

Impact of Mobile Health Technology in Improving the Maternal and Child Healthcare Services in Rural Bihar, India

By

Deepali Kaushik

*Dissertation submitted in partial fulfillment of the requirements of the degree
MBA Hospital and Health Management*

Academic year, 2018-2020



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ABSTRACT

Background- Technology have been used globally since many years recently for providing effective and quality health services resulting in enhanced uptake of maternal and child health. This report is based on the study aiming to analyse and provide evidence on the effectiveness of mobile health technology tool “Common Application Software” (CAS) used by the frontline workers for improving the delivery through an innovative initiative “Continuum of Care services” (CCS) in the rural settings of Bihar and its impact on the key maternal and child health indicators.

Methodology- The data used in the study was taken from the Round 10 and 11 of Household Survey (HHS) conducted in 534 blocks across 38 districts of Bihar using mixed sampling approach. This survey was conducted under an ongoing project in Bihar- Integrated Family Health Initiative (IFHI). The key components of service delivery such as visits by Anganwadi workers during and after pregnancy, anthropometric measurements by FLWs, participation of mothers in complementary feeding day, distribution of take home ration, proportion of mothers initiating exclusive breastfeeding and complementary breastfeeding, were included as indicators to measure improvement in service delivery quality.

Key findings- The CAS implemented districts were found having higher coverage for almost all nutrition related indicators in comparison to the rest districts of Bihar in both rounds of the survey i.e. Round 10 and Round 11 however there was a significant increase in the percentage coverage of the indicators in the CAS districts in Round 10 whereas there was a slight dent in coverage during Round 11.

Conclusion- The m-health intervention resulted insignificant improvement nutrition related key indicators as observed during the two consecutive Household Survey (HHS), hence re-emphasizing global evidences of how mobile technology usage in public health can improve the coverage of maternal and child health and nutritional indicators.

ACKNOWLEDGEMENT

The world is the best place to appreciate people who help in enabling others to develop and learn things. My dissertation report would not have been possible without the guidance of my mentors who have guided me at every step of my work and for letting me learn and grow.

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I perceive this opportunity as a vital leaning in my professional development. I will strive to gain this knowledge and experience in the best possible way and I will continue to work on the growth and learning and in getting the desired career goals.

Sincerely

Deepali

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LIST OF SYMBOLS/ABBREVIATIONS

ABBREVIATIONS	FULL FORM/EXPLAINATION
ANC	Ante-natal care
ASHA	Accredited Social Health Activist
AWW	Anganwadi Worker
CAS	Common Application Software
CCS	Continuum of Care services
CF	Complementary feeding
FLW	Frontline worker
GoB	Government of Bihar
HHS	Household Survey
ICT	Information Communication and Technology
IFA	Iron Folic Acid
IFHI	Integrated Family Health Initiative
JSY	Janani Suraksha Yojana
JSSK	Janani Shishu Suraksha Yojana
LMIC	Low middle income countries
MMR	Maternal Mortality Ratio
MVY	Matritav Vandana Yojana
MWCD	Ministry of Women and Child Development
NNM	National Nutrition Mission
NRHM	National Rural Health Mission
PNC	Post-Natal Care
POSHAN	Prime Minister's Overarching Scheme for Holistic Nourishment
RMNCH	Reproductive, Maternal, Newborn and Child health
THR	Take Home Ration
VHND	Village Health and Nutrition Day
WHO	World Health Organization

INTRODUCTION

The maternal mortality ratio has been reduced by 38% since 2000 on a global level. (1) (2) The women of reproductive age dying due to maternal complications were found to be 26.3% lower in 2017 in comparison to 2000. (1) According to the estimates provided by World Health Organisation, 810 women died every day either due to complication during pregnancy or childbirth in 2017. (2)

Skilled care if provided to the women before, during and after the birth of the child is expected to help saving lives of mothers as well as children (2) , According to the Global Hunger Index-2019, India is ranked at 102th position amongst 119 countries in the race. (3) As per data collected by the Partnerships and Opportunities to Strengthen and Harmonize Actions for Nutrition in India (POSHAN) around 3 lakh children die the same day they are born whereas more than 8 lakhs die in their first month of life owing to several new born complications. (4) The major factors contributing to neonatal deaths were due to pre-mature birth, infections, birth asphyxia etc. (5) The first 1000 days between a woman's pregnancy till the child is up to age of 2 years (also called the window of opportunity) is considered critical to a child's holistic development and any inadequacy of nutrition during this time period may cause long-term malfunction of the body and the brain which may result in poor physical development and learning abilities of the child . (6) Also poor nutritional status of the mother-another contributing factor to malnutrition in the new-born. About 36% of women in India are underweight, and around 56% women and adolescent girls(aged 15- 19 years old) suffer from iron deficiency and anaemia due owing to undernourishment. (7)

With an aim to reduce maternal and neonatal mortality through increasing institutional deliveries, the Janani Suraksha Yojana was launched in 2005 by the government of India. (8) In 2011, Janani Shishu Suraksha Karyakram was launched to ensure free deliveries as well as transport facilities to the pregnant women. (9) To improve capacities of mothers in taking care of their children, the Integrated Child Development Scheme(ICDS) was launched in 1975 providing a package of six services under its coverage. (10) (11) Another important step by the Indian government in the health domain was the launch of the National Rural Health Mission (NRHM) which gave rise to the concept of ASHAs,

mid-day meal scheme, Village Health Nutrition Day (VHND), Pradhan Mantri Matritav Vandana Yojana aiming to improve health and nutritional status of the beneficiaries. (11) After the implementation of various schemes, institutional deliveries increased from 39% to 79% between 2005 and 2015 in India (12) and from 20% to 64% in Bihar. (13)

Regardless of the progress made towards maternal and child health, MMR and IMR in Bihar are still at 165 (14) and 35 respectively (15), and limited access of people to healthcare facilities may be one of the causal factors. The coverage of receiving full ANC is mere 6.6% whereas with a very high fertility rate prevails in the state. (13) To improve the maternal and child healthcare services, the Bill and Melinda Gates foundation along with the government of Bihar implemented the Ananya Program in eight high priority Districts of Bihar in 2011 (16) and in the later half of 2012, the ICT-CCS intervention was launched as an innovation in Saharsa District to meet the objectives of this Program. (16) (17)

Further, for scaling up the MNCHN services, GoB along with the support of CARE India launched a multifaceted program, Integrated Family Health Initiative (IFHI) in eight high priority Districts of Bihar, in 2011 to enhance the service delivery and progress towards achieving MDG 4 and MDG 5. After successful implementation of IFHI in those 8 Districts, it was scaled up to all 38 Districts of Bihar by 2013. [\[17\]](#) (18) (19) In many low and middle-income countries, mobile technology innovations have been used to improve the work effectiveness and quality of frontline workers and hence improved health outcomes. (20) (16, 18). Under the IFHI project, CARE India launched one such innovative solution, Continuum of Care Services, with the help of mHealth platform, implemented to enhance the health and nutrition outcomes with the help of mobile technology and thereby reducing the work related challenges and improving capacities of frontline workers for an improved and more efficient service delivery to pregnant women and young children. (17) [\[18\]](#) The pilot phase of CCS intervention was rolled out in 2012, including 4 blocks of Saharsa District of Bihar, implemented by the State Health Society, being one of the highest priority Districts in the maternal and child health indicators. (18) The feasibility of mHealth technology can be demonstrated by various studies discussing how use of mobile technology for continuum of care services related to RMNCHN domain had remarkable impact on the efficiency and quality of health service delivery and in strengthening of the health system as a whole. (18, 20)

A two-year randomised control trial was implemented to measure the impact CCS intervention and whether it was successful in improving the health indicators as expected.

