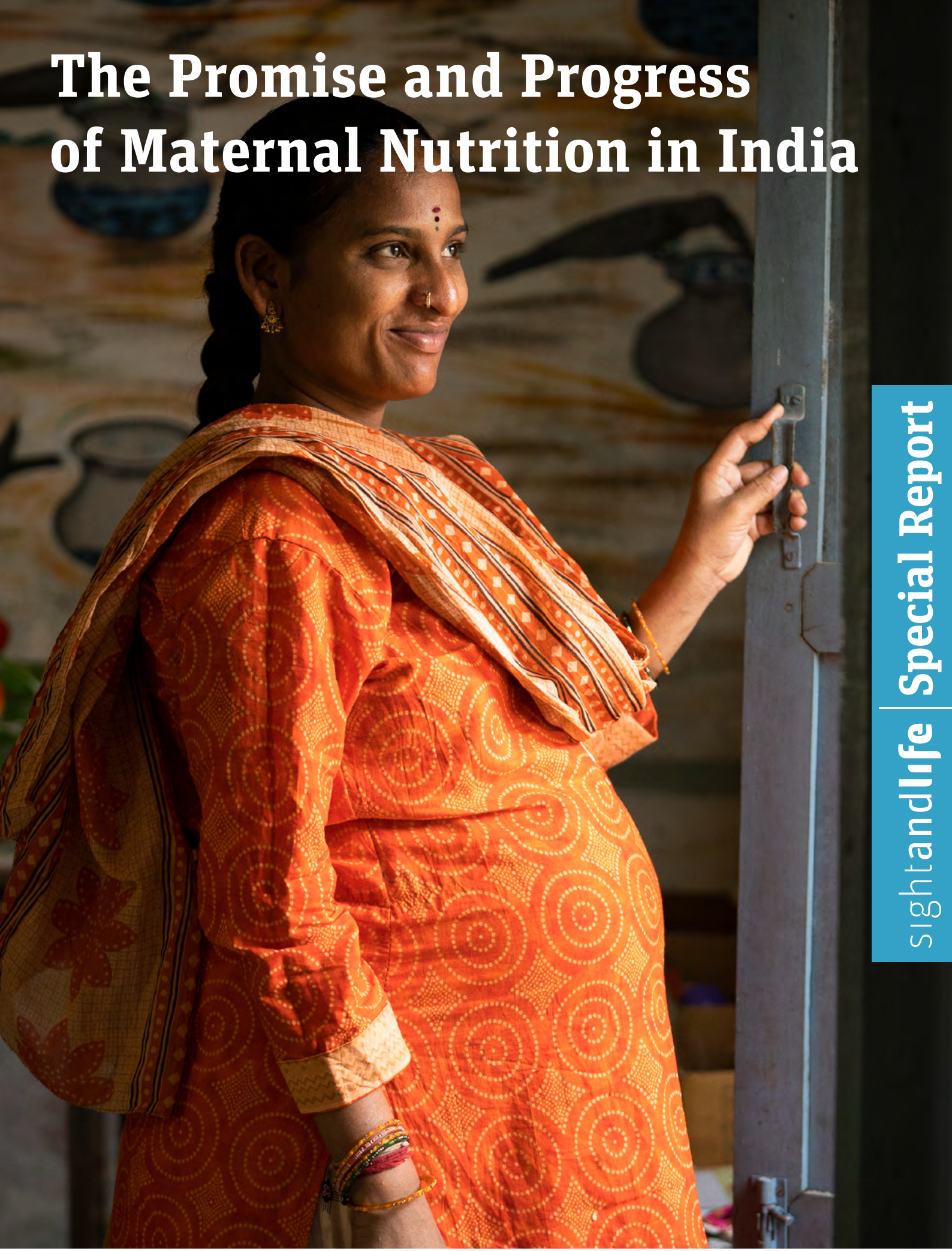
The Promise and Progress of Maternal Nutrition in India



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FIGO International Federation of Gynecology and Obstetrics
the Global Voice for Women's Health

FEDERATION OF OBSTETRIC AND GYNAECOLOGICAL SOCIETIES OF INDIA
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Foreword

Committed to Improving Maternal Health

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Maternal health has a direct impact on child health

FIGO and FOGSI are proud to take the lead in promoting women's health and reproductive rights across the world, and in India, and reducing disparities using scientific evidence and clinical expertise. Through membership of these organizations, we ensure committed professionals deliver the highest ethical standards of maternal healthcare. One of our missions is to disseminate knowledge and advance research in the field of Obstetrics and Gynecology.

We are very pleased to support this Special Report by *Sight and Life* that brings to light the progress and potential of maternal healthcare in India and lays down suggestions and plans for improving the same. It is a valuable resource for all stakeholders of maternal nutrition in India and beyond.

We believe that 'Women's Health is Nation's Wealth'. With better adolescent, prenatal and antenatal care, we can take care of the mother's nutritional status better and improve newborn health. To capitalize on the work already done in this aspect, we can work to make maternal nutrition in India an integral part of public healthcare delivery on the ground. This will involve better translation of policy to practice, as we strengthen public health services, and ensure last mile delivery of the recommended antenatal care routine for pregnant women in India.

The FIGO Nutrition Checklist, that focuses on the period before pregnancy, remains a significant tool towards achieving this. An evidence-based checklist, it is an initiative to address adolescent, preconception and maternal nutrition that captures information on special diets, maternal BMI, diet quality and micronutrients.

Diet diversity and weight monitoring are crucial aides in the collective effort to improve maternal nutrition. However, as this report showcases, maternal nutrition issues in India go beyond diets and weight – if we are to make serious gains in achieving our goals, we need to approach the issue in a more holistic manner, from prevention to cure. The large number of topics covered in this publication, from benefit schemes to disease control, from leveraging digital channels to personal outreach, adequately shows the effort that has been made by various stakeholders so far to advance the agenda – as well as the gaps that remain.

India has made huge progress in the area of maternal mortality, with almost a 70% decline over the last two decades. We are proud of this achievement and will continue to further this work. However, we firmly believe we can do more for maternal nutrition status in the country – there is need for more dialogue, research and knowledge. Improved maternal nutrition will not just impact maternal mortality but also advance women's health and that of newborns and help break the inter-generational cycle of malnutrition and poverty.

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Expert View

Challenges and Opportunities to Improve Child Nutrition Indicators

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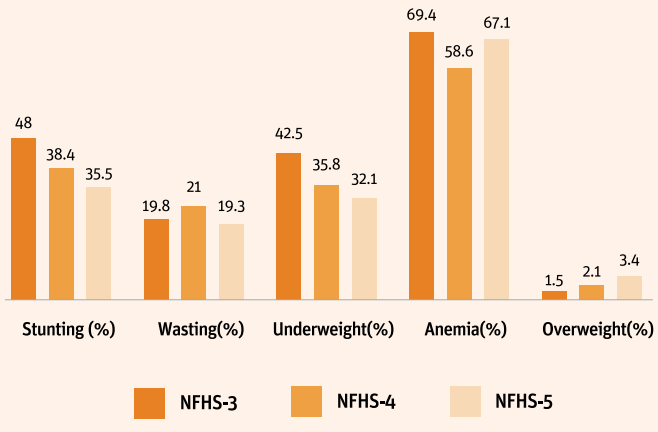
Introduction

The Integrated Child Development Services (ICDS) program is the world's largest integrated program, with over 14 lakh centers nationwide. Since its inception in 1975, the program has matured and child nutrition indicators improved over the decades, although, anemia has stagnated **(Figure 1)**. The government has been spending thousands of crores for nutrition intervention programs, but improvement in nutritional status of children is not commensurate with investments. Analysis of data shows that paying more attention on children from birth to 2 years and a modest focus to women planning for pregnancy can pay enormous dividends in terms of child nutrition.

FIGURE 1: Nutrional status in children under-5 in India



NFHS 3 (2005-06); NFHS 4 (2015-16); NFHS 5 (2019-21)

Problem Statement

The two main undernutrition indicators of public health concerns in India are stunting and wasting, both of which originate at birth and increase up to 2 years of age. Twenty percent of stunting and wasting is due to small size at birth, ~25% is due to diarrhoea and other infections; and a massive ~55% is due to sub-optimal feeding of children <2 years. It is crucial to prevent inadequate growth and development of children during their early phase as it predicts many short and long-term consequences.[1,2]

These children are likely to suffer from more frequent episodes of infections, may perform poorly in school, and may have low earning capacity as adults; undernourishment during childhood period contributes to the inter-generational transmission of malnutrition. As adults, children who faced nutrition insults during early phase of their life are more likely to develop diabetes, hypertension, stroke and CHD. [1,2] From 1990 to 2016 deaths, and disability- adjusted life years (DALYs) due to diabetes, hypertension, stroke and heart attacks have increased in India.

Nutrition status of children from birth to 2 years

Stunting and wasting occur in the first two years of age and establishes thereafter. In a cohort study conducted by us, nearly 15% were low birth weight (LBW) babies (<2.5kg), and all of them had lower length for gestational age.[3,4] By one month age, a significant proportion of infants had stunting and wasting. Though, the Z scores improved a little from birth to 6 months, there was a rapid decline in the scores from 6 to 24 months age, and the prevalence of stunting and wasting increased to 34% and 17% by 2 years age. Successive NFHS surveys also show significant level of wasting and stunting among one month old infants, both of which increase sharply from 6 months to two years age of infants **(Figure 2 & 3)**[5]. After 2 years age there is no further increase in the proportion of children with stunting and wasting. It was also observed that the LBW babies have lower Z scores and higher level of stunting and wasting at any given age from birth to 2 years compared to the babies with normal birth weight **(Figure 2)**, suggesting the need to improve birth weight.

Improving birth weight and paying attention to young child feeding (IYCF, from 6 to 24 months of age) practices will significantly impact nutrition indicators among children. To improve birth weight, nutrition status of women must be improved (30% of women have body weight <45kg around conception and 35% have height <150cm).

And, to improve child growth in terms of prevention of stunting and wasting, more intense focus is required on IYCF practices, which are extremely poor in India **(Table)**. It is clear form these observations that under-nutrition can be addressed effectively by paying more attention to young child feeding; and by improving health and nutrition status of women before pregnancy as well.

FIGURE 2: The Z scores fall and wasting increases from 6 months to 2 years

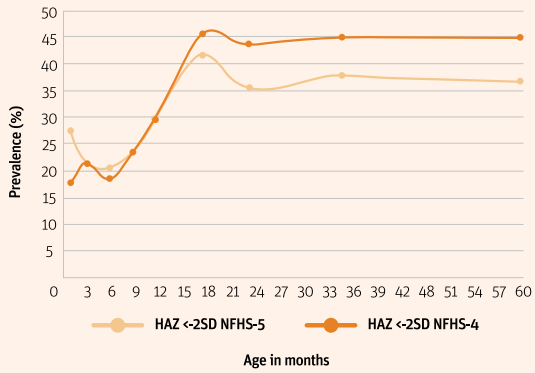
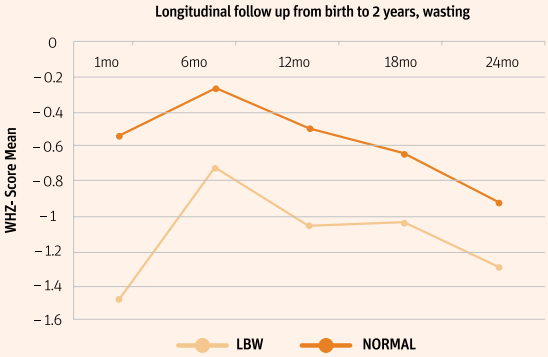


FIGURE 3: Proportion of children with stunting increases from 6 months to 23 months



Table

- 32% of mothers have low height (less than 155 cm).
- Only 42% babies have early initiation of breast feeding (EIBF).
- Only 43% babies are exclusively breast fed (BF) upto age 6 months.
- Complementary feeding is delayed in 70% infants.
- 90% of < 2 year old babies do not get adequate complementary feeding.

