Changes in key maternal, newborn and child health outcomes

Results from the 2013 Endline Household Survey

Key messages: **PRRINN-MNCH intervention in Northern Nigeria led to significant improvements in practically all maternal health outcomes.**

1. All health indices, but particularly those for mothers and children, are worse in Northern Nigeria.
2. From baseline to endline, there was significant improvement in every maternal, newborn, and child health outcome.
3. The four states are on track to meet the 2015 MDG4 target of a two-thirds reduction in the under-five mortality rate.

The challenge: poor maternal, newborn and child health indices

Maternal health outcomes in Nigeria are among the worst in the world, with Nigeria second only to India in the number of maternal deaths. In Northern Nigeria the maternal mortality ratio (MMR) is higher than the national average with recent estimates for the north over 1,200 deaths per 100,000 live births, compared to below 300 deaths per 100,000 live births in the south.

In Northern Nigeria, the rise in maternal mortality has been accompanied by a decline in antenatal care (ANC) and deliveries with a skilled birth attendant (SBA). According to the 2003 and 2008 Nigeria Demographic and Health Surveys, between 2003 and 2008, the percentage of women who received any ANC services for births in the previous five years dropped from 36.9% to 31.1% in the North West (including Katsina and Zamfara states) and from 47.3% to 43.0% in the North East (including Yobe state). Similarly, the percentage of women with skilled assistance at delivery declined from 12% to 8.9% in the North West and from 19.8% to 13.1% in the North East.

Along with these changes in maternal care patterns, there has been less progress in improving infant and child survival and primary care. As of 2008, the North West and North East regions had the highest proportions of children 12-23 months who had never been vaccinated, 48.7% and 33.9%, respectively, and fewer than 15% had a vaccination card. Vaccination coverage rates in Zamfara, Katsina, Jigawa and Yobe were all 5.4% and below. When they became sick with pneumonia, malaria or diarrhoea, under half of all sick children were taken to a health facility for treatment. Infant mortality rate (IMR) was 139 and 126 deaths per 1,000 live births, while under-five mortality was 217 and 222 deaths per 1,000 live births, respectively.

The response: the broad-based PRRINN-MNCH programme

In the face of this evidence of stagnation or decline in maternal and child health in the North West and North East, the Partnership for Reviving Routine Immunisation in Northern Nigeria (PRRINN) was established in 2006, and expanded in 2008 to include maternal, newborn and child health (MNCH), becoming the PRRINN-MNCH programme.

The assessment of the impact of the PRRINN-MNCH programmes uses a quasi-experimental design with pre and post-intervention household surveys in the intervention and control communities. The pre-intervention or Baseline Household Survey (BHS) was conducted in spring 2009 and the post-intervention household survey, the Endline Household Survey (EHS) was conducted in spring 2013.

The evaluation of the impact of the integrated MNCH package takes into account both availability of the programme and actual individual participation in any of the programme's community-based service activities. Availability of the programme was assessed by comparing intervention and control areas. Initially, Jigawa state was not included in the MNCH programme intervention, so the BHS did not include Jigawa. As the BHS was entirely pre-intervention, all responses in the BHS were considered control. However, for comparison purposes the BHS was subdivided into intervention (receiving the intervention starting in

2009), and control (not yet receiving any intervention).

By 2013 virtually all the state LGAs in the original sample had received statewide interventions, eg training of health care workers or facility upgrades, but not all had received the community engagement package. Therefore, in the EHS the control areas were those which had not yet received the integrated community engagement package, including any LGAs not in the original sample but which had begun to be included in the basic intervention. Individual exposure to the programme was assessed by each woman's responses to questions eliciting sources of information or health care advice and her explicit response to questions about observing or participating in activities introduced by the programme.

The study was approved by State Ethics Review Committees in each of the states. These ethics review committees are certified by the Nigerian Federal Government's National Health Research Ethics Committee to review and approve health research protocols for their states.

Sampling methodology

The sampling plan was a stratified two-stage cluster sample, with oversampling of individuals in the MNCH intervention clusters using a ratio of 2:1. This was because MNCH clusters cover a significantly lower proportion of the population of each state. Oversampling therefore provided a sufficient sample in the intervention areas to assess the impact of key elements within the intervention package on the key MNCH outcomes.

The primary sampling unit was the Local Government Area (LGA) – 24 in the BHS and 51 in the EHS. For the EHS, the same intervention LGAs as the BHS were included, with the exception of LGAs of the state capitals (considered not an appropriate control for the largely rural intervention), and the addition of the Jigawa intervention LGAs and any previously control LGAs which had the full intervention extended to their locality. The LGAs comprising the state capitals were included only during the baseline to assess the differences in services provided to residents patronising urban versus rural facilities. This enabled the team to devise appropriate strategies for referral from rural to urban facilities. The state capitals were excluded in the analyses reported here. The number of households selected per LGA was proportional to the size of the LGA.

