played by community-level health workers.

The pattern points to a region in which the first contacts with the health system have been secured, plausibly through humanitarian and community-level provision, but in which the continuity of care that the current international standard demands has not been secured. Within the region, Borno and Adamawa stand out in basic coverage; Gombe, Bauchi, and Yobe lag; and the treatment of community health extension workers changes the picture of skilled care altogether.

These findings are associations between region and service use. They cannot show that peace produced the coverage, that humanitarian action did, or that the surveyed population represents the entire region. What they do show is a region that is not visibly excluded from basic antenatal care, and a precise gap to close. For the study of peacebuilding, the lesson is that equitable recovery of services needs to be judged against the standard that now defines good care, rather than against the easy-to-reach standard. For Nigerian policy, the next task in the North-East is to turn first contact into continuous care and to make the arrangements that now deliver it, durable.

Declarations

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Competing interests. None declared.

Ethics. This is a secondary analysis of anonymised, publicly available survey data. Access was approved by the DHS Program on 19 October 2026 for the registered research project (Section 3.8).

Data availability. The NDHS 2023-24 data are available from the DHS Program on registration and subject to its terms of use (dhsprogram.com). The author's access to this paper was approved, and respondent-level data cannot be redistributed by the authors. The R analysis code, which contains no respondent-level data, will be made available upon request.