Recommendations for 1000 + Days Programme

Pre-pregnancy / The Pre-conception period (chart)

- All women planning for pregnancy (newly married couples) require nutritional assessment and appropriate counselling/ interventions to improve bodyweight and hemoglobin status in the preconception period.
- Other areas that need attention include hygiene practices, deworming and inculcation of healthy dietary habit.

This phase can be used for counselling on appropriate age for pregnancy.

- Advocacy of dietary diversity is needed to improve overall nutrition status. Overweight women should be counselled for appropriate bodyweight.
- For those planning for second pregnancy, suitable guidance on birth spacing must be provided to reduce the risk of adverse outcomes for mother and child.

Pregnancy

Women who test positive for pregnancy must be provided standard pregnancy care in the nearest facility and counselled for healthy/ balanced diet during pregnancy and this opportunity should be used for counselling on EIBF practices and its benefits.

Post Delivery

Following delivery, Early Initiation of Breastfeeding (EIBF) should be followed strictly apart from the standard care. For mandatory implementation of EIBF the WHO guidelines given below should be followed. Women must be counselled about the breastfeeding practices and appropriate methods including the goodness of breast milk. From the 6th month, appropriate nutrition education should be continued and complimentary feeding practices and diet diversity education must be imparted.

Recommendations for 1000+ Days Programme

Improvement in Early initiation of breastfeeding (EIBF) (WHO guidelines)

- Implementation of strict regulation on EIBF and overall BF practices in all private/ public hospitals/ facility.
- Having a written infant feeding policy, in all private/ public hospitals/ facility, to be communicated to staff and parents.
- Establishment of data-management systems and monitoring on BF practices in all private/ public hospitals/ facility.
- Having adequately trained staff to support BF practices in the hospitals/ facility.

Breastfeeding is essential for newborn health

Recommendations for 1000+ Days Programme

Improvement in exclusive breastfeeding practices up to 6 months

- Policy to Ensure that staff have sufficient knowledge, compe tence and skills to support breastfeeding among anganwadi teachers, ANM. Also, counselling pregnant women on BF practices.
- Counselling mothers on complementary feeding practices, dietary diversity, minimum acceptable diet and minimum meal frequency. Need to demonstrate recipes in certain areas.
- To enhance focus on THR composition, delivery and uptake. and counselling on THR.

Complimentary feeding should begin after 6 months

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Dietary Entitlements: Scope for Further Research

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Dietary entitlements available through a country's social protection programs should address the full spectrum of malnutrition and be aligned to the larger principle of 'do no harm'. In India, dietary entitlements are available to pregnant and lactating women (PLW) either through the Integrated Child Development Services (ICDS) scheme in the form of take-home rations (THR) and hot cooked meals or through the targeted Public Distribution System (PDS) as part of monthly household rations. The latter, however, is independent of a woman's pregnancy status.

Dietary entitlements available through the ICDS can play an important role in improving the nutritional status of women during pregnancy and lactation, producing a long-term impact on pregnancy outcomes. This, of course, depends on the nutritional profile of the products and the instructions on consumption that the beneficiaries receive through frontline functionaries. ICDS provides 600 kcal and 18–20 g of protein per day as supplementary nutrition to PLWs, while antenatal care (ANC) guidelines state that a woman needs an additional 300 kcal per day during pregnancy and an additional 500 kcal during lactation to maintain her health as a mother, nourish the fetus, and lactate properly.

> **"Dietary entitlements can play an important role in improving the nutritional status of women during pregnancy and lactation"**

The ICDS supplementary nutrition for PLWs can be aligned to balanced energy-protein (BEP) supplements. If less than 25% of the total caloric content is from proteins, the supplements can help improve maternal nutrition and fetal growth in undernourished populations.

In 2019, the World Food Programme conducted a countrywide review of THR distributed through the ICDS. Within the same, a deeper analysis of THR distributed among young children revealed the average energy contribution from proteins, fats and sugar to be 12%, 22.5% and 23%, respectively. This reading for children gives us an idea of the energy contribution among PLWs as well.

ICDS is a strong platform to improve nutritional status of women and children

All of this points to a need to revisit the ICDS norms and reflect on the nutritional role of components such as fat, salt and sugar. However, a few grey areas of research need to be considered while enhancing THR for PLWs. These include (but are not limited to):

- the need for a countrywide mapping of composition and content to identify THR products that require improvement;
- analysis of the impact of improvised THR products on nutritional status and pregnancy outcomes; and
- comparative analysis of the delivery mode of supplementary nutrition to PLWs (THR or hot cooked meals) and intra-household consumption patterns of the entitlements for PLW.

Addressing these gaps before revising dietary entitlements would be useful, and would better target maternal malnutrition.

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Taking Double-Duty Actions

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Rapid changes in food systems, unhealthy food environments, increased availability of unhealthy ultra-processed foods, harmful marketing practices and sedentary lifestyles are together fueling increases in overweight and obesity among women and increasing risks of non-communicable diseases (NCDs) in India and South Asia. The prevalence and burden of overweight and obesity is fast rising and now exceeds underweight in the urban populations of some countries in the region.[1]

Rising obesity

The most recent India National Family and Health Survey (NFHS-5) 2021, while showing some improvement in low body mass index (BMI; <18.5 kg/m^2), reveals a worrying increase in overweight/obesity from 20.6% in 2015–16 to 24%. The rising prevalence of overweight/obesity is a cause for concern, as it diminishes the health and well-being of women, increases the risks of gestational diabetes, hypertensive disorders, and serious pregnancy and birth complications for the mother and newborn, among other detrimental consequences.

The double burden of malnutrition requires comprehensive policy and programmatic approaches, yet national responses continue to have a disproportionate policy focus on addressing undernutrition in women of reproductive age. Inconsistencies in policies and program guidance limit the implementation of double-duty actions, making it challenging to tackle the double burden of malnutrition. The WHO recommends counseling on healthy eating and keeping physically active to prevent excessive weight gain during pregnancy. However, the lack of an agreed indicator on counseling regarding healthy eating and physical activity to prevent excessive weight gain remains an impediment to assessing the translation of policies into practice, as well as to tracking progress.

"The double burden of malnutrition requires comprehensive policy and programmatic approaches"

The need for a whole-of-government approach

While measures being taken by the Government of India to prevent increases in overweight and obesity in its population are commendable, a whole-of-government approach is needed in order to address the double burden of malnutrition more impactfully. The implementation of recommendations from the 2021 National Convention on the Prevention of Maternal, Adolescent and Childhood Obesity will go a long way in helping curb the rise in overweight and obesity among women of reproductive age while ensuring that evidence-based actions to address the enduring undernutrition challenges are simultaneously scaled up with equity. Current efforts to strengthen the policy and regulatory environment around healthy food environments and to promote physical activity, healthy eating and lifestyles in India are critical, and could offer useful lessons for the rest of the South Asian region. The health sector needs to strengthen the integration of maternal nutrition interventions, including overweight/obesity prevention and management, in antenatal and postnatal care platforms.

A standard approach to preventing excessive weight gain

It is now time to ensure that greater attention is given to tackling the double burden of malnutrition in women of reproductive age. The economic and social costs of the double burden of malnutrition are high, and countries in the region are at the crossroads. Measures to prevent excessive weight gain should be a standard component of care for all women in all countries in South Asia region, especially during critical life stages such as pregnancy.

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A Finer Focus on Quality Antenatal Care

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Maternal nutrition presents a unique opportunity to positively impact the next generation, helping children reach their full potential. India is a rising economy, currently the fifth largest in the world, a reflection also of the remarkable progress the country has made in the social sector. And much more can be done, especially in the area of maternal health.

> **"It's time for focused investment in the first 280 days – the period of pregnancy within First 1,000 Days window"**

The nutrition community has, quite rightly, been pursuing the 'First 1,000 Days' window of opportunity over the last few years. However, the period of pregnancy – the first 280 of the 1,000 days – may not have received the same level of attention. A lot of valuable work has been done on infant and young child feeding (IYCF), including breastfeeding practices and child diets, to address growth faltering. A more focused investment in the period of pregnancy itself, and in the mother herself, will go a long way to positively impact pregnancy outcomes, break the vicious intergenerational cycle of malnutrition, and help the child reach her full potential.

Providing quality antenatal check-ups (including ultrasound), testing and treating for anemia, infections and other medical conditions will ensure healthy outcomes for both mother and child. Maternal diet will also need to be improved and vitamin supplementation provided as necessary. Few countries have the capability to deliver this at scale, but India does, with large government programs that provide a platform to target the most nutritionally vulnerable women. With the right resource allocation and policies that empower women for decision-making, India can become an exemplar for the rest of the world.

> **"We need to invest in research for interventions for adolescent girls"**

Adolescent health: the second window of opportunity

To make real intergenerational impact, we need to start early. Adolescent health is an area crying for increased investments in the space of nutrition. The current World Health Organization (WHO) guidelines recommend deworming and weekly supplementation of iron and folic acid (IFA), but adolescent girls need more than this if they are to have a healthy productive life.

Menstruation-related blood loss plays an important role in anemia among adolescents. Girls also drop out of school due to lack of facilities they need for sanitation and menstrual hygiene. Socio-cultural norms still play a large role in undernutrition of adolescent girls. Many girls get married at too young an age and become pregnant when their bodies are not ready. According to NFHS-5, 23.3% women in India get married before the age of 18 years.[1] There is a need to invest in implementation research for multi-dimensional nutritional strategies beyond IFA and deworming for adolescent girls and young women. It is the lack of multisectoral strategies and interventions rather than the lack of intention on the part of parents that leads to a girl becoming an adolescent mother, which in turn feeds into the cycle of poverty and malnutrition.

Strengthening service delivery to provide quality care

There has been a constant debate regarding which products can be used and which can't. Some of these debates just reflect an endeavor to find a "silver bullet" to complex solutions. Usually, the victims of these debates are the most vulnerable part of a population, who are dependent on public health delivery and are impacted by policies. Maternal anemia is one such example.

All women need quality antenatal care, and no product can replace this lifesaving service. During antenatal care, testing for anemia is compulsory. If they have anemia, the cause(s) need to be determined and treated. This is a clinical approach, and service delivery needs to make sure this service is available to all women, everywhere.

A public health approach is needed to address the burden

of caloric, protein and micronutrient deficiencies and provide the most impactful product for all pregnant women. There are multiple public programs that aim to supplement the calorie and protein intake of women during pregnancy. However, the effectiveness of these programs is highly inconsistent due to societal, cultural and economic realities that influence behaviors of individuals, families and communities. Similarly, iron and folic acid have been recommended by the WHO for almost 50 years to impact maternal anemia. However, progress has been grossly suboptimal till date and anemia remains one of the biggest public health problems in India.

Strategies like strengthening of antenatal care services, including early identification and management of infections and other high-risk conditions, are increasingly being deployed on ground and have resulted in promising results in improving the birthweight of the newborn. There is, however, a need to rapidly scale up these ANC strengthening interventions.

Given the high prevalence of undernutrition during pregnancy in LMICs, and the burden of undernutrition on the most vulnerable, it is prudent to accelerate the formulation of evidence-based strategies to decisively address maternal undernutrition. This will need strong and urgent global and in-country consultation, coordination and harmonizing of the scientific rigor of testing newer interventions with political urgency. The time to act is now.

India can champion this change thanks to the recent nation-wide campaigns like Anemia Mukt Bharat Abhiyan, a campaign that enjoys the commitment of top political leadership.