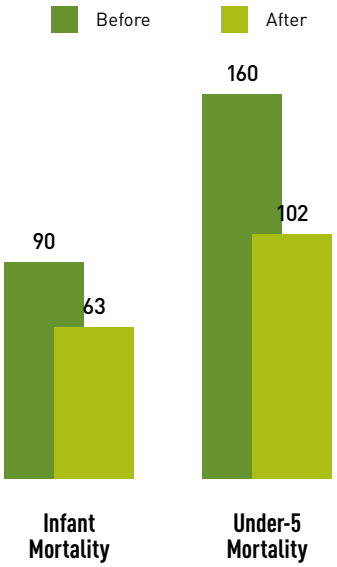
The study was designed with an 80% power to detect a 2.5% change in the percentage of women delivering with the assistance of skilled birth attendants between the BHS and the EHS. The BHS was designed to be representative of all ever-married women in the household and required a sample of 5,560 households, while the EHS was designed to be representative only of ever-married women with a birth in the previous five years, with a minimum sample requirement of 2,310 households.

Oversampling was used to increase the number of intervention community respondents to provide additional power for behaviours with a lower frequency but which were of particular interest to the programme, such as receiving advice from a community health worker. Because stratified sampling was used with differential sampling proportions for the intervention and control strata, weights are used in the analysis.

Within the LGA, the sample of households was allocated to intervention and control communities in proportion to the size of the community or village. The sampling fraction for each community was determined by information on the total households from the community leadership. Households within each selected community were randomly sampled using a procedure similar to that used in the WHO-EPI (World Health Organization Expanded programme on Immunization) cluster surveys, namely by numbering then sampling households according to the community sampling fraction along randomly selected paths leading out from the centre of the village.

The household was the ultimate sampling unit. In compounds of one to three households, one household was randomly chosen for interviews; in compounds with four to six households, two were surveyed; in compounds with seven or more households, three were surveyed. Within each randomly selected household in the BHS, all ever-married women of childbearing age (15-49 years) were interviewed, whereas in the EHS only one ever-married woman with at least one child born in the last five years was selected for interview. The inclusion criteria were changed for the midterm and endline surveys because of the need to focus on women with pregnancies and births during the intervention. The completed interviews were 6,842 in the BHS and 4,612 in the EHS.

Fig 1: Infant and under-5 mortality rates (per 1,000 live births)



The surveys

Interviewers who had completed secondary school or higher were trained to visit the selected women at home with a questionnaire that included translation of key concepts and terms in the local languages (eg Hausa, Kanuri). Most of the interviewers were females, responding to cultural expectations and beliefs that encourage female interviewers to interview female respondents. The questionnaires were standardised across the three survey rounds and used close-ended questions from the 2008 Demographic and Health Survey to allow comparisons of results with other national or state-level data.

The question topics covered age, parity, economic status, literacy in any language, wife rank, antenatal care and delivery characteristics, source

of health advice for the woman or the baby during last pregnancy, experience of labour and delivery complications, knowledge of maternal and newborn danger signs and how to respond to them, actual response to danger signs of infant and child illness, and infant and child mortality.

Questions and/or their response codes were modified in line with the programme goals to focus on the specific components included in the PRRINN-MNCH programme. In addition, the EHS respondents were asked to give feedback on several of the programme interventions, such as what improvements they had noticed in the clinic in the past year or whether they had observed anyone using specific programme components.

Analysis

At the analysis stage, the inclusion criteria for both surveys was narrowed to ever-married women, aged 15-49 years, with a birth in the previous five years. The data from the BHS and EHS were merged into one combined data set, using one uniform variable format. Respondents were assigned to the control or intervention groups based on the level of PRRINN-MNCH programme intervention at the time of the survey. The dependent variables are the key health behaviours pertaining to maternal, newborn care and care of sick children. Infant and child mortality rates were calculated using standard demographic estimation methods. The infant and child mortality rates were calculated using the retrospective reports of births and deaths in the previous 12 months and five years, per the standardised format of the Demographic and Health Surveys.

Rates were calculated separately for each survey period, aggregating the reported births and deaths per household. We first verified the number of births and deaths for the appropriate reference period (one or five years) using the built-in cross-referencing between questions, excluding implausible values (eg deaths of children under five exceeding births, after controlling for children moving in and out of the household), and then calculated the mortality rates using the appropriate births denominator.

The bi-variate analyses of the two sets of survey data were conducted using sampling weights based on different sampling fractions in the intervention and control areas. We examined changes in the proportion with the designated MNCH behaviour or outcome, contrasting all pre-intervention responses (all BHS) versus the post-intervention responses from the EHS, intervention versus control. Because the intervention was implemented in stages across clusters, some of the respondents received the intervention only in the year prior to the EHS, and they could not be considered to have fully experienced the intervention. Therefore, the comparisons by intervention include those with only one year of exposure in the control group. We assessed the degree to which the intervention and control groups differed using the Chi-square statistic. Analyses were performed using Stata 12.0 (Statacorp, College Station, TX).