The study observed a positive impact of use of mobile job aid on the level of co-ordination among FLWs, their service quality, confidence and capacity to deliver and also improved the maternal and child health indicators. (16) This two-year evaluation performed by Mathematica Policy Research concluded that after the introduction of the ICT-CCS intervention in Saharsa, there was a significant impact on the maternal and child health indicators and behaviour of the mothers. (16) (18) After the successful implementation of this tool, the Government of India scaled up and rolled out the new version of the intervention in eight high priority states of India. (16) (21, 22) Later on, CCS technology and Saharsa outcomes were reviewed and adopted by Ministry of Women and Child Development (WCD) and further some additions of six layers of the dashboard and the modules formed Common Application Software (CAS), which was an enhanced version of CCS, as one of the main component of the POSHAN Abhiyan working in 29 states and 6 union territories after the initial scaling up. (22)

Overall, as a part of the assessment, some nutrition specific also indicators were assessed by comparative analysis between CAS and Non-CAS districts through the household survey data (HHS) from rounds in 2018 and 2019. The current study aims to assess whether the CAS program was able to have a positive impact on the nutrition relevant indicators in Bihar.

LITERATURE REVIEW

CHILD HEALTH AND NUTRITION OVERVIEW IN INDIA

The data taken from Partnerships and Opportunities to Strengthen and Harmonize Actions for Nutrition in India (POSHAN) says that 309,300 babies are dying on the day of their birth, and 876,200 babies have died during their first month of life due to several new born complications. (4)

According to a study done by WHO to reduce the double burden of malnutrition in the South-East Asia Region, about 36% of the population of women are underweight, and 56% of women and 56% of adolescent girls between 15 and 19 years old suffer from iron deficiency anaemia due to undernourishment in India. (7)

The first 1000 days (also called the window of opportunity) has been considered as a critical time for the child's development and the inadequacy of nutrition during this time period causes long-term ill effects to the functioning of the body systems of the child. (6)

PROGRAMMATIC REQUIREMENTS IN THIS DOMAIN

One of the most important intervention initiated by the ministry of Women and Child Development for child health and nutrition is Integrated Child Development Scheme (ICDS), launched in 1975, providing a package of six services to the beneficiaries. Other important interventions included National Rural Health Mission (NRHM) giving rise to the concept of ASHA, mid-day meal scheme, Village Health Nutrition Day (VHND), Pradhan Mantri Matritav Vandana Yojana aiming at improving the health and nutritional status of the beneficiaries. (10) [11]

After the successful implementation of various schemes for health and nutrition in India, the Prime Minister launched National Nutrition Mission (NNM) in convergence with the existing schemes in keeping view the importance of adequate nutrition for the children. For achieving success on the grassroot level, it was launched as Jan Andolan which involves people's participation in spreading awareness about nutrition. (4)

EMERGENCE OF TECHNOLOGY FOR IMPROVING MOTHER AND CHILD HEALTH IN INDIA

The data from a study conducted on Continuum of Care Services in low and middle-income countries showing the strengthening of health system depicts that the mobile technology helped in strengthening of the health system with enhanced service delivery quality. This platform increased the coverage of selected indicators in the implemented district in comparison to the other districts and the previous year data. (23)

A brief report by Mathematica policy research on the technological intervention depicts that after the implementation of ICT-CCS intervention in Saharsa district, the coordination among FLWs increased with their enhanced confidence and performance levels. This intervention also impacted the maternal and child health nutrition and reproductive health indicators with enhanced output. (24)

The results from the study done on the role of the mobile technology in improving ASHAs knowledge and skills in Gujarat tribal areas concluded mHealth to be a beneficial intervention for improving knowledge and skills of ASHAs related to maternal and child health and further improvement in the indicators. (25)

The pseudo randomised control trial performed to assess the impact of m-health voice messages for infant care and knowledge on it among women in India described that m-health voice messages helped in improving the knowledge among mothers about the infant care practices and impacted the infant health outcomes with better coverage of the indicators. (26)

A study performed on the evaluation of mobile health technology intervention to improve the indicators of mother, new-born and child health in rural India suggested that the Im TeCHO intervention was found effective in improving the performance of FLWs and increased in the coverage of RMNCHN related behaviours and indicators. The impact of this intervention was accepted and found useful at the primary healthcare delivery level. (27)

The study done on assessing the impact of mobile health intervention used by health volunteers of community for the improvement of maternal and child health indicators in rural areas conveys that after the implementation of mobile health intervention, the coverage of IFA supplementation, self- reporting of the pregnancy and after delivery complications increased significantly. This intervention also helped in increasing the FLWs capacity to deliver quality services to the beneficiaries and its utilization. (28)

The study performed on depicts the use of tool for the FLWs improved co-ordination, increased effectiveness of work and enhanced confidence among the FLWs. This intervention also resulted in improved maternal and child health and nutrition indicators and behaviours. (16)

METHODOLOGY

OBJECTIVE

To assess the impact of the mobile technology in improving the maternal, new-born and child health as well as nutrition indicators in rural Bihar.

RESEARCH QUESTION

Has mobile technology improved the maternal and child health and nutrition indicators in the rural areas of Bihar or not?

RESEARCH DESIGN

In this current study, the data used has been taken from the Round 10 and Round 11 of household survey under the IFHI project which was initiated by CARE India collaboratively with Government of Bihar (29).

STUDY SETTING

In the household survey, the blocks that were performing poor in context of health indicators. As the blocks were the smallest units of implementation, on this basis selection was done and the data was collected from each of these blocks through the household surveys.

The Round 10 and Round 11 of the household survey were conducted in September 2018 and September 2019 respectively. The survey was conducted in 538 blocks across the 38 districts of Bihar.

STUDY POPULATION AND INSTRUMENT

The population selected for the study included mothers of the infants living in rural areas of Bihar. The population was further categorised into four sub-groups having mothers of 0-2m, 3-5m, 6-8m and 9-11m old infants. For each sub-group of the selected respondents,

a separate questionnaire was administered. From each subgroup, selected interviews were conducted in each selected block.

SAMPLE SIZE CALCULATION

As the survey was implemented in 534 blocks of 38 districts in Bihar, the sample size was estimated by having alpha error of 0.05 and beta error of 0.2. By applying these assumptions, the sample size for each district turned out to be 384 with a loss factor of 1%, it was finalized as 388.

After determining the sample sizes at block levels, it was ensured if the samples allocated for each block were at least 19 or not. If the sample size of any particular block was less than 19, then it was raised up to 19, hence increasing the sample size of the district having such blocks also increased. Hence the final sample size for each district raised up to 519. Taking all these factors into consideration, the overall sample size across all the districts was 15,687 and it resulted in the number of respondents up to 78,435 at the state level.

SAMPLING METHODS AND TECHNIQUES

For calculating the sample size, the multi-stage sampling methodology was used. In each selected block, the Anganwadi centres and other institutions providing basic health services were randomly selected through probability proportionate to size (PPS) sampling technique. From each selected Anganwadi catchment area, systematic random sampling method was applied to identify the eligible households. The eligible households were selected on the criteria which contain the mothers of children aged 0-2m, 3-5m, 6-8m, 9-11 m completed.

For conducting the survey, this strategy was used in each district and for each AWC, mothers who were having children of the above mentioned four age groups were interviewed.