"We need to establish clear parameters to track and evaluate gestational weight gain"

Sharper focus on gestational weight gain

South Asia has a huge problem of low birth weight. However, very often, it is only once a child is born with low birth weight, and consequently with a higher risk of death, that interventions such as kangaroo mother care (KMC) and assisted feeding kick in to save the child's life. Weight gain during pregnancy is a strong indicator of healthy fetus growth,[2] yet tracking of gestational weight gain is not usual practice in India. As of now, the overall evaluation skills and knowledge of healthcare workers on gestational weight monitoring is limited, and there's little or no clarity on reporting or recording.

We need simple tools to allow healthcare workers to track gestational weight gain and provide relevant advice to mothers. This intervention can help in monitoring fetal growth in the womb, as not all mothers have access to periodic ultrasound services. Research in such simple interventions can go a long way in making sure that babies are born healthy, and mothers have a positive pregnancy experience.

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Maternal Malnutrition: Challenges, Drivers and Solutions

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Even a decade ago, thinking about maternal nutrition in India conjured up images of thin, undernourished and anemic women. Today, as we look towards the Sustainable Development Goals for India, as well as South Asia, the problem definition for maternal nutrition is much more complex than a simple image of a hungry and anemic woman. The evolution of our understanding of maternal nutrition and of the challenge itself, is well captured in this *Sight and Life* Special on the Promise and Progress in Maternal Nutrition in India.

The multiple challenges of maternal nutrition and the changes they have seen over time require deeper analysis, with better data than what is currently available. Some of the systems solutions captured in this Special Report focus on food systems and poor diets, others on health services, and yet others on approaches that address socio-economic causes. However, with limited data on diets, on the quality of services and on economic challenges, we don't have the full picture about the true nature of the determinants of poor maternal nutrition outcomes or of the drivers of positive changes across India.

> **"It is crucial to identify novel ways of bringing young women together and for each other"**

As we look ahead to a new era of policy efforts and program improvements, we must also make investments in strengthening the evidence base on drivers of poor maternal outcomes and on effective solutions that truly tackle the root causes.

- Tracking progress on maternal diets is essential; in an era where the nature of the maternal nutrition problem is shifting, understanding one of the major causes – poor diets – clearly remains a challenge.
- Investing deeply in understanding the substantial social determinants of maternal nutrition: these range from early marriage and early pregnancy to other forms of gender imbalances and challenges.
- Putting quality care for women and their families at the center of all services delivered requires a mindset that views every woman and her family as a client rather than a beneficiary.
- Taking a whole-of-society perspective to address maternal nutrition comes from acknowledging the ways in which patriarchy is responsible for it. It is crucial to identify novel ways of bringing young women together and for each other in tackling a key challenge area.
- Program models for supporting better nutrition among urban communities must approach design, implementation and learning in a frame that does not impose rural design features on programs for urban populations. This requires new approaches to research.

In closing, the diversity of approaches documented in this Special Report are a reminder of the innovation and creativity with which nutrition programs need to be addressed in a country as large and as culturally and linguistically diverse as India. These program efforts, however, must continually center around a solid epidemiological and biological analysis of the challenge of maternal malnutrition. Constantly revisiting and testing assumptions, along with the use of thoughtful and grounded research, is essential to progress.

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Maternal Malnutrition: Causes, Solutions and Recommendations

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Causes

There are many contributors to maternal undernutrition, including social, normative, cultural, structural, economical, geographical and environmental factors. Together, these lead to poor access to the appropriate diet and care needed throughout the reproductive stages of life. Biological factors such as increased nutritional requirements during the critical phases of pregnancy and lactation, inter-generational impacts that may contribute to maternal short stature (a powerful determinant of reproductive health and birth outcomes), and morbidity and poor appetite during pregnancy, are also at play.

Gender and women's status are key drivers, especially in many areas of India. For example, women in India may gain only 6 kg on average during pregnancy (half the recommended level), similar to women in many countries of Africa, but the BMI at the end of pregnancy in the case of Indian women only reaches the pre-pregnancy level of Africans, as it is so low to begin with.[1] Although progress is slowly being made, India continues to have over 18% women with low BMI, while the worldwide population mean BMI has increased. India also has over 20% overweight among women,[2] adding to double burden of malnutrition.

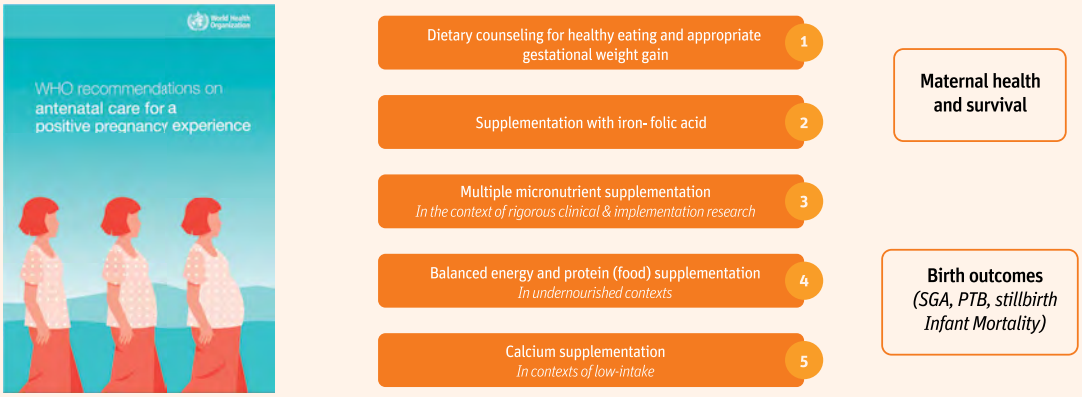
> **"We have a slew of evidence-based interventions and strategies to tackle maternal nutrition"**

Potential solutions

Fortunately, we have a slew of evidence-based interventions and strategies to take programmatic action to tackle maternal malnutrition. The recent World Health Organization (WHO) antenatal care (ANC) guidelines include such interventions for nutritional support during pregnancy **(Figure 1)**. These need to be integrated as part of ANC within the health systems or other platforms.

Counseling for healthy eating and physical activity to prevent excessive weight gain, as well as increased energy intake to promote increased weight gain in undernourished contexts, is recommended for pregnant women. Universal daily iron-folic acid (IFA) supplementation is recommended, as well as balanced energy and protein (BEP) supplementation in undernourished contexts, which includes India. Multiple micronutrient supplementation (MMS), also containing IFA, has shown itself to be superior relative to IFA for reducing low birth weight,[3] and is recommended in the context of rigorous research, including implementation research to test the feasibility, cost, acceptability, and other aspects of switching from IFA to MMS. Lastly, high-dose calcium (1.5–2 g) is recommended for reducing the risk of preeclampsia in low-intake settings.

FIGURE 1: WHO guidelines and interventions for nutrition-related antenatal care to improve maternal and newborn outcomes



Maternal anemia needs specific mention, as its prevalence continues to range between 50% and 60% among women of reproductive age and women in a state of pregnancy in India (NFHS-5). A large proportion of this is likely iron deficiency anemia, although other etiologies such as nutritional deficiencies (including B_{12} and vitamin A), and, in some settings, hookworm and malaria may also exist. A multi-pronged approach relying on food fortification targeted at women and girls, or intermittent iron supplementation as is perhaps needed in India, followed by IFA during pregnancy, is required.[4] Screening and treatment of mild, moderate and severe anemia will be needed to address the long-standing public health problem of maternal anemia.

> **"A multi-pronged approach targeted at women and girls is required"**

Recommendations

In summary, nutrition guidelines for pregnancy exist, but implementation lags and nutrition quality and identification of nutritionally at-risk pregnant women in ANC needs urgent attention. Work is urgently needed to develop recommendations for women during lactation where none exist, and research on evidence-based interventions for preconception and adolescence lags. Clear, rigorous and consistent evidence exists for the benefit of antenatal MMS; BEP supplementation in high-burden areas should be implemented to achieve optimal gestational weight gain and birth weight.

Interventions in pregnancy are some of the most cost-effective and beneficial interventions that need to be scaled. Financial and programmatic commitment is urgently needed, especially in India, where the magnitude of the problem is the largest.

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A Three-Step Strategy

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The causes for maternal malnutrition are well known and not very different from country to country. Inadequate or imbalanced diet, protein deficiency, social injustice – time and again, we have failed to address these issues, leading to a vicious inter-generational cycle of malnutrition among women of reproductive age.

A very large and coordinated systemic change is required to overcome this longstanding problem. There is a need to convince nations that investment in maternal health is the best investment they can make for the future of the country. In my opinion, we need a three-level strategy to tackle this significant issue: at the government level, the healthcare professional level, and the individual level.

> **"Investing in maternal nutrition, and thereby in the life course at the very beginning, has an enormous impact on the country's economy and growth"**

Changing the economic model

Amartya Sen famously defined human development as "advancing the richness of human life, rather than the richness of the economy." Our governments need to take the lead from this thought and stop measuring development merely in terms of gross domestic product (GDP). Our progress should be measured in terms of value of life. In fact, investing in maternal nutrition, and thereby in the life course at the very beginning, has an enormous impact on the country's economy and growth, as healthy generations turn out to be more productive. There is an urgent need for new economic models that value maternal nutrition as the very foundation of a robust economy.

Governments tend to think of growth in terms of GDP – but the truth is that a large amount of work that contributes to a nation's growth doesn't 'technically' contribute to GDP. Most of that work is conducted by women, be it breastfeeding a child or nurturing the family. What we need to understand is that this unpaid work actually does contribute to the nation's economic growth.

Involving the healthcare professional

Once the government is convinced of turning the idea of GDP and economic growth, it can communicate with doctors, gynecologists and obstetricians, midwives and community health workers, and involve them in doing far more than just deliver babies.

These healthcare professionals are the guardians of the future. They can ensure that women of reproductive age follow a healthier lifestyle, diet, and a good routine that carries on to the baby's early life stages. For instance, local healthcare workers can have simple tools such as a nutrition checklist that just asks simple questions on consumption of junk food, adequate supplementation, etc. This does nothing more than identify families that are at potential malnutritional risk and refer them to the services of a nutritionist. There are pilots on such programs that are being conducted in India and South Africa, and one will be surprised at how many pregnant women, especially in the rural areas, never even end up seeing an obstetrician. Such a simple checklist can really help to highlight maternal health issues.

IEC tools being leveraged by the frontline health workers

Engaging the individual

Finally, we need to promote health metrics among young people. We at Southampton University conduct a program called LifeLab that aims to raise awareness among teenagers about the science underpinning health issues. The idea is to engage tomorrow's

parents about health and nutrition. Engaging adolescents creatively, working with them instead of talking at them, can get them excited about – and invested in – their own, and their future child's health. Such engagement can be done via schools, religious centers, or local community groups. With insight into simple issues, young people are empowered to make better nutritional choices before thinking of parenthood.

"We need to promote health metrics among young people"

Nations worldwide invest huge amounts of time and money in technology, sports and infrastructure, but the health of an individual is where we need to invest if we are to make any of that other investment useful.

As a vibrant, dynamic, and diverse nation, India has the opportunity to demonstrate that investment in maternal health and nutrition today is the best type of investment we can make for tomorrow. It is good for the woman, her health and future, the child and the family, and for future generations too. India has highly creative and committed individuals, and I have great hopes that the country will be able to take big leaps forward in the near future. The world is watching and hoping to follow India's lead.