Background characteristics of women surveyed

While the BHS and EHS survey respondents were fairly similar in age, marital status and education attendance, they differed in several other ways. The age distribution of the BHS and EHS respondents is very similar, with about one-third of respondents aged 20-29 years, and another one-fourth aged 30-34 years. In both surveys, virtually all women are currently married, but the EHS has slightly more women who are polygynous, second or higher ranked wives.

The percentage with formal education rose slightly from 18.8% to 23.5%, and along with this increase there were also more women with post-secondary schooling, among those with any education.

However, the proportion unable to read in any language increased from 45.3% to 69.0%. In the EHS, significantly more women reported earning money through farming or agricultural activities, which increased from 44.3% to 59.0%. The women interviewed in the EHS were also much more likely to have access to a mobile phone (7.9% vs. 42.8%), evidence of the rapid expansion of mobile

Table 1: Background characteristics of women surveyed in BHS and EHS, Katsina, Yobe, and Zamfara States

Characteristics	Baseline	Endline
Age group	%	%
15-19	4.7	2.6
20-24	11.1	13.7
25-29	19.2	22.8
30-34	22.0	24.9
35-39	16.0	16.1
40-44	13.8	12.9
45-49	13.3	7.0
Marital status		
Married	97.2	99.5
Widowed	1.1	0.8
Divorced	1.7	0.7
Rank of wife		
1	80.6	74.4
2	16.8	20.2
3	2.1	3.4
4	0.6	0.6
Formal education		
Yes	18.8	23.5
No	81.2	76.5
Level of education		
Primary	53.0	47.4
Secondary	34.7	20.3
Post-secondary	12.3	32.3
Able to read or write		
Not at all	45.3	69.0
Hausa	16.4	12.4
Arabic	29.6	14.4
English	8.8	4.2
Occupation		
Farming	44.3	59.0
Trading/selling	17.5	10.2
Housewife	30.3	26.0
Other	7.8	4.8
Cell phone ownership		
Yes	7.9	42.8
No	92.1	57.2

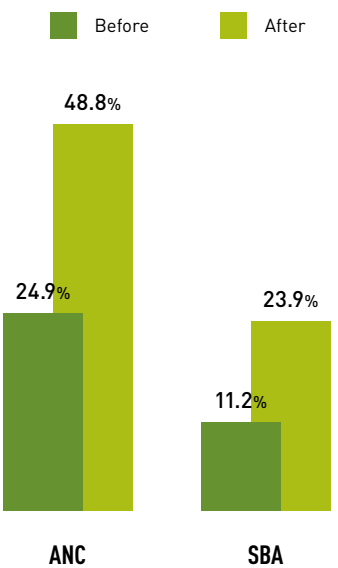
phone access nationwide in the last five years. These differences reflect the transformations to these communities as more and more women are being drawn into the labour force to complement the meagre family income.

The results: improving health indices

Key outcomes

From baseline to endline, there was significant improvement in every targeted maternal, newborn, and child health outcome. Under-five mortality per 1,000 live births declined from 160.0 to 102.2 and infant mortality from 90.0 to 63.0. The maternal mortality ratio (MMR) at the baseline was at least 1,270 per 100,000 live births, which was the ratio calculated using the sisterhood method in the PRRINN-MNCH midterm survey of 2011,[1] and considered conservative given other estimates for MMR in Northern Nigeria averaging 2,420.[2] Using the sisterhood method with data from the EHS, the MMR is estimated to have gone down to 1,190. It had barely gone down, to 1,260, in the control communities, but went down considerably to 1,057 in the intervention communities with the full community engagement set of interventions.

Fig 2: Women who had ANC or a SBA for their last pregnancy and delivery (%)



Improvements were seen in the proportions of women having a skilled birth attendant (SBA), which increased from 11.2% to 23.9%, having two or more anti-tetanus vaccinations from 71.8% to 86.2%, and delivery with a caesarean section, which increased from 0.74% to 1.54%. The proportion of women having at least one antenatal care visit (ANC) doubled from 24.9% to 48.8% (see Fig 2).

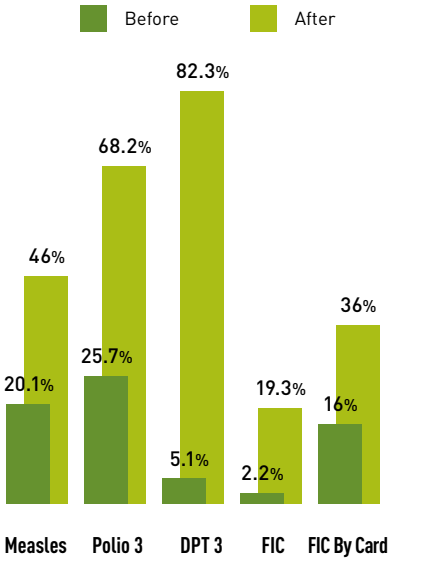
Childhood vaccination rates also rose significantly, with the proportion of one-year-olds with measles vaccine rising from 20.1% to 46.0%, polio3 from 25.7% to 68.2%, and DPT3 from 5.1% to 83.3%. The proportion of one-year-olds fully vaccinated according to documentation on the child's vaccination card and by maternal self-report rose from 2.2% to 19.3%, while the proportion fully vaccinated among children who have vaccination cards rose from 16.0% to 36.0% (see Fig 3).