RESULTS

1. Anganwadi Worker (AWW) visits during pregnancy in each trimester

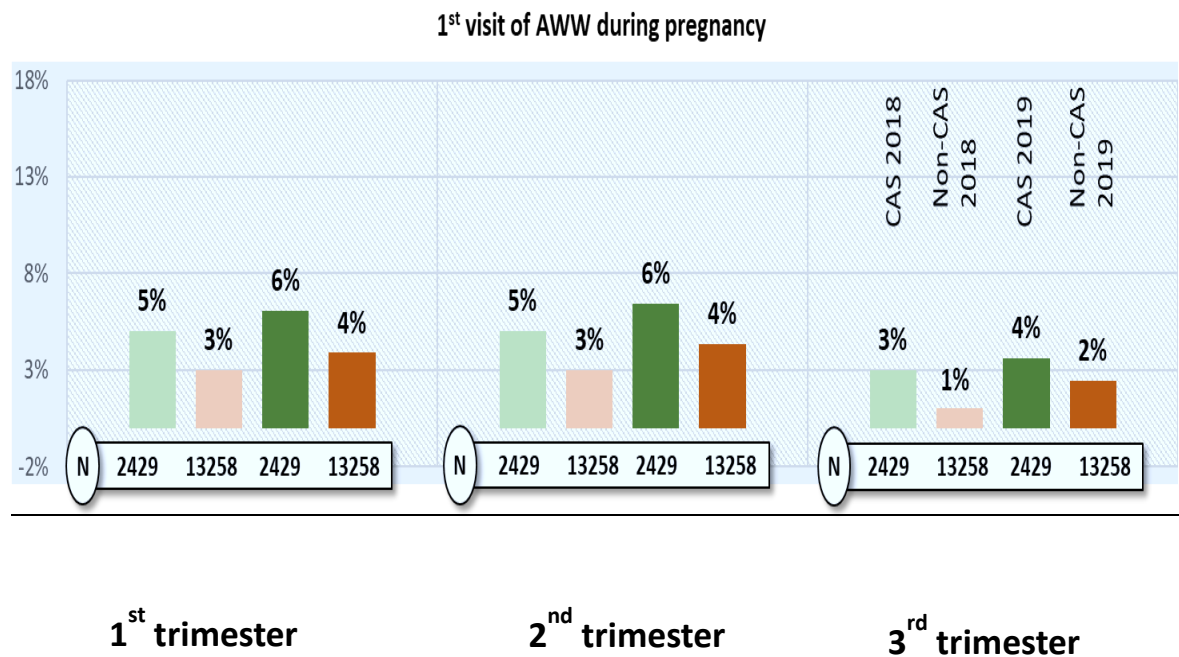


Figure 1: AWW visits during pregnancy

INTERPRETATION:

ANC visits play a vital role in the maternal health outcomes. ANC visits are mandatory for adequate maternal care. Further, the visits during first trimester leave a better impact on the mother's health and the pregnancy outcomes.

While considering AWW visits to the mothers during the first trimester, the proportion was higher (5%) in CAS districts in Round 10 (4.29-6.44) in comparison to non-CAS districts (3%) (2.47-3.06). This proportion again increased with time in CAS districts (6%) in round 11 (5.10-7.39) and non-CAS districts having (4%) less proportion (3.37-4.06).

The visits of the AWWs in second trimester were almost similar to the first trimester in both rounds for CAS as well as non-CAS districts. In Round 10, it was higher (5%) in CAS districts (3.62- 5.69) comparatively (3%, 2.88- 3.53 in non-CAS districts). In Round 11, the proportion increased in CAS (6%, 5.18-7.37) as well as non-CAS districts (3%, 2.88- 3.53).

The visits by AWWs in the last trimester also play a vital role in the pregnancy outcome. In third trimester, CAS districts again had a better proportion (3%, 2.55- 4.40) in comparison to the non-CAS districts (1%, 1.26- 1.70) in Round 10 and in Round 11, the proportion in CAS district increased again (4%, 3.09-5.01) having better proportion than the non-CAS districts (2%, 2.01-2.55).

2. Mothers visited at least once by AWW during pregnancy

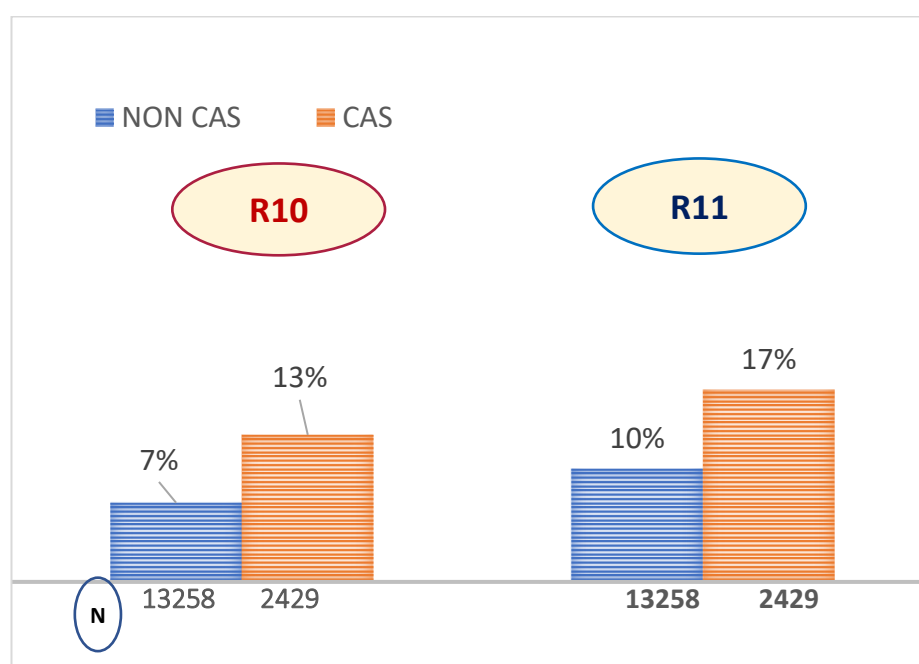


Figure 2: AWW visits at least once during pregnancy

INTERPRETATION:

During pregnancy phase, visits by the AWWs play an important role in the betterment of the mother's health as well as the child's health. Proper counselling and check-ups during the pregnancy period can help in reducing the maternal and child health complications.

The proportion of mothers visited at least once by the AWWs during the pregnancy period was considerably higher in the CAS districts during both the rounds. In Round 10, the CAS districts were having 13% mothers who were visited at least once (11.76-15.07) by the AWWs and the proportion was just 7% in non-CAS districts (6.88- 7.84).

This proportion increased again in Round 11 for CAS (17%, 14.83-18.30) as well as non-CAS districts (10%, 9.75-10.86).