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Time to Take the Next Steps

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Women's health, nutrition, and wellbeing, across the continuum of preconception to postpartum, are critical for ensuring positive long-term outcomes for both mothers and their offspring. Although we have made significant progress in reducing the prevalence of underweight among women of reproductive age, there is considerable heterogeneity by region, and other problems remain. Unlike undernutrition and anemia, for instance, updated data for specific micronutrient deficiencies and dietary intakes is limited and sparse. Studies have shown that several micronutrient deficiencies (in respect of iron, vitamins A, D, B_1, B_2 B_{12}, folic acid, and zinc) are common among women of reproductive age, especially during pregnancy and lactation, when women have increased requirements. For example, studies from Bangladesh and Nepal show that almost 80% of women had at least two or more micronutrient deficiencies at the outset of pregnancy.[1,2]

"Women's status faces many challenges across the globe"

Distal causes

Distal causes, namely the underlying social, economic and political context, as well as the lack of capital (financial, human, physical, social and natural), may affect maternal nutritional status directly or indirectly. Of particular note is the fact that the status of women – including access to education, age of marriage, maternal empowerment, and gender equality – faces many challenges across the globe. The co-occurrence of several micronutrient deficiencies in many low-resource settings reflects the role of common underlying causes. For instance, poor water and sanitation increase the risk of infectious diseases, malnutrition and mortality, and may disproportionately affect women. Similarly, food insecurity may also affect women disproportionately in many settings and can be influenced by the affordability and availability of food as well as the distribution of food between household members. Collectively, these factors influence the conditions of women (inadequate dietary intake, care for women, and disease) both before and during pregnancy.

"Approaches that address the food environment and promote both the quality and quantity of women's diets are required"

A balanced quality diet drastically improves maternal and child health

Priority areas

Despite progress due to investments in improving early childhood nutrition and girls' education, there remain several important priority areas and knowledge gaps in the context of improving women's nutrition before and during pregnancy. While there is a strong

evidence base for maternal nutrition interventions, most of these focus on pregnancy, which is a very important yet narrow window of opportunity. The next frontier requires a greater focus on the implementation of science as well as greater equity to decrease global maternal undernutrition disparities that use a life-cycle approach. Strategies that address the dual burden of malnutrition, including undernutrition and obesity as well as micronutrient malnutrition, are also urgently needed. These strategies require approaches that address the food environment and promote both the quality and quantity of women's diets as needed. Last but not the least, we need interventions to strengthen health systems: this will ensure timely access to quality antenatal and post-partum care, targeted interventions for high-risk groups, innovative strategies that prioritize preconception nutrition, and access to health and family planning resources.

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A Study on Improving Coverage of Essential Interventions

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Background

India seeks to make iron and folic acid universally accessible to adolescents and women of reproductive age.[1] Here, we discuss an experience from a 2020 trial that may be of interest to program managers. The trial was conducted in South Delhi, among urban mid-to-low socioeconomic populations with a high burden of morbidity in women of reproductive age.[2] A package of interventions in the domains of health, nutrition, psychosocial support and WASH (water, sanitation and hygiene) was delivered during preconception, pregnancy and childhood both separately and together.[3] Baseline anemia (hemoglobin <12 g/dL) prevalence in 6,673 women aged 18 to 30 years and identified through a survey was 59.6%.

The national guidelines for diagnosis, management and prophylaxis were followed.[1] The Sanginis (ASHA-like community health workers recruited through the study) followed up on a weekly basis to counsel women and deliver interventions.

Non-anemic women received weekly iron-folic acid (IFA), under direct supervision. Twice-daily IFA was given for mild (Hb 8 to 10.9 g/dL) and moderate anemia (Hb 11 to 11.9 g/dL). Sanginis made twice-a-week contacts to encourage intake and ensure quarterly follow-up visits to physicians at the study outreach clinic. Women with severe anemia (Hb <8 g/dL) were referred to a tertiary hospital, followed by close supervision at home.

The weekly delivery of IFA for non-anemic women was more than 90%. More than 75% of anemic women consumed IFA tablets twice a day for three months.

Numbers speak

After three months of treatment, 55% of women with mild to moderate anemia recovered (Hb≥12 g/dL), 12% improved (Hb change ≥1 g/dL), and 33% did not improve (Hb <1 g/dL); in those severely anemic, 41% recovered (Hb ≥12 g/dL), 40% improved (Hb change ≥2 g/dL), and 19% did not improve (Hb <2 g/dL). The mean (SD) change in Hb was 1.2 (1.1) g/dL for mild to moderate anemia, and 4.3 (2.2) g/dL for those severely anemic. One year after enrolment, the proportion of women with moderate anemia fell from 27% to 10% (see **Table 1)**.

TABLE 1: Decline in levels of anemia observed during first year of study

Anemia Category	At baseline (n=6,673)	At 12 months (n=3,078*)
Severe anemia	212 (3.2%)	4 (0.1%)
Moderate anemia	1,779 (26.7%)	304 (9.9%)
Mild anemia	1,988 (29.8%)	872 (28.3%)
No anemia	2,694 (40.4%)	1,898 (61.7%)

**All tested except those who became pregnant and were randomized again, or were censored*

Our study showed that marked improvement in anemia status is achievable. Possible reasons contributing to these results: the optimization of intervention delivery by linking homes and health facilities through the study outreach clinic; use of an electronic tracking system for women with 'high risk' conditions such as anemia, undernutrition, reproductive tract infections and thyroid disorders, to enable close follow-up; observed intake of IFA, uninterrupted supplies and the support of Sanginis. High adoption rates were observed for anemia during pregnancy and other interventions too. While these results were seen in the context of a trial, the study was large (13,500 women) and population-based, and some lessons may be relevant for national programs.

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Adjusting and Adapting the Maternal Nutrition Policy

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Pregnancy is a period of heightened nutrition vulnerability, with potentially grave impact on fetal and infant growth, as well as the onset of noncommunicable diseases in adult life. Malnutrition in women remains a persistent public health concern in India, with an undernutrition prevalence rate of 19%. Anemia and overweight/obesity, meanwhile, are at 59% and 24% respectively.[1]

While the implementation of a number of nutrition-sensitive determinants of malnutrition – facilitated by high-level political support – has resulted in a remarkably positive shift in the past few years **(Figure 1)**, direct maternal nutrition interventions are limited to provisions under the Integrated Child Development Services' (ICDS) supplementary nutrition program (SNP) and supplementation with iron-folic acid (IFA) and calcium. Data on the progress of these interventions is available only for IFA.

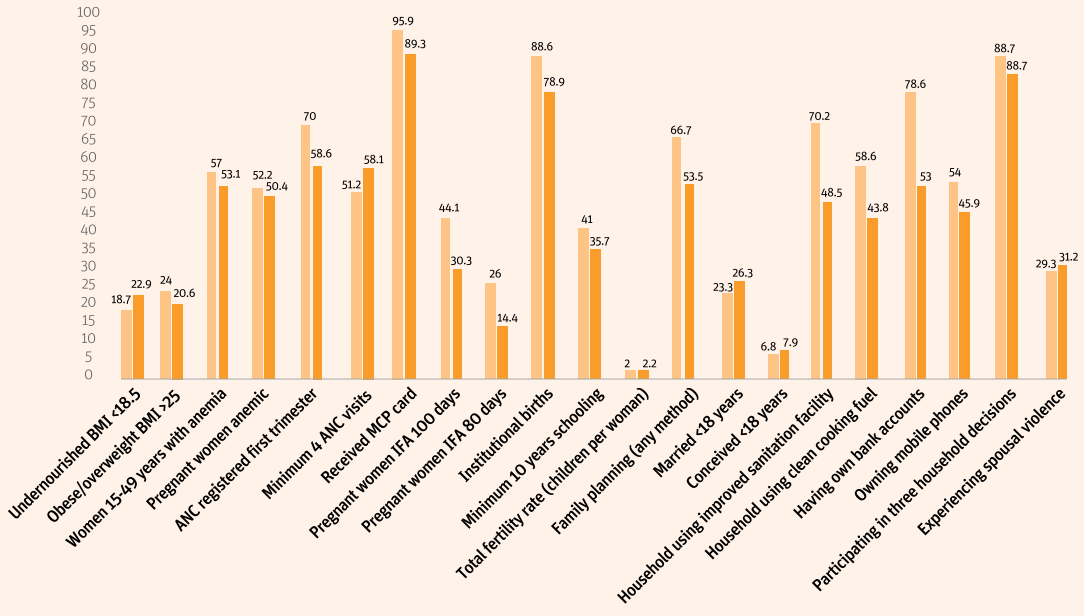
Iron-folic acid supplementation

IFA has gained substantial political visibility, leading to its active mainstreaming through Anemia Mukt Bharat (AMB) – the national flagship program to reduce the prevalence of anemia through a comprehensive strategy – in the antenatal care (ANC) package, with defined targets. The percentage of women consuming IFA tablets for a minimum of 180 days has nearly doubled, rising from 15% in 2015–16 to 26% in 2019–20. However, regrettably, 60% of anemic women are not included in the roll-out of the treatment dose of IFA tablets (two tablets per day for at least 180 days). Moreover, the information on the implementation of the treatment dose is not captured in the latest National Family Health Survey, and the constraints on its implementation should be challenged.

Mainstreaming nutrition interventions in the ANC package

Unlike the nutrition-sensitive interventions, there is an absence of a national policy for direct maternal nutrition interventions such as weight-gain counseling against body-mass index (BMI) measure, weight monitoring as part of the ANC care package, and institutionalizing regular diet-nutrition counseling.

FIGURE 1: Women's nutrition and status of determination of malnutrion: comparison of NFHS-5 (2019–21) with NFHS-4 (2015–16)



Source: IFPRI data note

Such a lacuna leads to poor integration of delivery of nutrition services with ANC, missing the opportunity of benefitting 7 out of 10 pregnant women registered for ANC in a timely manner. There is an urgent need to use the four (minimum) ANC contact points for delivery of direct nutrition services.

"Healthy diets and regular intake of nutrition supplements have a positive impact on birth outcomes"

Recent studies present evidence that improving consumption of healthy diets and regular intake of nutrition supplements has a positive impact on birth outcomes in undernourished women. It is imperative that we move away from the current excessive dependency on SNP. Mainstreaming nutrition interventions in the ANC package and using ANC contacts in both the public and private sectors, with the health sector taking the lead, is imperative if we are to make a difference to maternal and child nutrition in the first 1,000 days of life.

Maximizing linkages with existing interventions

We need to act now to implement a national multisectoral public policy on maternal diet and nutrition that addresses the gap in the availability of diversified foods for low-quintile women with limited resources. The POSHAN Abhiyaan (National Nutrition Mission) strategy refers to establishing POSHAN Vatikas (kitchen gardens), poultry and dairy-keeping. These interventions should be targeted at families with a member with first trimester ANC registration as well as beneficiaries of the government maternity benefit scheme. Moreover, the maternal nutrition policy should explore and articulate the scope of inclusion of fortified foods in the Public Distribution System (PDS) food basket, which is exclusively for those families with pregnant women. Such linkages with existing interventions have the potential to make a real difference.

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The Evidence Base

The First 1,000 Days: Opportunities and Gaps

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Women in India step into childbearing role with multiple disadvantages

In India, nearly 65,000 babies are born every day. Among these, 40% are born to women who are younger than 20 years.[1] Early motherhood competes with women's own development and compromises fetal and child growth,[2] and *that is strike one against optimal pregnancy and child outcomes*. Next, women in India enter pregnancy with poor nutritional status. Over half of the women of reproductive age are anemic, 19% are underweight and 24% are overweight or obese,[3] and *that's strike two*. Iron deficiency in the first trimester of pregnancy has serious consequences for birth size of the infant and perinatal mortality, and is likely associated with preterm delivery.[4] Similarly, women who are underweight before and during pregnancy are at higher risk of preterm birth and small-for-gestational-age babies, whereas those who are overweight are at higher risk of pre-eclampsia and gestational diabetes, and have greater chances of caesarean delivery.[5]

Nutrition continues to be important during pregnancy, and the goal during this period is to ensure healthy weight gain and to prevent or manage micronutrient deficiencies. Indian women's diet during pregnancy is suboptimal and is characterized by low energy, macronutrient imbalance and inadequate micronutrient intake [6,7] and *that's strike three*. For example, in 2016, only a third of the pregnant women in Bihar and more than half of the pregnant women in Odisha and Chhattisgarh achieved recommended dietary diversity scores (consumed ≥5 food groups in a day).[7] Along with poor diet quality, which has implications for healthy weight gain, more than half of the pregnant women are anemic[3], and *that's strike four*. Micronutrient supplementation during pregnancy can address nutrition deficiencies but only has modest effects on birth weight and does not influence child health outcomes.[8]

Healthy diets are a must during pregnancy

About 40% babies in India are born to women who are younger than 20 years

Lactation is yet another phase during the First 1,000 days, during which maternal and child nutrition are tightly interlinked. Maternal body-mass index and adiposity are positively associated with the nutritional value of milk,[9] which means that poor pre-pregnancy and pregnancy nutrition will affect the quality of milk. During the postpartum period, women's nutritional and physical health needs are greater than during pregnancy, along with the added stress of nourishing the newborn and the potential for postpartum depression. However, during this period, child health takes precedence over maternal health, and *that's strike five*. While interventions do exist for women during this period, focus shifts onto the infants, and their mothers become conduits for child nutrition. For example, child feeding becomes the focus of counseling during the lactation period, and it is a missed opportunity for promoting women's health, contraception and birth spacing, and for identifying mental health issues. The maternity benefit programs' conditionalities shift from women's care (e.g., antenatal care [ANC] check-ups) to fulfilling child-level care (immunization, for instance), thus turning the health system's attention to the child as well.