There was a doubling in the percentage of women knowing at least four maternal danger signs (10.2% to 21.7%) as well as a very large increase in the proportion of women knowing the number of visits required for a child to complete the vaccination series, from 7.7% to 44.2%. The proportion of women with standing permission to take a child to the health clinic also increased from 40.2% to 82.7%.

Disaggregating the EHS results into the intervention and control communities shows that the achievements observed overall between the baseline and midterm are primarily in the intervention communities (Table 2, columns 3-4). While the under-five mortality rates and IMRs declined in the control areas, the decline was much greater in the intervention areas, where the under-five mortality rate dropped to 95.2 and the IMR declined to 50.8. For several of the maternal and child health care utilisation indicators, the improvements in the intervention areas outpaced those of the control areas: any ANC from trained personnel (53.0% vs 44.6%, p<0.001), percentage of one-year-olds who have the measles vaccination (49.9% vs 41.4%, p=.001) and who are fully immunised according to doses reported by the mother and on vaccination cards (21.7% vs. 16.4%, p=.007).

Half of all women who had any ANC (55%) did so by the fourth month of their pregnancy in the intervention communities, compared to only 41% in the control communities (chi-square=28.3, p=0.002). In the intervention communities, 29.4% of women knew at least four maternal danger signs, compared to 14.0% in the control communities (p<0.001). In the intervention communities, 47.5% of the mothers of infants knew the number of visits required to fully immunise their child, compared to only 41.4% in the control communities (p=0.066).

Fig 3: One-year-old vaccination rates by antigen, (based on maternal self report or card notation)



Key outcomes by state

Because of a smaller number of respondents in the states, we cannot calculate robust estimates of maternal, infant and child mortality, so these are omitted from the state outcomes. For each state, we summarise the major changes in MNCH health outcomes and behaviours from baseline to endline survey for that state and then we assess the significance of the difference between the intervention and control areas. In addition, because there was no baseline survey conducted in Jigawa in 2009, the EHS results for Jigawa are compared to those for all three states together in 2009.

Jigawa: Compared to the baseline 2009 results for all states (used as the baseline for Jigawa), there were significant improvements in all key MNCH outcomes with the exception of

Table 1: Comparison of key MNCH outcomes, Baseline 2009 (BHS) to Endline 2012 (EHS), PRRINN-MNCH states of Katsina, Yobe, and Zamfara

Key maternal health indicators	BHS	EHS	EHS Control	EHS Intervention	BHS v EHS	Intervention v Control
Under-5 mortality rate /1,000 live births	160.0	**102.2**	116.8	**95.2**	7.74(<0.001)	1.86(0.062)
Infant mortality rate /1,000 live births	90.0	**63.0**	88.6	50.8	2.31(0.019)	2.23(0.026)
Maternal mortality ratio /100,000 births*	>1271	**1190**	1262	1057	NA	.NA
% births attended by a skilled birth attendant	11.2	**23.9**	24.2	23.5	210.6(<0.001)	0.295(0.587)
% women aged 15-49 who have 2+ TT doses	71.8	**86.2**	86.5	86.0	28.25(<0.001)	0.069(0.793)
% caesarian section rates	0.74	**1.54**	1.55	1.53	5.51(0.019)	0.003(0.957)
% women receiving ANC by trained person	24.9	**48.8**	44.6	53.0	153.2(<0.001)	32.05(<0.001)
% 1-year-olds immunised against measles	20.1	**46.0**	41.4	49.9	13.44(<0.001)	4.970(<0.001)
% 1-year-olds that have received OPV3 (polio3)	25.7	**68.2**	69.3	67.4	25.38(<0.001)	0.671(<0.413)
% 1-year-olds that have received DPT3	5.1	**83.3**	84.0	82.7	65.4(<0.001)	0.447(<0.504)
% 1-year-olds fully immunised (maternal self report)	2.2	**19.3**	16.4	21.7	11.60(<0.001)	7.402(<0.007)
% 1-year-olds fully immunised (vaccination cards)	16.0	**36.0**	38.4	34.0	13.98(<0.001)	3.472(<0.062)
% women with standing permission to take child to a health centre	40.2	**82.7**	82.7	82.8	860.2(<0.001)	2.786(<0.248)
% women who know 4 maternal danger signs	10.2	**21.7**	14.0	29.4	230.0(<0.001)	161.03(<0.001)
% mothers of children under 2 years who know number of visits needed	7.7	**44.2**	41.4	47.5	163.0(<0.001)	3.379(<0.066)

* MMR includes Jigawa. t-test is used for the mortality and c-section rates, while chi-square is used for all other comparisons

knowledge of maternal danger signs (Table 3.1). Overall, the rates more than doubled, and for some outcomes they tripled. The proportion of women having any ANC rose from 24.9% to 84.6%, delivery with an SBA from 11.2% to 27.0%), and 2+ anti-tetanus vaccinations from 18.6% to 76.1%.