3. Mothers visited at least once by AWW after delivery

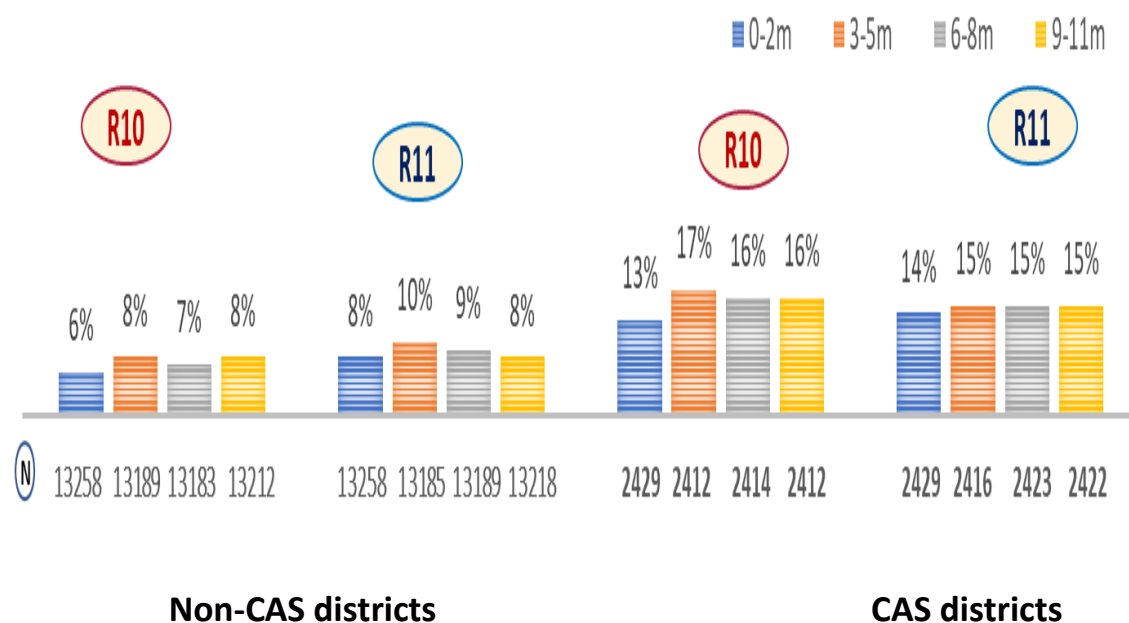


Figure 3: AWW visits after delivery

INTERPRETATION:

Post-natal care, ie care after the delivery protects the mother and child from long term complications and helps in preventing maternal and neonatal deaths. Hence, timely post-natal care is required to improve the health of mother and child.

After delivery, the proportion of mothers who were visited at least once by AWWs were almost double (ie. 13%, 11.74-15.06, which was 6%, 5.49- 6.36, in non-CAS districts) in Round 10 in CAS districts.

This proportion was again considerably higher in Round 11 again among the CAS districts (14%, 12.39-15.70 in CAS and 8%, 7.03-7.99 in non-CAS) in all age groups (0-11 m).

4. Child's weight was measured by AWW during the previous month

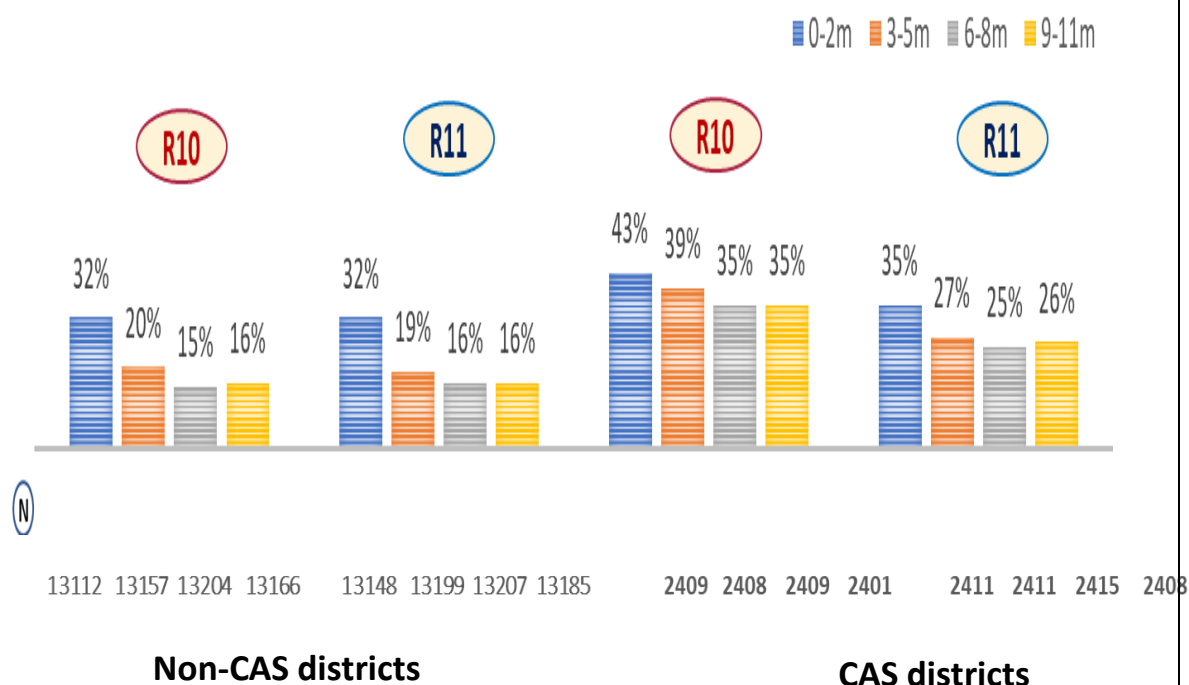


Figure 4: Measurement of child's weight

INTERPRETATION:

The proportion of mothers having children whose weight (43%, 40.91-45.48) was measured during the previous month by the AWWs was significantly higher in all age groups (0-11 months) in the CAS districts in Round 10 comparatively (non-CAS, weight- 32%, 30.84-32.57).

However, a decline was observed from the previous year in Round 11, in CAS districts (weight- 35%, 6.39-9.01) while the proportion was same in non-CAS districts (weight- 32%, 30.72-32.45) in comparison to the last year.

The reasons for the improvement in the proportion of weight measurements could be the better understanding of the frontline workers about the measures on taking weight from the previous year in CAS districts.

5. Child's height was measured by AWW during the previous month

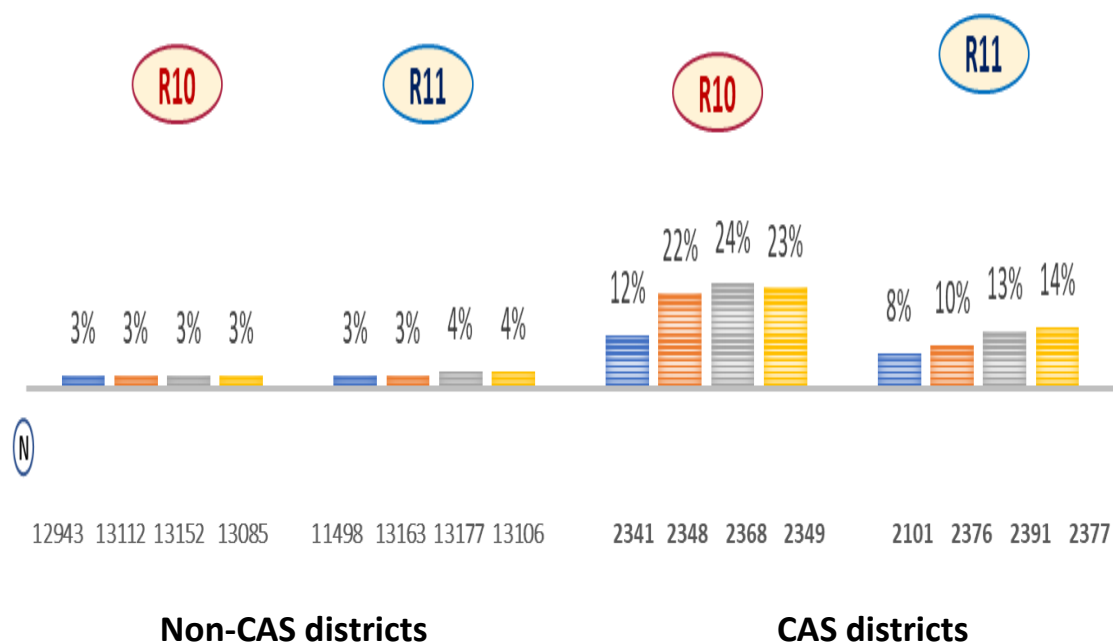


Figure 5: Measurement of child's height

INTERPRETATION:

Similar to the weight measurements, the proportion of mothers having children whose height (12%, 10.54-13.60) was measured during the previous month by the AWWs was significantly higher in all age groups (0-11 months) in the CAS districts in Round 10 in comparison to the non-CAS districts (3%, 2.42- 3.03).