Taken together, these multiple strikes against women's nutrition and health create a perfect storm for poor reproductive health and pregnancy outcomes, and for child growth and development, with implications for multiple generations.[10]

Policies and programs for women in the first 1,000 days

On a positive note, there are policies and programs in place in India that include many globally recommended interventions aimed at preventing or managing the health and nutrition of women throughout their reproductive stages. All these interventions are delivered by the Ministry of Health & Family Welfare and the Ministry of Women & Child Development and present tremendous

opportunities for making significant gains in women's nutrition.

Preconceptions: To prevent anemia and iron deficiency among adolescent girls and women of reproductive age, the World Health Organization (WHO) recommends daily or intermittent iron supplementation[11] along with bi-annual deworming.[12] In India, under the most recent anemia-free India strategy (Anemia Mukt Bharat), launched in 2018, adolescent girls and women of reproductive age are expected to receive IFA supplements once a week and deworming tablets once every six months.[13] In addition, out-of-school adolescent girls between 11 and 14 years of age are entitled to food-based supplements or hot cooked meals [14] in some states. Together, these programs, if implemented well, offer opportunities for improving nutrition during adolescence as well as during the preconception period. There is, however, limited data available to assess the status of implementation as well as the coverage of interventions,[14] and without such data, it is indeed difficult to identify gaps and to address them.

Pregnancy: ANC, micronutrient supplementation, and counseling about healthy diet and balanced energy-protein food supplementation are the recommended interventions during pregnancy. These interventions are delivered through the national programs in India. However, not all women receive these interventions: only 58% received at least four ANC visits, 88% received IFA, but only 44% consumed IFA for 100 or more days, while only 31% took an intestinal parasite drug during pregnancy.[15] Being an adolescent, having low education, or belonging to the poorest economic group affected women's receipt of ANC.[16] Consumption of IFA was influenced by a varied set of factors including women's knowledge, self-efficacy, support from family, social norms, use of ANC, and receiving counseling.[17]

To help close the nutrient gaps in women's diets during pregnancy, India's Integrated Child Development Services(ICDS) program provides food supplements. But only 66.4% of women received food supplements during pregnancy, according to the National Family Health Survey (NFHS 5) for 2019-21.[15] Although over time receipt of food supplements has improved and reached marginalized groups such as historically disadvantaged castes and tribes, the poorest are still left behind, especially in the largest states, which carry the highest burden of undernutrition.[18] Also, there is nearly no information available on the consumption of food supplements. This calls for identification of reasons for variable reach across states and low reach among the poorest and most needy, along with learning about consumption patterns among those who are receiving food supplements.

In recent years, a new program involving the bundling of interventions – combining food supplementation with ANC, counseling and micronutrient supplementation services – has been implemented in a some states.[19] In some states food supplements to take home, hot cooked meals are provided to pregnant and lactating women at the community-level centers, along with other health and nutrition services. This program model has the potential to be used as an effective platform for delivering a combination of services to pregnant women; there is, however, limited research examining the program implementation and nearly no rigorous evidence on the impact of the program.[19] In the context of the rising number of overweight and obese women, and the decline in the number of underweight women,[3] it is time to revisit and critically review food-based interventions during pregnancy and their delivery modalities with an intent to implement approaches that take into account diverse population needs. At the same time, efforts are needed to address the constraints contributing to low-quality diets among pregnant women: food unavailability, poor economic situation, low exposure to nutrition counseling, food restrictions and taboos, adverse family influence, and gender norms.[7]

Women in India are also entitled to maternity benefits via a cash transfer program launched in 2017 to partially compensate for the loss of wages due to pregnancy and childbirth.[14] This program could encourage women to use health and nutrition services. For example, exposure to Mamata, a conditional cash transfer scheme in Odisha, was associated with coverage of ANC,[20,21] receipt of IFA supplements[20] and counseling for breastfeeding.[21] Maternity benefit programs, when implemented well, support pregnant wom-

Beneficiaries provided with THR through ICDS to help close the nutrition gap

en's nutritional and health needs. There is, however, limited data on the implementation, reach and timeliness of maternity benefit programs[14], precluding our understanding of the extent of use and effectiveness of such interventions.

Delivery and PNC: Institutional delivery, counseling to support breastfeeding, PNC for women and babies, and food and micronutrient supplementation are the interventions available through government platforms during this critical life-phase. To ensure skilled-birth attendance for women from vulnerable families, the Government of India's cash transfer program, Janani Suraksha Yojana, gives cash to those who deliver in healthcare facilities. There are programs to cover out-of-pocket expenses during delivery and treatment of sick infants (Janani Shishu Suraksha Karyakaram), and to promote health and nutrition under home-based care for newborn, and young childcare through visits by frontline workers. In 2019, nearly 90% of births were attended by skilled health personnel, 89% of women delivered at a health facility and more than 75% of mothers and children had received PNC.[3] Coverage of food supplementation was low at 63%;[15] only administrative data are available to assess the uptake of IFA and calcium supplementation during this phase.

Overall, opportunities exist under various government programs for improving maternal nutrition during the First 1,000 Days. Coverage varied by interventions across geographies needs further investigation. Critical data gaps pertaining to reach, utilization and the impact of interventions need attention. Evidence gaps exist in the realm of 'how' to improve the delivery of interventions with quality rather than 'what' to implement.

"Turn the spotlight on to the woman and commit to women's nutrition for women"

Conclusion

A paradigm shift is essential for strengthening maternal health – committing to women's nutrition for women. The premise for focusing on women's nutrition continues to be for improving child health and development. Therefore, more opportunities exist for improving maternal care during pregnancy than during the pre-pregnancy and postpartum periods. While there is a need to close the intent and implementation gaps for interventions during pregnancy, additional efforts are required to revisit the tenets of programming, measuring coverage of the interventions for women, identifying gaps in implementation, and finding ways to close them. Finally, a sharper and stronger focus on the preconception period, adolescent nutrition, delayed first pregnancy, and increased birth interval is essential to improving maternal nutrition in India.

Pregnant women receiving THR at Anganwadi centre

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Pregnancy Nutrition Assessment: A Question of Diagnostic Accuracy

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Introduction

The recent National Family Health Survey (NFHS-5) 2019–21 in India shows an improvement in most indicators related to maternity and delivery care, as well as in nutritional status of under-5 children in comparison with the NFHS-4 (2015–16) figures.[1,2] Though there is a reduction from 22.9 to 18.7 in the percentage of women (15–49 years) with below normal body mass index (BMI), i.e., <18.5 kg/m^2, there is also an increase from 20.6% to 24.0% in women who are overweight or obese with a BMI≥25.0 kg/m^2.[1,2]

The percentage of mothers having at least four antenatal care (ANC) visits has increased from 51.2% to 58.1%.[1] Nutritional assessment and counseling are carried out during these visits. However, anemia among pregnant women has climbed from 50.4% to 52.2% and from 53.1% to 57.0% among all women between 15–49 years.[1] This highlights the fact that more rigorous screening for anemia is required at all levels and that it should be taken more seriously during the ANC check-ups.

Currently, antenatal services in India include basic healthcare to screen for and prevent pregnancy-related complications. The services include the following: history-taking, clinical examination, two doses of tetanus toxoid, laboratory investigations including urine test to confirm pregnancy, assessing presence of sugars and proteins, blood investigations for hemoglobin estimation and blood grouping, including Rh factor, and rapid test for malaria, as well as nutrition interventions such as iron-folic acid (IFA) and calcium supplementation, deworming and supplementary nutrition to meet a third of the day's energy-protein needs.[3-6] Nutritional screening still needs more focus.

> **"Test, treat, talk strategy is needed for combating anemia at all levels"**

What needs to be assessed?

Preconception weight, height, BMI, weight gain during pregnancy, anemia (hemoglobin levels), gestational diabetes, and blood pressure are the most important nutritional parameters for pregnant women. The dietary intake of these women can also be a good indicator of their nutritional status. As is true for all age groups, the 'ABCD' methods – i.e., anthropometry, biochemical, clinical and dietary assessment methods – can also be used.

Where is the assessment conducted?

The assessment for pregnant women from disadvantaged sections is primarily conducted at primary health centers and sub-centers, maternal and child health centers, government hospitals, and community events such as Village Health Sanitation Day or Nutrition Day. Though, ideally, nutritional assessment should include the estimation of energy as well as all macronutrients and micronutrients, it is usually not feasible in the population setting. Therefore the status of nutrients that are of utmost concern is not determined.

Methods of assessment and diagnostic accuracy

Among the various methods for assessment of nutritional status of women during pregnancy, the anthropometric assessment is the most widely used at the population level, as it does not require too many resources and is likely to provide useful information.

The World Health Organization (WHO) recommends that nutritional screening for pregnant women should include taking pre-pregnancy BMI, height, weight gain and screening for anemia.[7] However, the national guidelines/programs only cover gestational weight gain and anemia. Height measurements are also not always taken.[8]

Weight gain during pregnancy is an important indicator of maternal nutritional status and fetal growth. As pre-pregnancy weight is generally not available, weight is recorded during the first ANC visit and thereafter to determine the weight gain during pregnancy. As per WHO 2016, women who are underweight at the start of pregnancy should gain 12.5–18 kg, women who are normal in weight should gain 11.5–16 kg, overweight women should gain 7–11.5 kg, and obese women should aim to gain 5–9 kg.[3]

Other than weight, the height of the woman may also be measured to determine the BMI during the first ANC visit. Among pregnant women, low BMI multiplies the risk of preterm birth, small for gestational age neonates, low birth weight (<2,500 g) and infant mortality.[9-12] There is evidence that mortality risk is twice as high among those who have a very low BMI (<15) as compared to those who have a high BMI (>35).[13] Prevalence of thinness (BMI between 18.49–16) or severe thinness (BMI<16) ranges between 2% and 41% among women in the reproductive age group (15–49 years) in India.[14-23] In spite of thinness being a major issue among pregnant

women, screening of maternal thinness is not optimally addressed in the public health and nutrition programs.[8]

Even though maternal obesity has adverse health outcomes for mothers as well as children, clear guidelines for screening of obesity during pregnancy and a standard definition of obesity in pregnancy are missing.[24] Moreover, the reliability of anthropometric measurements for estimation of obesity has been a challenge. Though BMI is often used for assessing obesity, it has poor sensitivity (47.7%) and positive predictive value (67.7%).[25]

There are more reliable measures for determining obesity, such as bioelectrical impedance analysis, deuterium dilution, dual energy X-ray absorptiometry, hydrostatic weighing, ultrasound, and magnetic resonance imaging, but these are costly and difficult to implement at the population level.[26,27] Due to various challenges associated with these methods, simpler anthropometric measurements/indices such as BMI and total skinfold thickness are used at the population level.[28] Though total skinfold thickness measurement is a quick, convenient and relatively inexpensive method across all age groups, there may often be high inter and intra-observer variations associated with it, and the method requires rigorous training and expertise.[29]