Childhood vaccination rates also rose significantly, with the proportion having measles by age one rising from 20.1% to 63.6%, those with polio 3 rising 25.7% to 78.0%, and those with the third DPT dose from 5.1% to 79.0%. In all, the proportion of one-year-olds fully vaccinated rose from 2.2% to 31.1%, based on all doses reported by the mother and the card.

For those with a card, the proportion fully vaccinated rose from 16.0% to 24.5%. There was a nine-fold increase in the proportion of women knowing the number of visits required for a child to complete the vaccination series, from 7.7% to 44.0%. The proportion of women with standing permission to take a child to the health clinic more than doubled from 40.2% to 94.5%. There was no change in the percentage of women knowing at least four maternal danger signs, 10.2%.

Disaggregating the EHS into the intervention and control communities shows that the achievements were greater in the intervention than control communities for all the MNCH outcomes except most childhood vaccination coverage rates (Table 3.1, columns 3-5). The prevalence of the appropriate behaviour is significantly greater in the intervention than control community according to five key indicators: deliveries with SBAs (33.0% vs 21.3%,

p<0.001), deliveries by caesarean section (1.3% vs 2.5%, p=0.081), having at least one ANC visit (87.0 vs 82.3%, p=0.010), one-year-olds immunised against measles (66.7% vs 54.3%, p=0.061), and women having standing permission for health care visits (93.3% vs 95.8%, p=0.089).

Katsina: The improvements in Katsina were fairly close to those in all states from BHS to EHS (Table 3.2). For all but one of the key indicators, Katsina showed significant improvements over its own baseline in 2009: proportions of women with their most recent delivery by a skilled birth attendant (14.7% to 28.9%), having had two or more TT doses (29.6% to 87.2%), having ANC (32.0% to 62.5%), and having standing permission for health care from their husbands (33.3% to 90.0%). The proportion of women knowing four or more maternal danger signs rose from 12.0% to 20.2%, while those knowing the number of visits needed to completely immunise a child rose from 10.0 to 39.6%). One-year-old vaccination rates also rose significantly, with the proportion of one-year-olds having the measles vaccination rising from 21.4% to 61.7%, OPV3 (polio3) rising from 28.0% to 46.6%, DPT3 rising from 5.7% to 73.1%, fully-immunised based on the child's vaccination card and maternal report from 2.5% to 18.5%, and fully-immunised based only on doses reported in the child's card from 15.0 to 36.2%.

As shown in Table 3.2, columns 3-5, improvements in MNCH outcomes were significantly greater in the intervention than control communities for three key indicators: proportion of women receiving ANC from trained personnel (70.0% vs. 56.6%, p<0.001), knowing four or more maternal danger signs (30.2% vs. 11.6%, p<0.001), and knowing the number of visits needed to fully immunise a child (45.8% vs. 34.5%, p=0.007).

Yobe: Between the BHS and EHS, Yobe had significant improvements in all of the key MNCH indicators except caesarean deliveries (Table 3.3). The proportion of women with a skilled birth attendant for their most recent birth doubled, from 12.1% to 25.9%, along with almost a doubling in the proportion that had at least one antenatal care visit, which rose from 36.0% to 56.2%.

The rise in ANC is also reflected in quadrupling of the proportion of women with at least two TT doses, which increased from 17.2% to 86.0%. The proportion who had standing permission to take a child to a health centre increased from 49.8% to 80.0%, those knowing at least four maternal

Table 3.1: Comparison of key MNCH indicators, Jigawa (all state BHS) 2009 vs EHS 2013

Key maternal health indicators	Baseline 2009	EHS Total	EHS Control	EHS Intervention	Intervention v Control
% births attended by skilled birth attendant	11.2	**27.0**	21.3	**33.0**	26.55(<0.001)
% women aged 15-49 who have 2+ TT doses	18.6	**76.1**	74.0	78.1	0.076(0.782)
% caesarian section rates	0.74	**1.9**	1.3	**2.5**	3.052(0.081)
% women receiving ANC by trained person	24.9	**84.6**	82.3	**87.0**	6.601(0.010)
% 1-year-olds immunised against measles	20.1	**63.6**	54.3	**66.7**	3.502(0.061)
% 1-year-olds that have received OPV3 (polio3)	25.7	**78.0**	7.1	78.2	0.037(0.847)
% 1-year-olds that have received DPT3	5.1	**79.0**	81.4	78.2	0.324(0.569)
% 1-year-olds fully immunised (all sources inc maternal self report)	2.2	**31.1**	28.6	31.9	0.281(0.596)
% 1-year-olds fully immunised (children with vaccination cards)	16.0	**24.5**	22.9	**25.0**	0.131(0.717)
% women with standing permission to take child to health centre	40.2	**94.5**	93.3	**95.8**	4.838(0.089)
% women who know 4 maternal danger signs	10.2	10.2	10.3	10.1	0.011(0.915)
% mothers of children under 2 years who know number of visits needed	7.7	**44.0**	46.6	42.0	0.833(0.361)