In comparison to the previous year, there was a decline in the proportion of height measurements in Round 11, in CAS districts (8%, 2.65-3.32) while the proportion was again similar in non-CAS districts (3%, 2.65-3.32) in comparison to the last year.

6. Received any advice by AWW for child whose weight and height were measured

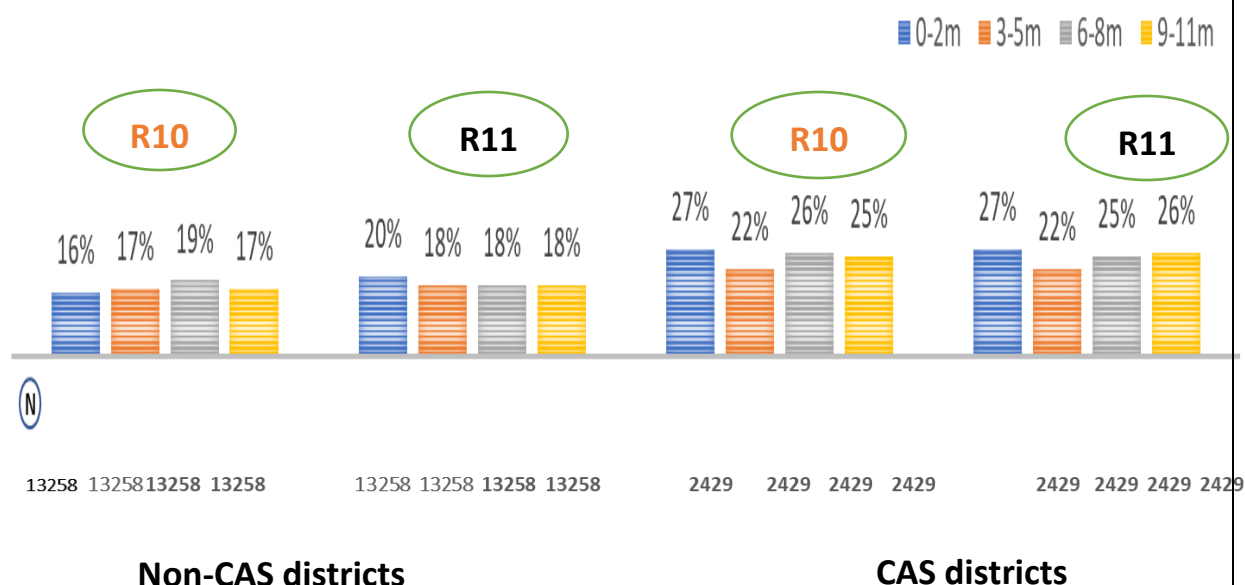


Figure 6: Received advice by AWW

INTERPRETATION:

Among those children, whose weight and height were measured, the proportion of households receiving advice from the AWWs was better among the CAS districts (26%, 23.07-29.91 in 6-8 m age group, 25%, 22.01-28.80 in 9-11 m age group) again, in all age groups (0-11 months) in Round 10 whereas the non-CAS districts were having a low proportion comparatively (19%, 16.74-20.36 in 6-8 m age group and 17%, 15.47-18.99 in 9-11 months age group).

In round 11, this indicator was having higher proportion in CAS districts. (25%, 21.28-28.99 in 6-8 m age group and 26%, 21.69-29.39 in 9-11 m age group). In non-CAS districts, the proportion was comparatively low. (18%, 15.77-19.24 in 6-8 m age group and 18%, 16.56-20.02 in 9-11 m age group)

7. Received Take Home Ration (THR) after delivery

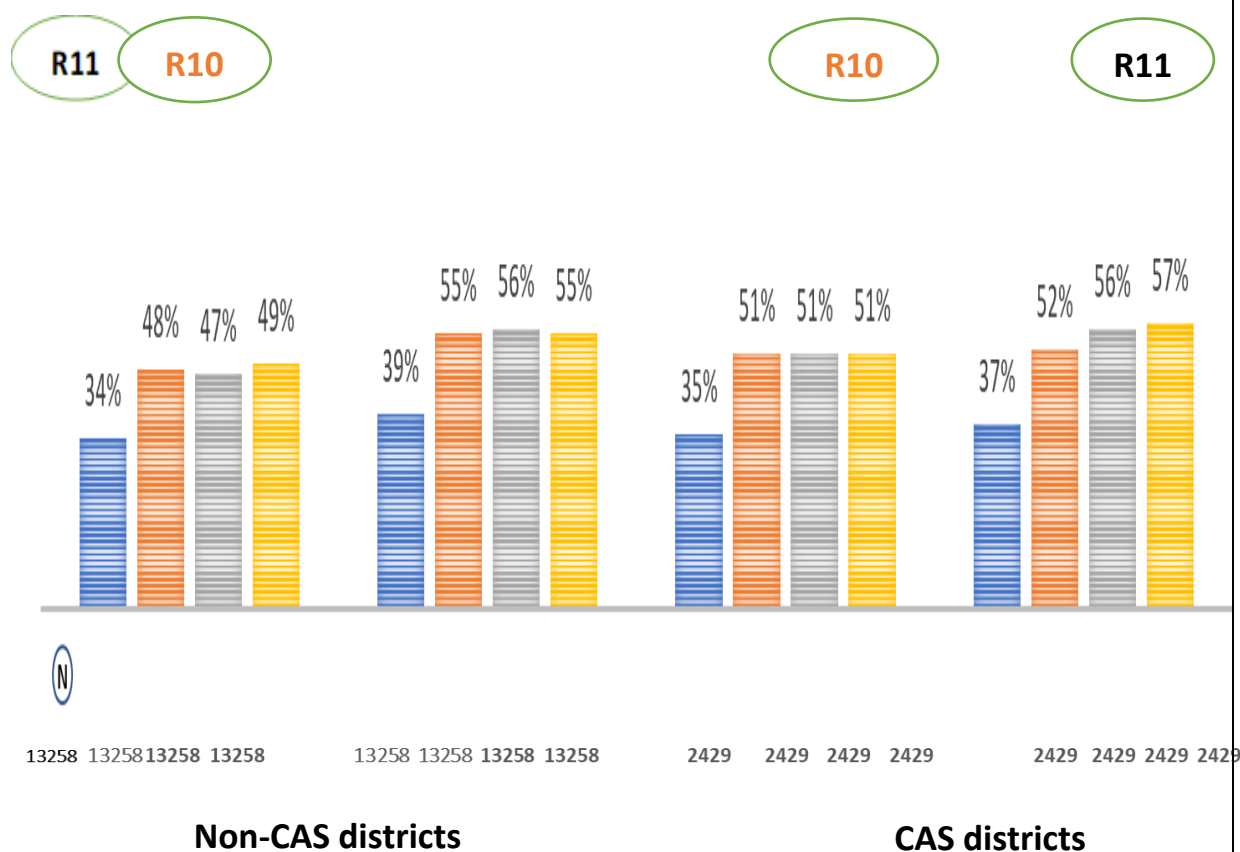


Figure 7: THR received after delivery

INTERPRETATION:

Take home ration is an important aspect for improving the nutritional status of the mothers as well as children. The data of take-home ration further infers that the proportion of women taking take home ration after delivery was slight high in CAS districts in all age groups in Round 10 (0-11 months) (35%, 32.69-37.11 in 0-2 month age group, 51%, 49.12-53.71 in 3-5 month age group, 51%, 48.43-53.03 in 6-8 month age group, 51%, 48.96-53.56 in 9-11 month age group) in CAS districts whereas the proportion in non-CAS districts was- (34%, 32.86-34.61 in 0-2 month age group, 48%, 46.95-48.80 in 3-5 month age group, 47%, 45.89-47.74 in 6-8 month age group, 49%, 48.07-49.92 in 9-11 month age group)

There was a decline in the proportion in CAS districts in comparison to non-CAS districts with time (0-8 months, Round 11) (37%, 34.79-39.25 in 0-2 month age group, 52%, 50.04-54.64 in 3-5 month age group, 56%, 53.83-58.38 in 6-8 month age group in CAS districts) (39%, 37.73-39.53 in 0-2 month age group, 55%, 54.39-56.23 in 3-5 month age group, 56%, 55.10-56.94 in 6-8 month age group in non-CAS districts)

The proportion was again high in 9-11 months age group in CAS districts (57%, 54.74-59.29) than the non-CAS districts (55%, 54.56-56.40).