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Figures

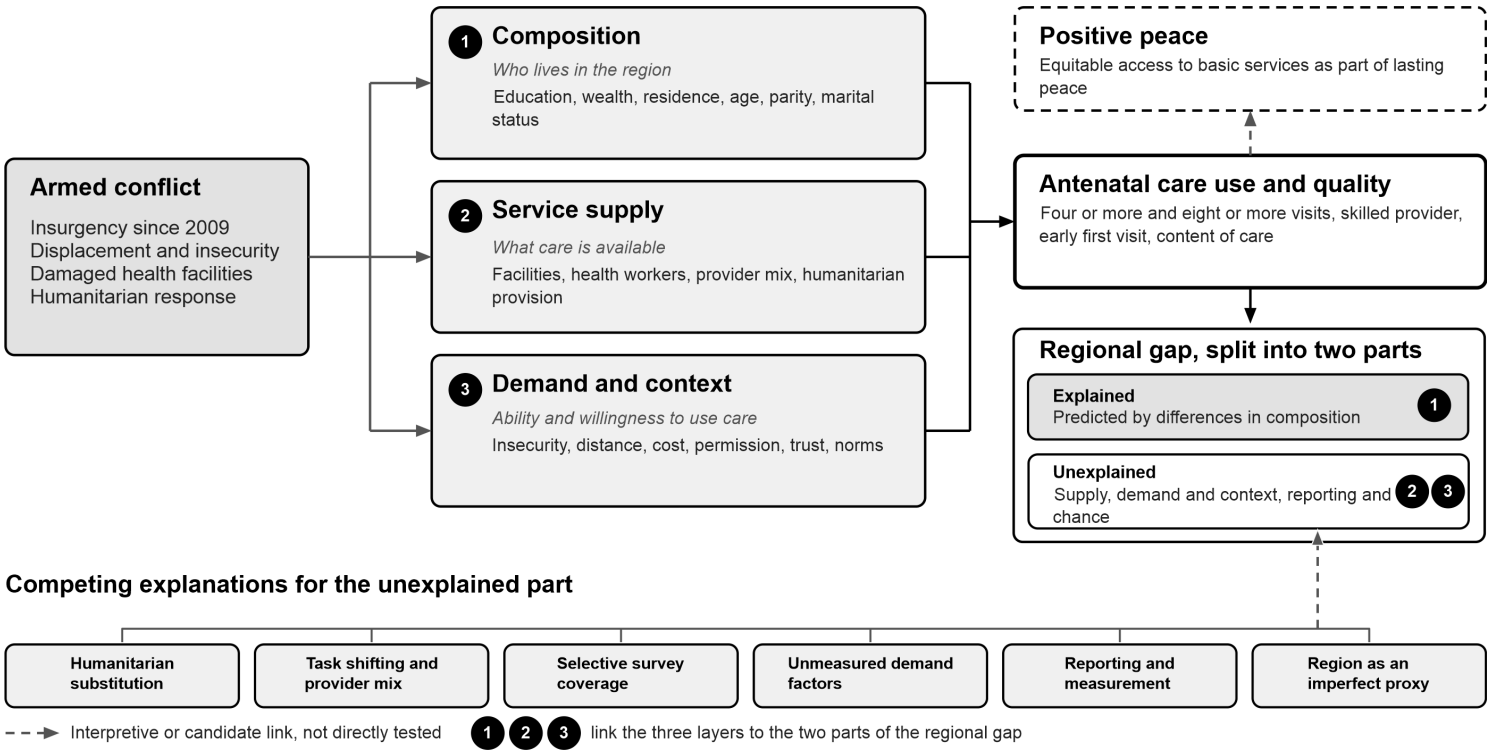


Figure 1

Conceptual Framework

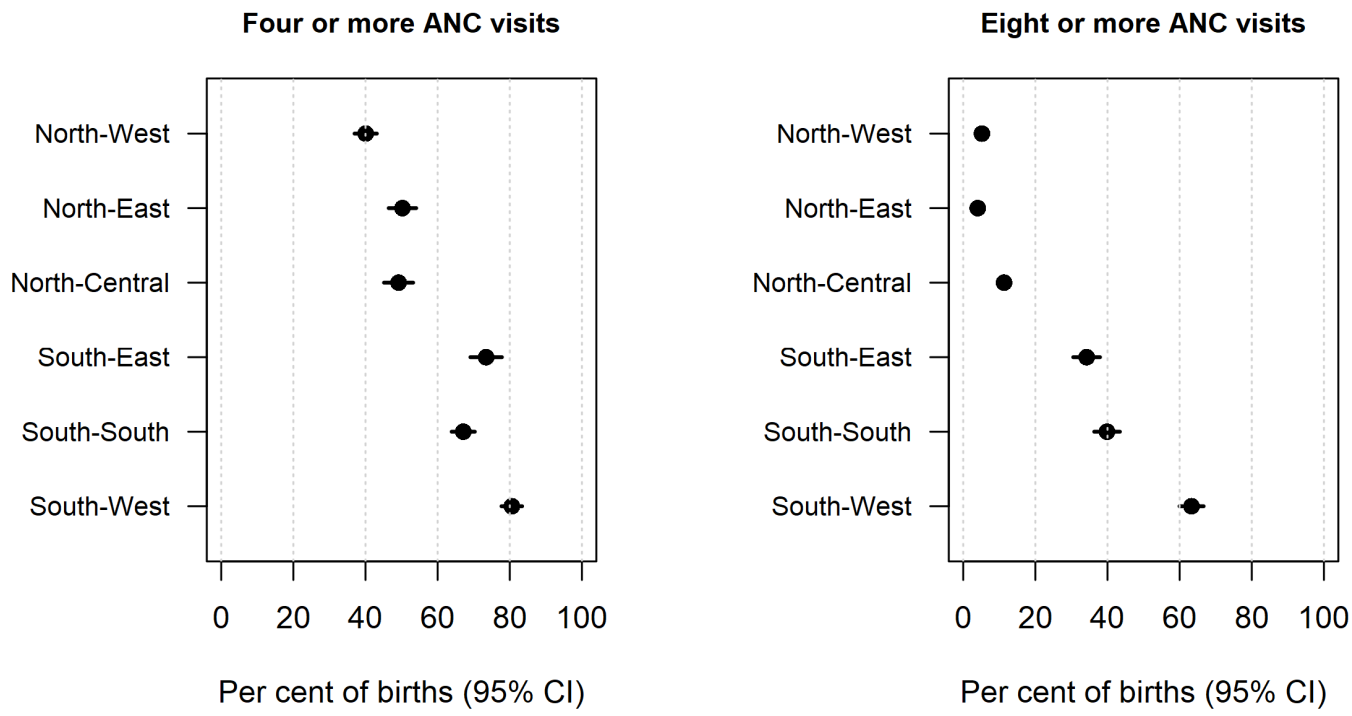


Figure 2

Four or more, and eight or more, antenatal care visits by zone, weighted percentages with 95% confidence intervals. NDHS 2023-24, eligible women (n = 13,968).