Note: Bold highlights Intervention>Control differences which are significantly different at p<=0.10 level.

danger signs rose from 10.2% to 32.0%, and those knowing the number of visits needed for a child to be fully immunised increased from 6.9% to 45.1%.

One-year-old vaccination rates also went up substantially, from 24.4% to 41.5% for measles, 22.9% to 77.3% for OPV3 (polio3), 9.2% to 78.0% for DPT3, and all recommended vaccinations (all sources) from 3.8% to 19.2%. Including only one-year-olds with vaccination cards, the proportion fully immunised rose from 7.2% to 55.0%.

In Yobe, there were greater improvements in the intervention areas relative to the control communities for four key MNCH indicators. In the intervention communities, more women had ANC for their last pregnancy (66.1% vs 48.0%, p<0.001), had standing permission to take a child to a health centre (83.0% vs 77.3%, p=0.008), and knew at least four danger signs (47.1% vs 19.4%, p<0.001).

Zamfara: As in the other states, Zamfara showed significant improvement from BHS to EHS for all but one of the key MNCH outcomes (Table 3.4). The proportion of women with ANC doubled, from 13.1% to 26.1%, and the proportion with a skilled birth attendant for their last birth quadrupled, from 4.2 to 16.6%. Along with the rise in ANC, the proportion with two or more anti-tetanus vaccinations rose from 9.4% to 84.5%. When compared to the baseline survey, all measures of immunisation status among one-year-olds showed significant improvements: measles vaccinations (14.8% to 26.1%), OPV3 (23.6% to 68.6%), DPT3 (0.8% to 96.9%), fully immunised according to maternal report and the child's vaccination card (0.2% to 11.5%), and fully immunised according to the child's vaccination card (if they had a card) (0.1% to 24.7%). Three times more women knew at least four maternal danger signs (4.4% to 12.2%) while twice as many had standing permission from their husbands to take the child to the health centre (47.5% to 78.2%). By the time of the EHS, half (51.1%) of the mothers of children under age two knew the number of visits needed to fully immunise a child, up from 3.0% at the beginning of the programme.

In Zamfara improvements in the control and intervention communities were about the same, with a few exceptions. Compared with the control communities, in the intervention communities women were significantly more likely to have had ANC (27.8% vs 23.7%, p=0.078) and to know at least

Table 3.2: Comparison of key MNCH indicators, Katsina BHS 2009 vs EHS 2013

Key maternal health indicators	Baseline 2009	EHS Total	EHS Control	EHS Intervention	Intervention v Control
% births attended by skilled birth attendant	14.7	**28.9**	27.1	30.9	2.603(0.107)
% women aged 15-49 who have 2+ TT doses	29.6	**87.2**	87.5	86.9	0.048(0.826)
% caesarian section rates	9.1	2.6	2.4	3.0	0.408(0.523)
% women receiving ANC by trained person	32.0	**62.5**	56.6	**70.0**	27.03(<0.001)
% 1-year-olds immunised against measles	21.4	**61.7**	68.3	59.8	1.445(0.229)
% 1-year-olds that have received OPV3 (polio3)	28.0	**46.6**	55.0	44.3	2.170(0.141)
% 1-year-olds that have received DPT3	5.7	**73.1**	71.7	73.5	0.082(0.775)
% 1-year-olds fully immunised (all sources inc maternal self report)	2.5	**18.5**	21.7	17.4	0.687(0.444)
% 1-year-olds fully immunised (children with vaccination cards)	15.0	**36.2**	46.7	33.3	3.625(0.057)
% women with standing permission to take child to health centre	33.3	**90.0**	89.6	90.7	0.904(0.636)
% women who know 4 maternal danger signs	12.0	**20.2**	11.6	**30.2**	83.64(<0.001)
% mothers of children under 2 years who know number of visits needed	10.0	**39.6**	34.5	**45.8**	7.171(0.007)

Note: Bold highlights Intervention>Control differences which are significantly different at p<=0.10 level.

four maternal danger signs (13.8% vs 10.0%). The proportion of one-year-olds who were fully immunised according to all sources was 16.0% in the intervention communities, double the proportion in the control communities (8.5%). For all the other indicators the proportions exhibiting the recommended MNCH outcome were equal or greater in the control than intervention communities.