8. Mothers participating in a demonstration of feeding/preparing food diversity

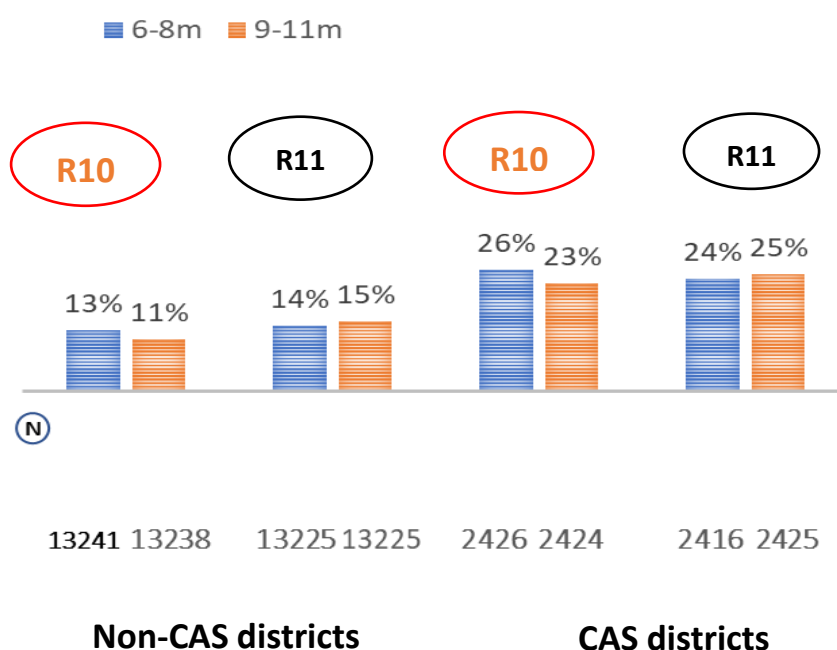


Figure 8: Participation of mothers in dietary diversity

INTERPRETATION:

Dietary diversity includes a number of food groups involved in the diet which ensures the proper uptake of the required nutrients by the child. It helps in adding many dimensions to the proper nutrition and health of the child. In Round 10, the proportion of mothers

who participated in the demonstration of feeding/dietary diversity was almost double in the CAS districts than the non-CAS districts.

In CAS districts, the proportion was- 26%, 24.32-28.41 in 6-8 months age group, 23%, 20.68-24.62 in 9-11 months age group. In non-CAS districts, the proportion was- 13%, 12.36-13.58 in 6-8 months age group, 11%, 10.42-11.56 in 9-11 months age group.

During the next round, the proportion was again significantly higher in the CAS districts. It was 24%, 22.12-26.13 in 6-8 months age group, 25%, 22.85-26.86 in 9-11 months age group in CAS districts while in non-CAS districts, the proportion was 14%, 13.68-14.95 in 6-8 months age group, 15%, 14.19-15.48 in 9-11 months age group.

9. Mothers attending complementary feeding (CF) day event

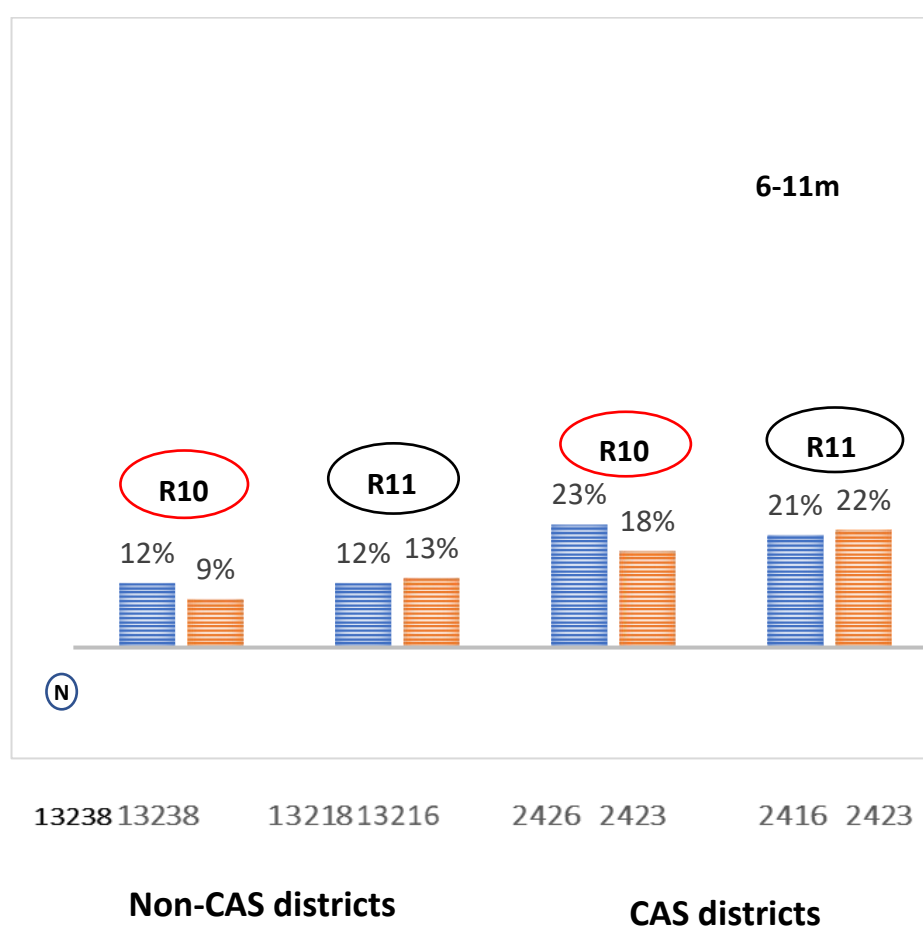


Figure 9: Complementary feeding day attended by mothers

INTERPRETATION:

Complementary feeding is initiated after 6 months of the child's age, in addition to the breastmilk. This gives adequate nutrition to the child and helps in further growth and development of the child.

Like the dietary diversity data, the proportion of women attending the complementary feeding day session was again almost double in the CAS districts, in Round 10 (23%, 21.46-25.36 in 6-8 months age group)(18%, 15.84-19.39 in 9-11 months age group) in comparison to non-CAS districts (12%, 10.98-12.15 in 6-8 months age group)(9%, 8.57-9.62in 9-11 months age group).

In Round 11, the proportion increased in the CAS districts and it was again significantly higher in the CAS districts (21%, 18.84-22.62in 6-8 months age group) (22%, 19.73-23.54 in 9-11 months age group). The proportion in non-CAS districts was almost similar to that of Round 10 (12%, 11.66-12.85 6-8 months age group) (13%, 12.06-13.27 in 9-11 months age group).