A recent prospective cohort study in Bengaluru reported that mid-upper arm circumference (MUAC) higher than 29.2 cm could serve as a suitable alternative for total skinfolds-based assessment for screening of obesity among pregnant women.[30]

MUAC is also an important indicator for assessing thinness.[31] Maternal weight and BMI have shown positive association with MUAC among pregnant women.[32] Various Indian studies on pregnant and non-pregnant women have suggested that MUAC <23 and <21 cm or <19 cm correlates with any form of thinness and moderate to severe thinness, respectively.[33,34] This also corresponds with Government of India guidelines on the management of undernutrition in pregnant women affected by tuberculosis.[35,36] Despite several advantages, MUAC is yet to be introduced for universal screening of thin and severely thin pregnant women.[8]

Some recent studies have indicated the use of neck circumference measurement for screening obesity. Patil et al suggested that neck circumference measurement was a cheap, socially acceptable, time-saving and less cumbersome method.[37]

Though biomarker assessment, in combination with other methods of assessment, can almost accurately determine the nutritional status of a pregnant woman, in most epidemiological studies involving large populations, the use of the Food Frequency Questionnaire (FFQ) is found to be more convenient and easier.[38,39]

None of the diet assessment methods such as 24-hour diet recall, diet history, FFQ and Weighed Food Record are considered gold standards for determining the nutritional intake of individuals.[40] It has been suggested that FFQ used during pregnancy can give a good estimate of the diet during that period.[41] FFQ can also help in identifying the risk of malnutrition at an early stage and initiating early corrective interventions.

"Close monitoring of the nutritional status of pregnant women at antenatal clinics is the need of the hour"

Rajarajeswari et al[42] developed an FFQ including 114 food items that were divided into seven groups, and the frequency of consumption of each item was given in the FFQ as per day, per week and per month, with the average consumption for each listed item. The authors later suggested that the FFQ was a realistic method for dietary assessment but that to get more accurate information, a concise questionnaire with pictorial representations and clues was required along with the use of a food atlas.

Micronutrient assessment mainly includes detection of anemia among pregnant women during the antenatal check-ups. This is done by estimating the hemoglobin level, and blood hemoglobin concentration below 11.0 g/dL denotes anemia among pregnant women. Various methods/devices, such as cyanmethemoglobin method, Sahli's method, WHO's Hemoglobin Color Scale and digital hemoglobinometers, can be used for estimation of hemoglobin.[43] Some of these methods used in community settings have limitations, ranging from lack of accuracy to high cost.[44,45]

Even the gold standard for hemoglobin estimation, the cyanmethemoglobin method has limitations such as time requirement, use of toxic reagents, and dependency on an operator.[46] Hemoglobin concentration is routinely measured using automated hematology analyzers. These are accurate and reliable, but expensive, and pose problems in transporting samples to the laboratory.[47]

Sahli's method of hemoglobin estimation is relatively inexpensive and easy to use, but also has it's disadvantages, such as subjectivity to visual color comparison, need for accurate pipetting, and low reliability. [37,50] Despite its limitations, in a developing country like India, it is the most common method used for hemoglobin estimation. It has a sensitivity of 83.7% and 90% and a specificity of 63.2% and 60.2% in capillary and venous blood, respectively.[37,]

From the perspective of developing countries, HemoCue has been suggested as a suitable method for initial screening of anemia, as it has the advantages of being reliable and portable without being dependent on power supply or extensively trained health workers.[50]

Digital hemoglobinometers are portable devices for measuring hemoglobin concentration that require little staff training. The devices also have high sensitivity (89.4%) and specificity (63.6%), and good diagnostic accuracy. Several digital hemoglobinometers have been tested. Some operational difficulties have been reported even with the newer ones, such as HemoCue 201+ and HemoCue 301.

For estimating hemoglobin in pregnant women, HemCue 201+ and HemoCue 301 have shown a moderate degree of agreement and concordance with the Sysmex autoanalyzer (considered to be the gold standard). The mean of difference in hemoglobin levels using HemoCue 201+ was - 0.53±1.01 and using HemoCue 301 was - 0.25±0.85 g/dL as compared to autoanalyzer. Sensitivity and specificity for detecting anemia was similar for both the devices. HemoCue 301 was found to have relatively better validity and reliability compared to HemoCue 201+ and has been suggested as a better point-of-care testing device.

Given that the incidence of vitamin D deficiency is high among pregnant women of Indian origin,[48,49] there is a growing interest to determine the impact of this deficiency on the offspring. Serum 25-hydroxy D concentrations were measured using radioimmunoassay and mothers were categorized as vitamin-D-deficient if they had serum concentrations of 25(OH)D<50 nmol/l. The study showed that 67% women had vitamin D deficiency, and the children born to these mothers had lower muscle mass and higher insulin resistance.

Conclusion

Close monitoring of the nutritional status of pregnant women at antenatal clinics is the need of the hour to ensure healthy pregnancy and a positive fetal outcome. Moreover, due efforts need to be made to include pre-pregnancy nutritional screening in the relevant adolescent and maternal interventions in the country. Trials to identify more accurate and feasible methods for determining the nutritional status of pregnant women in the community settings need to continue, so that nutritional issues among them can be identified at both an early stage and more accurately, to initiate prompt interventions to correct them.

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Leveraging the FIGO Nutrition Checklist

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Introduction

Improving nutrition in women before and during pregnancy has the potential to limit the cycle of suboptimal health and nutrition that can be passed across generations. Across India, there is vast variability in access to antenatal care (ANC), including nutrition. The International Federation of Gynecology and Obstetrics (FIGO) developed the FIGO Nutrition Checklist as a brief, evidence-based and validated nutrition assessment plus counseling tool. It can help healthcare providers when delivering nutrition assessments and providing advice on key issues. Here we discuss the FIGO Nutrition Checklist and how it can be applied in India to support action on maternal nutrition.

Reducing chronic disease

Globally, overweight or obesity-related chronic diseases are responsible for 4 million deaths annually, while up to 800 million people are undernourished, and at least 1 billion people are affected by micronutrient deficiencies.[1] The co-existence of high rates of undernutrition, overweight/obesity and micronutrient deficiencies presents a triple burden of malnutrition. This is a significant concern for mothers and their children in India.[2]

Status of maternal nutrition in India

In India, data from the Consumption Expenditure Survey of a nationally representative sample from urban centers and villages found limited intakes of fruits, vegetables, legumes, meat, fish and eggs in mothers.[7] In India, 24% of women have a body mass index (BMI) ≥25 kg/m², and the prevalence exceeds 40% in some regions.[8] Women with obesity have a higher risk of adverse maternal and child outcomes such as gestational diabetes, preterm births and large-for-gestational-age babies.[9-11] In addition, women with low BMIs are at an increased risk of complications.[12] Current estimates suggest that as many as 18.7% of women of reproductive age in India have a BMI <18.5 kg/m² and 57% have anemia.[8,13] Beyond treatment of anemia, improving maternal nutrition can prevent complications such as gestational diabetes mellitus or perinatal death, and can positively influence infant birth weight.[16-23] While the available evidence highlights the benefits of nutritional interventions during pregnancy, access to care is not

> **"57% of women of reproductive age in India have anemia, and access to care is not universal"**

Opportunities to improve nutritional status before and during pregnancy

Initiatives associated with POSHAN Abhiyaan aim to improve the nutritional care of mothers through programs such as the provision of food, nutrition supplements or cash transfers to women.[24,29,30]

A recent study in West Bengal found that only 18% of women interviewed had discussed nutrition with their obstetrician, and even fewer with a health worker.[31] Further action is needed to build capacity amongst antenatal healthcare workers in India to improve maternal nutrition.[24,25] They can leverage the contact they have with women throughout pregnancy to improve dietary intakes and support healthy gestational weight gain.[32] Use of existing antenatal health services and upskilling of the healthcare providers who care for pregnant women has the potential to address the accessibility issue with minimal impact on costs.[33]

More information on current weight, dietary intakes and micronutrient status is needed to guide appropriate nutrition counseling.[34] UNICEF recently launched treatment algorithms for antenatal providers. In these algorithms and the WHO guidelines for a positive antenatal experience, nutrition assessment is recommended for all women during pregnancy.[16,35,36] Most indices of the quality of diet rely on the collection of lengthy dietary information, with the use of tools such as a food frequency questionnaire.[37]

> **"The Checklist captures information on special diets, maternal BMI, diet quality and micronutrients"**

FIGO Checklist at work

While helpful for risk assessment and screening, the comprehensive algorithms discussed above may not be widely usable in busy clinical settings. However, the American College of Obstetrics and Gynecology (ACOG) recommends the development and use of more clinical checklists in obstetrics and gynecology.[38] The FIGO Nutrition Checklist [39] was created in 2015 by members of the FIGO initiative on adolescent, preconception and maternal nutrition. The content of the FIGO Nutrition Checklist is evidence-based, informed by the FIGO 'Think Nutrition First' guidelines and the US Institute of Medicine guidelines for gestational weight gain.[40] It captures information on special diets, maternal BMI, diet quality and micronutrients.[41] The aspects of diet quality assessed include intake of meat or chicken, fish, dairy, wholegrain carbohydrates, fruit and vegetables, packaged snacks, confectionary, or sugar-sweetened beverages.[42] The back of the printed Checklist provides evidence-based information for the healthcare provider.[43]

Previous evaluations of the FIGO Nutrition Checklist have shown promising results. Looking at the diet quality component alone, Tsoi et al found that 95% of the women in Hong Kong who completed the FIGO Nutrition Checklist reported at least one suboptimal dietary practice that could put them at nutritional risk for their pregnancy.[44] In Dublin, Killeen et al found that over 80% of the women completing the Checklist reported at least one diet quality nutritional risk and 16% reported three or more out of six potential issues.[41] Killeen et al also included obstetricians in their study and found that two of the three agreed that the checklist encouraged them to address nutrition as part of their standard care.[41] Most pregnant women in the Dublin study found the FIGO Nutrition Checklist quick and easy to complete and recommended it for use.[41] Tsoi et al sought to validate it as a nutritional assessment tool in pregnancy.[44] In Hong Kong, the authors found that the Checklist correlated with a validated food frequency questionnaire and diet quality including the Dietary Approaches to Stop Hypertension (DASH) and the Mediterranean Diet scores.[45] This supports the validity of the brief dietary assessment provided by the FIGO Nutrition Checklist compared to more robust tools.

FIGO Checklist in the Indian context

The FIGO Nutrition Checklist is validated and acceptable for use.[41,44] The next step is to support its implementation globally, particularly in regions such as India. However, embedding a new resource into clinical practice requires committed champions and support from senior management.[46] The FIGO Pregnancy Obesity and Nutrition Initiative (PONI) aims to bring the FIGO Nutrition Checklist to the frontline of ANC.[32] The FIGO PONI team has been awarded funds to advance the tool to an online offering that will support its widespread adaptation and adoption.[47] To achieve greater reach, the FIGO PONI team invites readers to consider implementation of the FIGO Nutrition Checklist in their practice and encourage translation and regional adaptation. While the Checklist is based on the standard Western diet, it can be adapted to suit regional differences. In Italy, for example, Parisi et al modified it to align more closely with the antenatal dietary guidelines of Italy. The authors found that scores were associated with outcomes such as pregnancy-associated plasma protein A and placental volume.[48] While the FIGO Nutrition Checklist is suitable for use in India in its current format, local modification may further enhance its regional utility.[24,49] For example, vegetarian sources of nutrients that meat, poultry, fish, and eggs typically provide – such as legumes, dried beans, millet, soybeans, nuts and dried fruits – could be added to it.[50] This adaptation would support health workers in addressing nutrition with a significant proportion of the Indian population who follow a vegetarian or vegan diet.[24,50,51] An additional question on micronutrients such as calcium could also be added.[35,36]

Conclusion

The FIGO Nutrition Checklist is a practical resource that can support health workers in assessing and treating nutritional issues, and it can be adapted to meet region-specific needs.[41] Adding it to the current resources and programs aimed at improving maternal nutrition as part of routine ANC practice may support accelerated progress on this key health priority. Localization of its use and documentation of how it is beneficial to tailor counseling may be useful. Program effectiveness of this Checklist is warranted in a cross-country context.