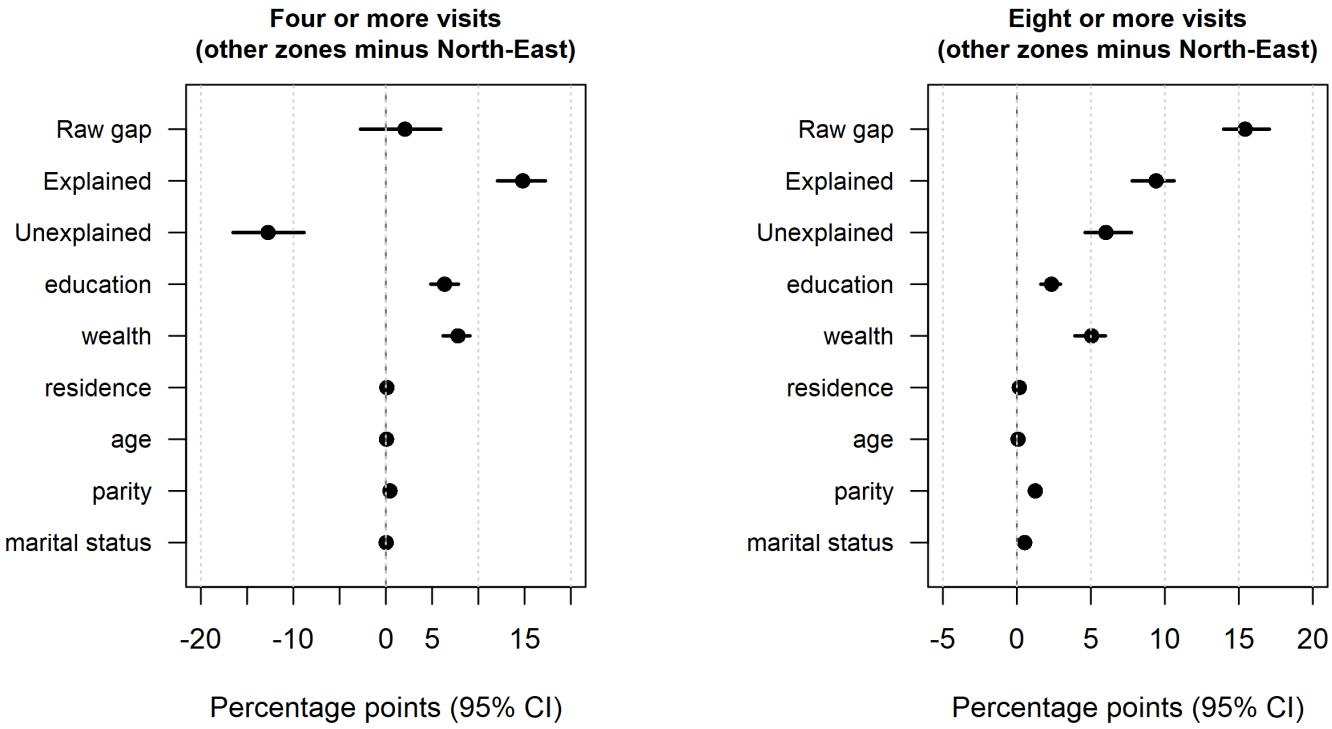


Figure 3

Decomposition of the gap between the other zones and the North-East, in percentage points with 95% bootstrap confidence intervals, for four or more visits (left) and eight or more visits (right). The two panels use different horizontal scales.