Conclusions

The study reports on changes in maternal and child health care and outcomes for the period 2009 to 2013. Specifically, the objective of this study was to assess the extent to which improvements in MNCH health outcomes or behaviours were significantly greater from baseline to endline, across all states and by state. From baseline to endline, there was significant improvement in every maternal, newborn, and child health outcome. As measured by several indicators, women knew and followed the recommended MNCH practices. Half of all women (48.8%) had at least one ANC visit for their last pregnancy, and one-fourth (23.9%) delivered at a facility with a skilled birth attendant. In the intervention communities, the MMR was estimated to decline to 1,057, down from almost 1,300 per 100,000 live births at baseline. Their children were much more likely to receive recommended vaccinations before age two, and at the end of the programme, the immunisation rate for those with vaccination cards had risen from 16% to 36%.

Significant changes

The reduction in the MMR from 1,260 to 1,057 per 100,000 live births is an encouraging sign, reflecting the combined effect of both the facility and community demand generation activities. Several maternal care measures suggest that there is an increase in birth preparedness, with an increase in ANC consultations, knowledge of at least four maternal danger signs and having standing permission to go to the health centre. Implementation of the integrated maternal care initiatives to strengthen emergency obstetric care services in the target clusters, support midwifery skill enhancement, facilitate access to these obstetric care services through emergency transport schemes, and continued expansion of the community engagement efforts to promote birth preparedness and planning appear to have contributed to the maternal mortality reductions.

Accompanying these changes, child mortality dropped by about one-third,

Table 3.3: Comparison of key MNCH indicators, Yobe BHS 2009 vs EHS 2013

Key maternal health indicators	Baseline 2009	EHS Total	EHS Control	EHS Intervention	Intervention v Control
% births attended by skilled birth attendant	12.1	**25.9**	26.2	25.4	0.142(0.706)
% women aged 15-49 who have 2+ TT doses	17.2	**86.0**	87.4	83.2	0.898(0.343)
% caesarian section rates	2.7	1.0	1.2	0.8	0.412(0.521)
% women receiving ANC by trained person	36.0	**56.2**	48.0	**66.1**	52.18(<0.001)
% 1-year-olds immunised against measles	24.4	**41.5**	44.6	38.1	1.349(0.245)
% 1-year-olds that have received OPV3 (polio3)	22.9	**77.3**	75.3	79.6	0.818(0.366)
% 1-year-olds that have received DPT3	9.2	**78.0**	75.3	81.0	1.448(0.229)
% 1-year-olds fully immunised (all sources inc maternal self report)	3.8	**19.2**	18.7	19.7	0.056(0.813)
% 1-year-olds fully immunised (children with vaccination cards)	7.2	**55.0**	59.6	49.7	3.136(0.077)
% women with standing permission to take child to health centre	49.8	**80.0**	77.3	**83.0**	9.660(0.008)
% women who know 4 maternal danger signs	10.2	**32.0**	19.4	**47.1**	138.5(<0.001)
% mothers of children under 2 years who know number of visits needed	6.9	**45.1**	42.0	51.0	1.119(0.290)

Note: Bold highlights Intervention>Control differences which are significantly different at p<=0.10 level.

with under-five mortality per 1,000 live births declining in the four year interval from 160.0 to 102.2 and infant mortality from 90.0 to 63.0 per 1,000 live births.

At this pace, the four states are on track to meet the 2015 MDG4 target of a two-thirds reduction in the under-five mortality rate. Between the baseline and endline, there was a significant increase in the proportion of one-year-olds with specific antigens and in the proportion with all recommended doses, as reported by the mother with or without confirmation against the child's vaccination card. Further, the one-year-old vaccination rate for all recommended antigens was greater in the intervention than control communities.

This suggests the focused efforts by the programme to educate women and men about the importance of childhood vaccinations is vital, for example in the intervention communities almost half of all mothers of one-year-olds or infants knew how many visits it takes to completely immunise the child.

Hence, it is also possible that their recollection of the number of visits and the "see and do" drill of pointing to where the child gets each vaccination is effective at helping mothers remember that doses were given. Thus, the difference between the intervention and control communities in maternal report of a fully immunised child could reflect better recall of vaccinations or real differences in vaccine delivery in the intervention communities.

Varying immunisation coverage rates

The large difference in immunisation coverage rates when only doses reported on cards are counted suggests that part of the difference may be in the reporting of doses, not in access to cards. These reporting differences notwithstanding, the higher complete immunisation coverage rate based on maternal report may also reflect the combined impact of the programme's interventions on improving vaccine supplies and delivery services at the primary health care (PHC) clinics coupled with radio jingles and community dialogues to help men and women understand about immunisations and prompt attention to the care of sick children.