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Relevance of the New ICMR-NIN Nutrient Requirements Guidelines for Anemia

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Introduction

Anemia caused by iron deficiency in pregnant women continues to be a public health concern globally. In India, the universal pharmacological iron and folic acid (IFA) supplementation to pregnant women has not led to a significant reduction in the prevalence of anemia, which, in 1998–99,[1] was at 49% according to the National Family Health Survey (NFHS)-2 and is currently at 52.2% (NFHS-5).[2] The policy response to the widespread presence of anemia continues to be 'supplying more iron' through fortified foods, in addition to oral/parenteral IFA supplements.

However, as per the 2020 guidelines on nutrient requirements for Indians by the Indian Council of Medical Research–National Institute of Nutrition (ICMR–NIN)[3], the iron requirements of pregnant women as well as other age/physiological groups are estimated to be lower than what the previous guidelines recommended. It is therefore necessary to examine the iron supplementation through various programs in light of the revised requirements.

> **"The iron requirements of pregnant women are estimated to be lower than what the previous guidelines recommended"**

Herein we aim to review the unique biology of iron during pregnancy and evaluate the supplemental IFA dosages provided to beneficiaries through multiple ongoing programs against the background of the new guidelines by the ICMR–NIN. We believe that this will stimulate discussion about the need for re-evaluating some of the anemia control programs in view of the potential adverse implications for maternal and fetal well-being of supplying higher-than-required iron dosages during pregnancy.

Maternal hemoglobin and birth outcome

Substantial evidence shows that the relationship between maternal hemoglobin and birth outcomes (including low birth weight or LBW and preterm birth or PTB) follows a 'U'-shaped curve with worse outcomes at the lower and higher ranges of maternal hemoglobin concentrations. In a large study across different racial-ethnic groups in the United Kingdom, the lowest incidence of LBW was observed at maternal hemoglobin concentrations of 9.5–10.5 g/dL.[4] A recent study from Bangladesh also showed the association of high plasma ferritin in the third trimester with LBW.[5] This relationship, however, varies depending upon the gestational age at the time of measuring maternal hemoglobin. Maternal anemia in the first trimester is consistently associated with LBW and pre-term birth (PTB), whereas this relationship is not seen in the second and third trimesters. Many studies have shown higher hemoglobin during the last two trimesters to be associated with LBW and inconsistent associations with other outcomes such as PTB, small-for-gestational-age babies, and stillbirth.[6,7]

A number of mechanisms are implicated as responsible for the adverse effects of high iron status on birth outcomes. Higher hemoglobin may lead to insufficient plasma volume expansion, apart from causing increased blood viscosity and compromised placental blood flow.[6] Moreover, higher circulating non-transferrin-bound iron can cause lipid peroxidation and DNA damage of placental cells.[9] Excess iron can also impair systemic response to infections and inflammation, alter the gut microbiome and increase risk of copper and zinc deficiency, with adverse implications for birth outcomes.[9-11]

Anemia thresholds and prevalence

The World Health Organization (WHO) recommends a single hemoglobin cut-off to identify anemia in pregnancy,[12] although physiological plasma volume expansion in the second and third trimesters leads to lowering of hemoglobin concentration irrespective of iron status. Gestational age-specific hemoglobin thresholds

are therefore desirable to avoid overestimation of anemia prevalence and burden. There is also an ongoing debate on the need for separate hemoglobin thresholds for different racial and ethnic groups.[13] Recently, gestational age-specific normative hemoglobin centiles have been computed using the INTERGROWTH-21st study data among 3,502 pregnant women from urban areas in eight countries including India, who had and who had uncomplicated pregnancies and received optimal antenatal care (ANC). The ≥10th centile was considered as the normal hemoglobin and <3rd centile as the cut-off for low hemoglobin.[14] The hemoglobin estimation was done at all sites using venous blood sample by reliable automated methods. The threshold defined for normal hemoglobin in the first trimester is close to the current WHO cut-off for anemia (<11 g/dL), but the values for the second and third trimester are lower by 0.5–1 g/dL. Using these threshold values, the prevalence of anemia in pregnant women is likely to be much lower than the current estimates from the NFHS-5 survey. Furthermore, multiple studies have also reported overestimation of anemia in capillary blood samples used in the NFHS surveys, and the correction of blood-sample-related bias (≈ 0.5 g/dL) may lead to downsizing of anemia prevalence by 15–25 pp in women and children in India.[15]

> **"The unique biology of iron during pregnancy increases the risk of adverse effects related to excess iron"**

Biology of iron during pregnancy

Due to the absence of obligatory excretory mechanisms, the whole-body iron homeostasis is achieved solely via regulating intestinal absorption of iron. It is well known that iron absorption from foods increases two-to-three-fold during the second and third trimesters.[16] Moreover, hepcidin, an iron regulatory hormone that blocks intestinal iron absorption in the state of iron sufficiency, is partially suppressed during pregnancy.[17] There is evidence that maternal hepcidin also blocks placental iron transfer.[18] Therefore, the suppression of hepcidin may be needed for optimal iron transfer to the fetus. Interestingly, maternal hepcidin levels remain relatively unperturbed by iron supplementation, and substantial iron absorption may occur even in iron-replete pregnant women.[19] This unique biology of iron during pregnancy increases the risk of adverse effects related to excess iron in pregnancy.

Adverse effects of iron supplementation

Currently, WHO recommends supplementation of 60 mg/day iron in pregnancy in areas where anemia is a severe public health problem (prevalence >40%). This is based on a systematic review in 2012 which showed that iron supplementation reduced risk of LBW by 19% as well as maternal anemia and iron deficiency at term.[20] However, updated evidence showed lower benefit (with borderline statistical significance) of iron supplementation on LBW, with no benefit for other birth outcomes.[21] Routine iron supplementation in non-anemic, well-nourished pregnant women has been questioned by some researchers, as it may result in significant increase of reactive oxygen species and lipid peroxidation.[8] Further, evidence suggests that the supplemental intake of high-dose iron in iron-replete pregnant women may also be associated with negative consequences such as LBW, preterm birth and an increased risk of gestational diabetes.[22] In a cohort of 1,196 non-anemic pregnant women from South India who were prescribed 45 mg of elemental iron per day, women in the highest tertile of supplemental iron intake (>39.2 mg/day) had an increased risk of having term LBW babies compared to those in the lowest tertile (-36.6 mg/day) (adjusted risk ratio: 1.89; 95% confidence interval: 1.26, 2.83).[23]

Revised iron requirements

The physiological iron requirements in pregnancy are computed using a factorial approach by summing up components of iron loss from body and additional iron required to support fetal and maternal tissue growth, including expansion of hemoglobin mass. The estimates of nutrient requirements are periodically revised as knowledge advances and new information becomes available. The previous ICMR–NIN committee in 2010 provided a single value of recommended dietary allowance (RDA), which is the 97.5th percentile of the distribution of requirements.[24] This value defines the requirement of an individual where the risk of inadequate intake is very low. The revised requirements published in 2020 provide additional metrics apart from the RDA: estimated average requirements (EAR; reflects the average requirement of population) and tolerable upper intakes (TUL; derived from the toxicological framework representing the highest level of daily intake that is not likely to pose risk of adverse health effects for most individuals).[3] The comparison of previous and current recommendations is outlined in **Table 1**. The differences in the nutrient requirements estimated in 2010 and 2020 are related to the fact that the previous recommendation based on the iron loss did not consider the variance of the iron loss, nor of the body weight for individuals in a population. Robust methods have been used to arrive at estimates of EAR, RDA and TUL for pregnant women, considering pre-pregnancy body weight of 55 kg (coefficient of variation=15.6%), gestational weight gain of 10–12 kg, and increased dietary bioavailability of iron in pregnancy (12% vs 8% in non-pregnant state). The resultant estimated requirements are much lower than the previous recommendations (35 mg/day as per previous guidelines vs 21 mg/day as per recent guidelines).

Dietary inadequacy of iron

Previous estimates of dietary nutrient inadequacy or nutrient gap were computed against the RDA, which exceeds the requirement

TABLE 1: Differences between 2010 vs 2020 recommendations for iron by ICMR

Variable	Requirement calculations 2010	Requirement calculations 2020
Requirement	Single requirement value of 35 mg/d was calculated	EAR and RDA were calculated
Basal loss	14 µg/kg, no CV	Basal loss with CV 14 µg/kg, CV 29.2%
Body weight	Calculated for a single value of body weight (95th percentile of pre-pregnancy weight of 55 kg)	CV of body weight considered 55 kg, CV 15.6%
Absorption factor used	8%	12%
Gestational weight gain	Gestational weight gain 10 kg and 12 kg	Gestational weight gain 10 kg, CV 5.8%, and 12 kg, CV 5.8%
Iron requirement	Single value of requirement: 2.8 mg/d	Requirement range from 2.31–2.41 mg/d (for 10 kg weight gain) 2.49–2.61 mg/d (for 12 kg weight gain)
Recommendation	Single recommended value of 35 mg/d	Trimester-wise EAR and RDA for 10 kg and 12 kg weight gain
TUL	Not presented	Presented

EAR or Estimated Average Requirement; RDA or Recommended Dietary Allowances; CV or Co-efficient of variation; TUL or Tolerable upper limit.

of 97.5% of the population, resulting in overestimation of the prevalence of inadequate intakes. The new guidelines for the first time provide values of EAR, which is an appropriate metric for measuring population-level nutrient inadequacy. Calculating the risk of inadequate dietary intake requires comparing the distribution of intakes and requirements. Where the nutrient intake data are normally distributed, the proportion of population with intakes below the EAR reflects the level of inadequacy. When the data is skewed, application of EAR to the distribution of nutrient intake in the population using the probability method is recommended to assess the prevalence of inadequate intakes.[3,25]

Using the iron intake data from the National Nutrition Monitoring Bureau (NNMB) urban survey, which is skewed (geometric mean ± SD: 11.9±1.5 mg/day),[25] the estimated dietary inadequacy against requirement distribution among pregnant women is 91%. However, in a hypothetical setting where all the population meets their individual requirements, the computed adequacy or inadequacy against EAR will be 50%,[3,27] and thus the effective dietary inadequacy of iron intakes in Indian pregnant women translates to 41% (91–50%). Therefore, the additional dosage of iron that needs to be supplemented (through all approaches) should aim to reduce the inadequacy levels from the current 91% to 50%. The calculated additional iron requirement to reduce the population inadequacy to 50% is 9.5 mg/day, while additional iron supplementation needed to achieve the inadequacy of 25% and 5% will be 13 mg and 16.5 mg/day, respectively. However, at 13 mg and 16.5 mg/day additional iron intakes, the proportion of subjects exposed to excessive iron intake beyond the TUL will be about ~0.6 to 2%, which translates to large numbers **(Table 2).**

TABLE 2: Targets for reduction in inadequate iron intake and the projected excess from the TUL (pregnant women, based on NNMB 2016 data, N=320)[26]

Variable	Addition of excess iron required (mg)	% of population above TUL
Level of inadequacy 50%	9.5	0.3
Level of inadequacy 25%	13.0	0.6
Level of inadequacy 5%	16.5	1.9

Estimated requirements vs iron supplemented

Although the additional iron requirement for pregnant women as per the above estimations is only about 9.5 mg/day, currently, as per the Anemia Mukt Bharat (intensified iron-plus initiative) program, 60 mg of iron/day is provided to pregnant women and a larger dose of 120 mg/day is given to anemic women.[28] The additional iron contributed by the intake of fortified salt (10 g/day) and fortified rice (200 g/day) will be about 10 mg and 8 mg, respectively. Thus the supplemental iron dosages through multiple programs are much higher than those needed to bridge the nutrient gap. The estimated proportion of women consuming iron in excess of TUL will thus be significantly high if multiple program are implemented simultaneously in same population.[29]

Conclusion

Iron supplementation for pregnant women is guided by studies focusing on increment in maternal hemoglobin rather than birth outcomes.[30] The available knowledge on favorable birth outcomes at a hemoglobin range of 9.5–10.5 g/dL and the adverse impact of iron supplementation in non-anemic iron-replete women on maternal and birth outcomes prompt us to reconsider the current strategies of multiple supplementation approaches. The lower hemoglobin cut-offs identified by the INTERGROWTH-21st study, which included women who had optimal ANC, also need to be noted. Instead of the current 'one-size-fits-all' approach, a more precise 'screen, test and treat' approach needs to be implemented in order to minimize harm while maximizing benefits. Dietary approaches promoting diversity and food synergies, which provide multiple nutrients safely, should be prioritized.