10. Proportion of mothers giving exclusive breastfeeding

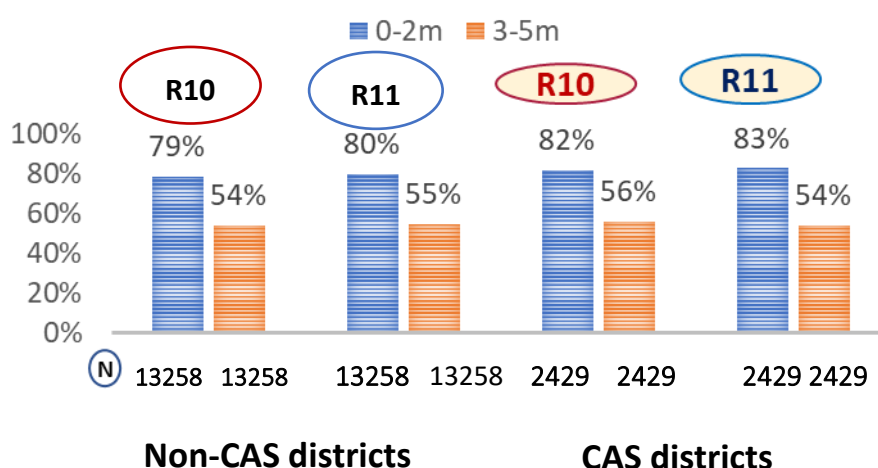


Figure 10: Mothers giving exclusive breastfeeding

INTERPRETATION:

Breastfeeding provides adequate nutrition, helps in protecting the child against many infections and diseases and it also helps to build the immune system to child to fight such

diseases. If we talk about the proportion of mothers providing exclusive breastfeeding to the children, it was found that 82% mothers in 0-2 months age group, practiced the exclusive breastfeeding in CAS districts in Round 10 while this proportion was 79% for the age group of 0-2 months, in non-CAS districts which was slight less than the CAS districts. In 0-5 months age group, the proportion was 56% in CAS districts and it was 54% in case of non-CAS districts.

In Round 11, there was an increase in the proportion of women giving exclusive breastfeeding in CAS as well as non-CAS districts in comparison to the previous year. In 0-2 months age group, the proportion was 83% and in 0-5 months age group, it was 54% in CAS districts. In non-CAS districts, the proportion of women giving breastfeeding in 0-2 months age group was 80% and in 0-5 months age group the proportion was 55%.

11. Proportion of mothers practicing dietary diversity

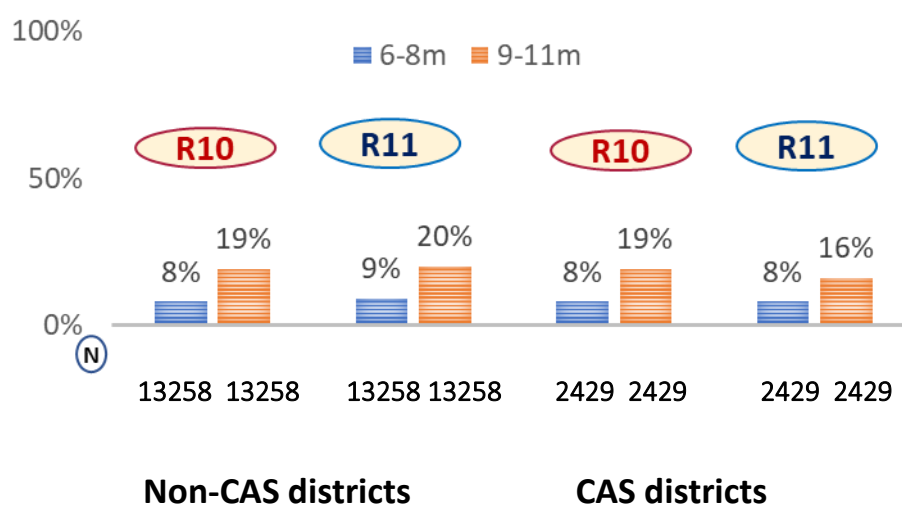


Figure 11: Mothers practicing dietary diversity

INTERPRETATION:

The data about the proportion of women practicing dietary diversity infers that the proportion of women practicing this in CAS districts was almost similar to the non-CAS

districts in Round 10 in all selected age groups. (8% in 6-8 months in CAS and non-CAS districts, 19% in 9-11 months age group in CAS and non-CAS districts).

In Round 11, the proportion was slight less in CAS districts in comparison to the last year as well as in comparison to the proportion of non-CAS districts in the Round 11. The proportion in CAS districts was 8% (6-8m) and 16% (9-11m) while in non-CAS districts, the proportion was 9% (6-8m) and 20% (9-11m).

12. Proportion of mothers initiating complementary feeding

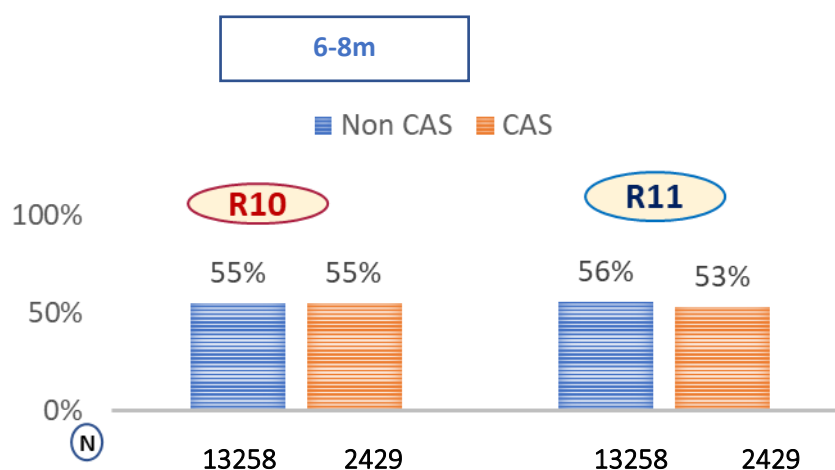


Figure 12: Mothers initiating complementary feeding

INTERPRETATION:

The proportion of mothers initiating the complementary feeding in 6-8 months age group of children was almost similar (ie. 55%) in CAS and non-CAS districts in Round 10.

In Round 11, there was a slight improvement in the proportion in non-CAS districts in comparison to the previous round. (56%). While in CAS districts, the proportion was 53%, which was slight less in comparison to the last year data as well as non-CAS districts in Round 11.

13. Proportion of malnourished children

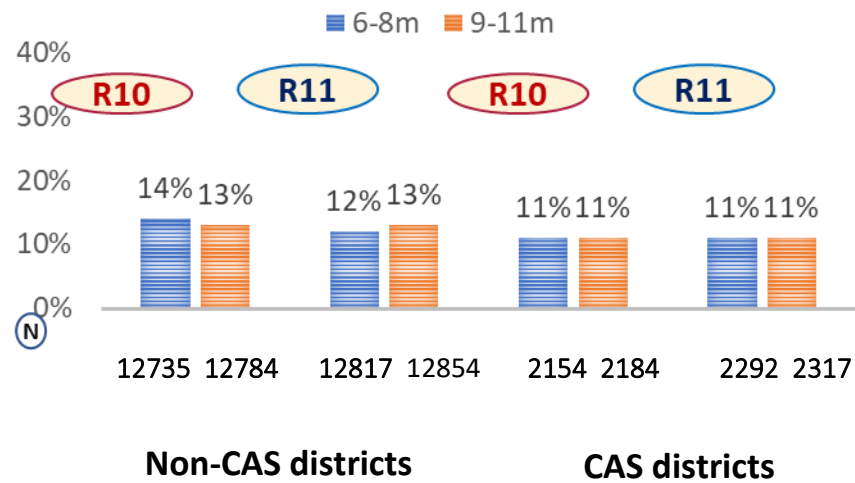


Figure 13: Proportion of malnourished children

INTERPRETATION:

The proportion of malnourished children in Round 10 was significantly lower (11% in 6-8 m, 11% in 9-11 m) in the CAS districts comparatively in all the selected age groups of 6-11 months. (14% in 6-8 m, 13% in 9-11 m in non-CAS districts).