This increases the visit rates to the PHC, which increases opportunities for vaccinations. The immunisation rates are not uniform across all antigens. In many clinical settings the standard

Table 3.4: Comparison of key MNCH indicators, Zamfara BHS 2009 vs EHS 2013

Key maternal health indicators	Baseline 2009	EHS Total	EHS Control	EHS Intervention	Intervention v Control
% births attended by skilled birth attendant	4.2	**16.6**	17.6	15.8	0.889(0.3467)
% women aged 15-49 who have 2+ TT doses	9.4	**84.5**	82.1	86.1	0.780(0.377)
% caesarian section rates	3.0	1.0	1.0	0.9	0.001(0.973)
% women receiving ANC by trained person	13.1	**26.1**	23.7	**27.8**	3.105(0.078)
% 1-year-olds immunised against measles	14.8	**26.1**	24.4	28.5	0.735(0.391)
% 1-year-olds that have received OPV3 (polio3)	23.6	**68.6**	66.7	71.5	0.943(0.332)
% 1-year-olds that have received DPT3	0.87	**96.9**	96.2	97.9	0.805(0.370)
% 1-year-olds fully immunised (all sources inc maternal self report)	0.2	**11.5**	8.5	**16.0**	4.781(0.029)
% 1-year-olds fully immunised (children with vaccination cards)	0.1	**24.7**	29.4	25.0	0.016(0.900)
% women with standing permission to take child to health centre	47.5	**78.2**	80.8	76.2	4.665(0.097)
% women who know 4 maternal danger signs	4.4	**12.2**	10.0	**13.8**	4.980(0.026)
% mothers of children under 2 years who know number of visits needed	3.0	**51.1**	63.0	49.2	4.094(0.043)

Note: Bold highlights Intervention>Control differences which are significantly different at p<=0.10 level.

immunisation protocol is to deliver all vaccines for which a child is eligible but not yet received.

This practice would lead to immunisation coverage rates which are similar across antigens. Yet, in our survey, the rates differ. The differences between immunisation rates by antigen could reflect problems with the supply of vaccines. In addition, community-based campaigns, eg for polio vaccines, can independently raise the coverage rate for that antigen, in this case polio.

Polio immunisations are delivered annually through a series of monthly campaigns where volunteers go door to door to identify children eligible for the polio vaccine. The vaccines are delivered in the community, which means that it is very easy for children to have or even exceed the number of recommended polio immunisations.

DPT3 supplies also were out of stock in some of the states. Whether or not the child lived in the intervention or the control community, there was no DPT3 to be given. Shortages of vaccination cards may also have influenced the coverage rate for all antigens based on cards, which also was higher in the control than intervention communities.

Significant improvements in intervention communities

The improvements were greater in the intervention communities than in the control communities for most of the key MNCH behaviours: MMR, infant and child mortality rates, ANC, complete immunisation coverage, knowledge of maternal danger signs and of the number of visits needed to complete the childhood immunisation series. Each of these variables reflects key dimensions of the MNCH interventions, and the greater improvements seen in the intervention communities suggest that the programme is having an impact.

For the remaining MNCH outcomes, the intervention communities' rates did not differ significantly from those of the control communities. There are several possible reasons for this lack of difference. First, many of the programmes, particularly initiatives to upgrade facilities or adopt statewide health systems reforms, were implemented throughout the state, and these state-level programmes, such as improvement of drug supplies and training of health care workers, could have made it possible for all families living anywhere in the state to achieve improved health outcomes.

Second, initiatives sponsored by other agencies or programmes, such as the child nutrition programme implemented by Save the Children International or the mass immunisation campaigns of UNICEF, could have independently raised health outcomes in both the intervention and control areas.

Third, the intervention activities and particularly the community demand-generation activities were rolled out by cluster, and by the time the EHS was conducted, the vast majority of the LGAs had already had some exposure to the intervention. However, not all the intervention areas had received the intervention throughout the intervening period between the BHS and EHS. Therefore, some of the EHS intervention communities might have been less 'intervention' and more 'control'. We have minimised this potential effect by excluding from the intervention any community which had received the intervention in the year before the survey date.

Differences between states

The states differed in their level of health outcomes and in the amount of change they demonstrated from baseline to endline. Jigawa achieved the highest immunisation coverage rates, which reflects the prior existence of the immunisation programme in Jigawa prior to its implementation in other states. Jigawa also showed the biggest improvements in outcomes in the intervention areas. Katsina had the highest level of outcome for ANC-related patterns, while Yobe and Zamfara each had effective community education programmes, as evidenced by the high proportion of mothers knowing four or more maternal danger signs (32.0% among Yobe mothers) and knowing the number of visits needed to complete the child vaccination series (51.1% in Zamfara).

In summary, after four years there were significant improvements in virtually all targeted health behaviours and, importantly, in maternal, infant and under-five mortality. This is seen most clearly in the comparison of the outcomes for the intervention versus control communities, suggesting that the work of the programme through local communities and PHC services had a measurable impact. Statewide improvements after implementing the complex, integrated, and multi-level set of interventions have nonetheless contributed to improvements in the control communities.

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