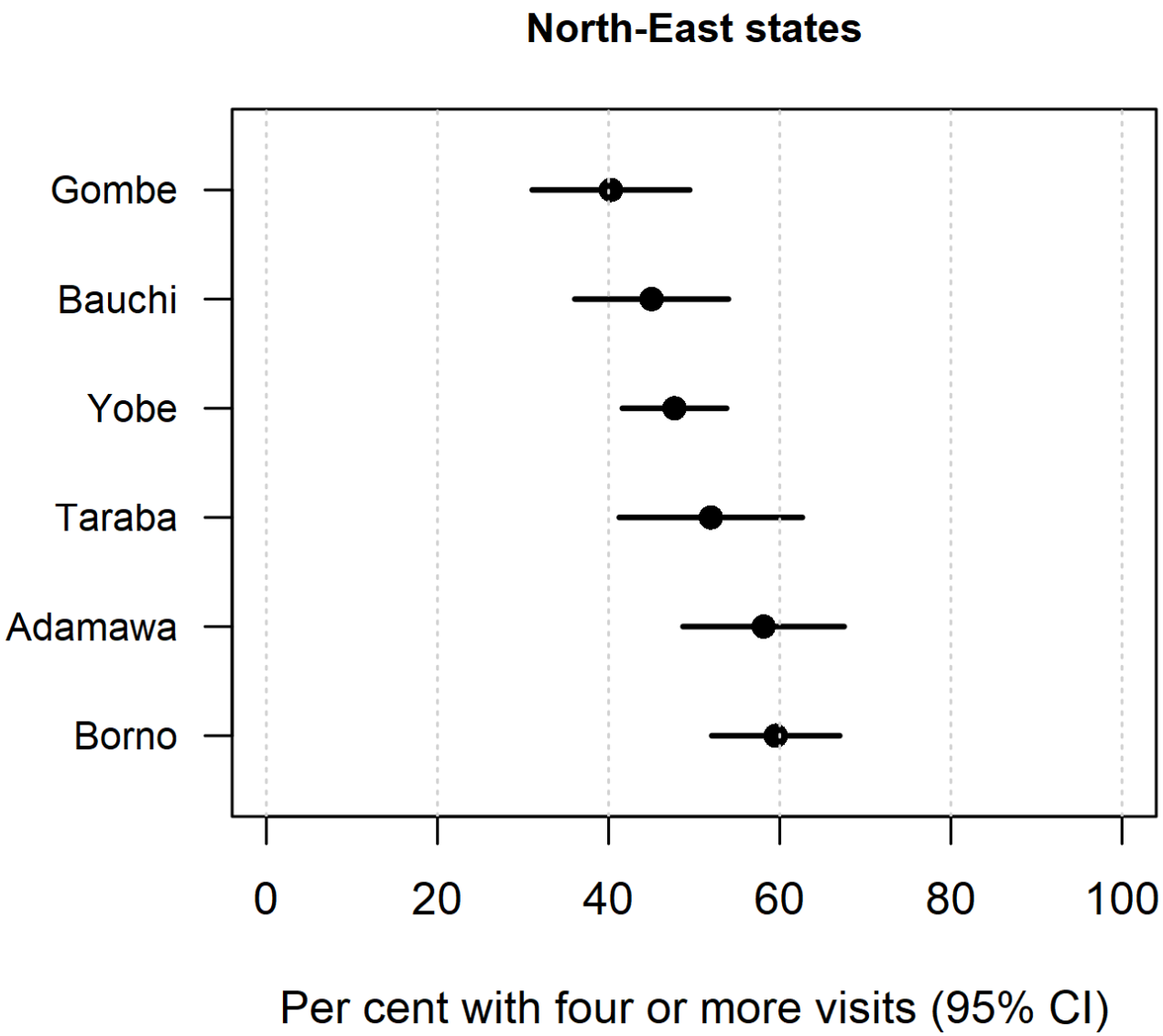


Figure 4

Four or more antenatal care visits by the North-East state, weighted percentage with 95% confidence intervals. State estimates rest on 380 to 614 births and are indicative.