In Round 11, the proportion in CAS districts was again lesser 11% in 6-8 m, 11% in 9-11 m) than the non-CAS districts in all age groups of children (12% in 6-8 m, 13% in 9-11 m).

DISCUSSION

This study presents the impact of a mobile health technology intervention i.e. Common Application Software (CAS) on the maternal and child health indicators through improved performance of the frontline workers, their better co-ordination and changed behaviour of mothers in the selected Districts of Bihar, a state poor in most of RMNCHN indicators. The implementation of CAS included real time monitoring, supervision and capturing of the data related to key domains of nutrition and pregnancy outcomes such as- antenatal check-up, AWWs home visits to the pregnant mothers during the pregnancy and after pregnancy, anthropometric measurements of the children, counselling of mothers and their participation in the demonstration of feeding/preparing food, distribution of take home ration to the pregnant and lactating mothers as well as for children, mothers practicing exclusive and complementary breastfeeding, mothers practicing dietary diversity etc. The intervention aimed at improving the key health and nutrition indicators in Bihar as well as the overall utilization of services which was quite poor in Bihar.

The study evaluated that the coverage of key indicators of maternal and child health as well as nutrition was higher in the CAS implemented districts in comparison to rest of the Districts of Bihar as well as in comparison to the previous year data of the same Districts. Moreover, the intervention led to better planning, monitoring, enhanced confidence among the frontline workers and their home visits were increased after the intervention. The visits can have a direct link with the improvement in the key health and nutrition components. As the number of visits increased (ANC visits at least once during pregnancy were 13% and 17% in CAS districts and 7% and 10% in non-CAS districts in Round 10 and 11 respectively), the number of ANC check-ups increased and resulted in better pregnancy outcomes. The proportion of mothers participating in demonstration of feeding/dietary diversity (26% and 23% in CAS and 13% and 11% in non-CAS districts in Round 10) and the mothers attending complementary feeding day was almost double (23% and 18% in CAS and 12% and 9% in non-CAS districts in Round 10) in the CAS implemented districts. This could be related to the fact that after delivery, the exclusive and complementary breastfeeding counselling and demonstrations by the FLWs resulted in better understanding of the lactating mothers in providing adequate nutrition to the children. However, the proportion in some indicators was similar in both- the

implemented districts as well as the rest of the districts. The reasons could be many which are beyond the scope of this study.

Similar studies have been carried out various regions of India showing the evidences on improved health outcomes post such technological interventions. One randomised control trial done in Maharashtra on M-Sakshi app demonstrated that mobile technology has successfully improved the coverage and quality of maternal and child health and nutrition services in hard to reach rural areas, improving the FLW engagement and participation with the help of mobile phones. [30] One more study on intervention launched in Uttar Pradesh, the neighbouring state of Bihar, also observed after the implementation of m-health intervention, the coverage of IFA supplementation (increased up to 12.58%), self-reporting of the pregnancy (13.11%) and after delivery complications increased (19.6% more reporting) significantly. This intervention also helped in increasing the FLWs capacity to deliver quality services to the beneficiaries and its utilization. [28] Hence, we can observe that the indicators were having improvements in their coverage after the launch of m-health interventions. The study done on the coverage of CCS using mobile technology in the middle and low-income countries concluded that such initiatives helped in health system strengthening with improved and enhanced service delivery quality. This m-health platform increased the coverage of selected indicators in the implemented District of Bihar in comparison to the other Districts and the previous year data. The percentage of ANC visits was 50% in the implemented districts and 29% in rest of the districts. Early initiation of breastfeeding was only 62% in the control group while it was 76% in the intervention areas. The percentage of complementary feeding was higher in implemented areas (41%) in comparison to the control areas (32%). However, the distribution and uptake of IFA tablets was not very high due to possible reasons of shortage of the supply of tablets. But this intervention strengthened the health system in the implemented area. [23] A study conducted in settlements of Mumbai, for combating malnutrition under a community-based program, concluded that by embedding the WHO tables for accessing and diagnosing malnutrition into mobiles, there was a significant reduction in the error rate detection of malnutrition (after implementation, the error rates got reduced to 0.7% from 5.5%). It had also put the frontline workers on same pace by reducing the variability in error rates and improving the FLWs performances. [31] Hence this was proven that the m-health technology tools help in reducing the malnutrition levels and have a better impact on the indicators. One more randomised control trial conducted

in Saharsa district of Bihar evaluated that the ICT-CCS, a mobile-based tool helped in improving the co-ordination among the frontline workers, better supervision and with enhanced confidence among them. This ultimately had a direct impact on the improvement in the antenatal care (ANC visits during pregnancy increased by 11% in third trimester), pregnancy outcomes, nutrition components and reproductive health of the beneficiaries. Hence mobile technology helped in improving RMNCHN indicators and also behaviour of mothers with respect to nutrition to their child in the implementation sites. There was an increase of 13% in skin to skin care and immediate breastfeeding after delivery increased up to 12%. [16] A systematic review done on the role of mobile applications in improving the ANC and PNC in LMIC depicted that m-health applications are helpful in improving the maternal and child health indicators, but some detailed interventions are important and needed to be implemented. [32] This analysis helped in concluding the impacts of m-health intervention by comparing the continuum of care services and nutrition components in the implemented and non-implemented Districts of Bihar.

The outcomes achieved after the implementation of this intervention, can help in improving the health status of the mothers as well as the children and overall improvement in the health indicators of Bihar as this intervention has helped in the better coverage of the indicators as well as their quality and service delivery as there was a significant difference in the coverage in CAS and non-CAS Districts. However, there are certain limitations in this study. This study does not actually reveal the reasons why the proportion of some indicators remained same in CAS Districts during both rounds of the survey (Round 10 and Round 11). This study could also not explain why there was no difference in the coverage of certain indicators in CAS as well as non-CAS Districts.

CONCLUSION

Summarising the study, it can be concluded that this intervention has significantly impacted many of the maternal and child health and nutrition indicators positively which were achieved through better co-ordination among the frontline workers resulting in their increased responsibilities and enhanced confidence to deliver the quality services to the beneficiaries. This intervention can help in providing a strong evidence against the improvements and advancements in the mobile health technology in future. The outcomes achieved after the implementation of this intervention, can help in improving the health status of the mothers as well as the children and overall improvement in the health indicators of Bihar as this intervention has helped in the better coverage of the indicators as well as their quality and service delivery as there was a significant difference in the coverage in CAS and non-CAS districts.

RECOMMENDATIONS/SUGGESTIONS

However, there are certain gaps in this study. This study does not actually reveal the reasons why the proportion of some indicators remained same in CAS districts during both rounds of the survey (Round 10 and Round 11).

This study could also not explain why there was no difference in the coverage of certain indicators in CAS as well as non-CAS districts. There could be certain reasons behind the patterns of change in the indicators as well as their coverage which could be highlighted in the study.

However, there was no major change in the behaviour patterns in terms of nutrition indicators.

There was no specific increase in the co-ordination among the frontline workers in many districts which would directly or indirectly have impacted the nutritional aspects of the districts.

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