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Why We Need to Address Maternal Thinness and What We Need to Do

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Background

Studies have shown that children born to mothers who are short, too young, thin or anemic are more likely to experience intra-uterine growth restriction (IUGR), and to be born preterm, small for gestational age (SGA) or with low birth weight (LBW), and be stunted. These mothers are also at a greater risk of dystocia (difficult labor) and hemorrhage.[1,2] The prevalence of LBW is highest in Asia, predominantly because of undernutrition of the mother prior to and during pregnancy.

There are qualitative differences in dietary requirements during early and late pregnancy, with micronutrients and proteins being required in early pregnancy, and calories and other nutrients later. A paradigm shift – from efforts to improve size at birth to efforts to improve fetal growth and development – might provide fresh insight into the problem.

Micronutrient deficiencies during pregnancy have serious implications on the developing fetus. Nearly half the pregnant women in Asia still suffer from varying degrees of anemia, with the highest prevalence in India, which also has the highest number of maternal deaths in the region. Of specific concern are compliance with iron supplementation, cultural beliefs regarding diet in pregnancy, and the issue of nutrition supplementation and fortification. The coexistence of risk of LBW or IUGR associated with essential fatty acid docosahexaenoic acid (DHA) and vitamin B_{12} intake or status observed in the Indian sub-continent also requires further examination.[3]

> **"Micronutrient deficiencies during pregnancy have serious implications"**

According to the World Health Organization (WHO), underweight in women is mild when body mass index (BMI) ranges between 17.00 and 18.49 kg/m^2, moderate between 16.00 and 16.99 kg/m^2 and severe <16 kg/m2.[4] Approximately 19% of Indian women of reproductive age (15–49 years) are underweight, with BMI of <18.5 kg/m2.[5] Children under five years with severe acute malnutrition (SAM) in India are 8% (NFHS 5, 2019–2021)[5] and the factors responsible for SAM in children are directly and indirectly related to maternal factors such as maternal malnutrition, poverty, food insecurity, ignorance, illiteracy, lack of empowerment, lack of awareness about appropriate infant and young child feeding practices, and poor hygiene and sanitation. Moreover, one of the review studies on the nutritional status of pregnant and lactating women showed that women in developing countries consumed only two-thirds of the recommended daily intake of energy and that their average weight for height was, in most cases, well below the 50th percentile for small-framed women in developed countries.[6]

Thus, lack of emphasis on maternal nutrition is unacceptable given the importance of nutrition to women's health, pregnancy outcomes, and child survival. There is a need to implement effective nutrition-related programs for women in the reproductive age group.

Implementation of maternal nutritional services in nutritional rehabilitation centers

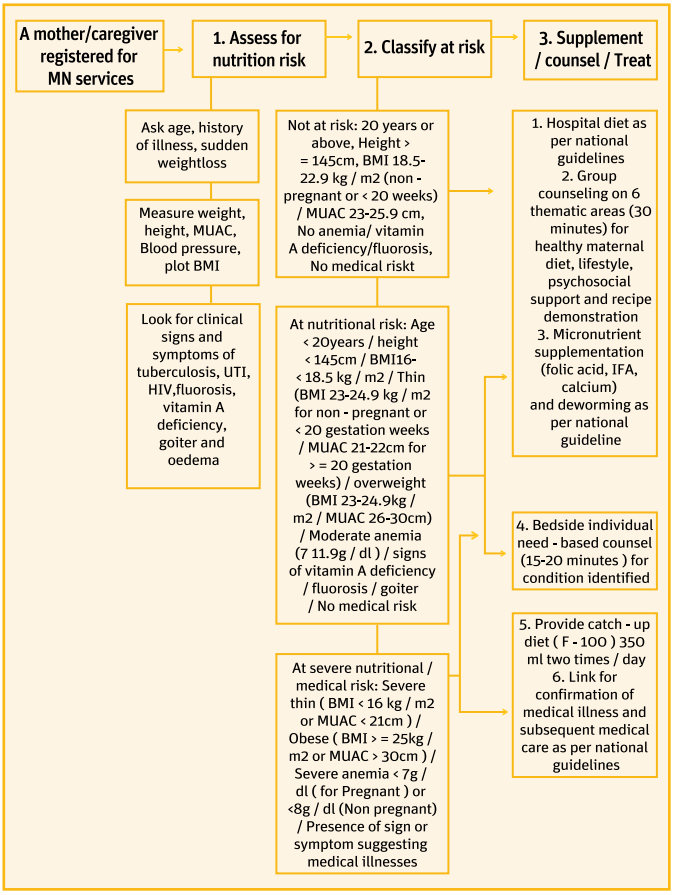
Currently, India has 1,151 functional Nutrition Rehabilitation Centers (NRC), set up by the Government of India (GOI) under the Ministry of Health and Family Welfare (MoHFW) to provide in-patient care for medically complicated children with SAM.[7] As part of in-patient care, mothers/caregivers stay with admitted children for the complete duration of the treatment. Most of these mothers/caregivers admitted to the NRCs are also malnourished and suffer from medical complications. We used this opportunity to develop and pilot a package of nutritional services for mothers.

First, we conducted a study between September 2016 and November 2017 in four NRCs (three located in Delhi [Kalawati Saran Children's Hospital, Hindu Rao Hospital, and Bhagwan Mahavir Hospital] and one in Aligarh (Jawaharlal Nehru Medical College and Hospital, Aligarh Muslim University) to determine the nutritional status of mothers. Of the 427 mothers assessed, 25% were low in stature (stunted, height <145 cm) and 44% were malnourished either by BMI or mid-upper arm circumference (MUAC). By BMI, 23% were underweight (BMI <18.5kg/m^2) and 5% were severely underweight (BMI <16 kg/m^2). By MUAC, 41% were malnourished (MUAC <23cm) and 3.5% were severely malnourished,(MUAC <19cm). Overweight or obesity was also documented in 27% (by Asian cut-off, BMI ≥ 23 kg/m^2) and 17% (by WHO cut-off, BMI ≥25kg/m^2).[8]

This was followed by developing an algorithm **(Figure 1)**, contextualizing, pre-testing and presenting a maternal service package to GOI. Briefly, the maternal nutrition (MN) service package included the following services:

1. Assessment of nutritional status through measurement of weight, height, MUAC, blood pressure, blood sugar, hemoglobin and examination of clinical signs and symptoms following standard protocols.
2. Classification of risk category (nutrition risk/medical risk) based on the assessment.
3. Provision of nutrition health education and counseling (group-based/individual-need-based) and interventions, referral and treatment of medical illnesses.[9]

FIGURE 1: Maternal service package algorithm



Source: *Sethi V, Kumar P, De Wagt A. Field Exchange issue 59, January 2019*

Screening for malnutrition included parameters by the Ask – Measure – Look for – Test – Classify approach to detect those at nutrition risk/severe nutritional risk/medical risk:

- Short (Height <145 cm).
- Young (Age <20 years).
- Thin (BMI <18.5 kg/m^2 [<20 weeks gestation for pregnant women] or MUAC <23 cm) as well as those with MUAC <21 cm for additional food supplementation.
- Overweight (BMI 23–24.9 kg/m^2 [<20 weeks gestation for pregnant women] or MUAC >26 cm and Obese (BMI ≥25 kg/m^2 [<20 weeks gestation for pregnant women] or MUAC >30 cm).
- Inappropriate gestational weight gain (<1 kg or >3 kg/month, after the first trimester in pregnancy).
- Anemic (Hemoglobin <11 g/dl for pregnant women and <12 g/dl for lactating women).
- Any other medical risk (presence of any symptoms including fever, cough, blood in sputum, increased urinary frequency/burning during urination, recurrent or prolonged illness, clinical sign of goiter or fluorosis or vitamin A deficiency (night blindness, Bitot's spot), oedema (Grade +, ++) for post-partum women, etc.).
- Testing: Hemogram, Fasting blood glucose.

Based on screening, mothers were classified as belonging to three action-based, color-coded categories **(Boxes 1 to 3):**

BOX 1:

Not at nutritional risk. All of the following:

- Age ≥ 20 years.
- No signs of malnutrition (height ≥150 cm and BMI 18.5–22.9 kg/m² if not pregnant or less than 20 weeks of pregnancy; if over 20 weeks pregnant, use MUAC 23–25.9 cm).
- No anemia (≥12 g/dl non-pregnant and ≥11 g/dl for pregnant).
- No medical risk.

BOX 2:

At some nutritional risk. Any of the following:

- Young (age 18–20 years).
- Short (height 145 – <150 cm).
- Thin (BMI 16.0 – <18.5 Kg/m² if not pregnant or less than 20 weeks of pregnancy or MUAC 19–22.9 cm if over 20 weeks pregnant).
- Overweight/pre-obese (23–24.9 kg/m2) if not pregnant or less than 20 weeks.
- Pregnant or MUAC 26–30cm if over 20 weeks pregnant).
- Mild/moderate anemia (hemoglobin 7–10.9 g/dl (pregnant) / 8–11.9 g/dl [non-pregnant]).

BOX 3:

At severe nutritional risk / medical risk. Any of the following:

- Very young (age <18 years) or very short (height <145 cm).
- Severely thin (BMI <16.0 kg/m² if not pregnant or less than 20 weeks pregnant or MUAC <19 cm if over 20 weeks pregnant).
- Obese (BMI >25 kg/m2 if not pregnant or less than 20 weeks pregnant or MUAC >30 cm if over 20 weeks pregnant).
- Severe anemia (hemoglobin <8 g/dl if not pregnant or <7 g/dl if pregnant).
- Presence of symptoms/signs suggesting medical illnesses, including:

- Fever with chills ≥3 days , cough >2 weeks/ blood in sputum, urinary complaints, recurrent or prolonged illness, signs of goiter, vitamin A deficiency or fluorosis, raised blood pressure, raised fasting blood sugar.

"There is a need to increase awareness of the importance of assessing the nutritional status of women in reproductive age groups"

All the mothers, irrespective of nutritional status, were provided with a hospital diet as per the Operational Guidelines on Facility Based Management of Children with SAM (MoHFW, 2011) and the Janani Shishu Suraksha Karyakaram (JSSK) diet guidelines (MoHFW 2018). They were also given IFA and calcium supplements as per national guidelines. As per GOI guidelines, mothers in the second trimester of pregnancy were provided with a single, oral-dose deworming tablet (400 mg of albendazole) if not already provided elsewhere. Daily group counseling was extended by 30 minutes for five days per week using counseling aids, covering one of five thematic areas per day (micronutrients and anemia; diet diversity; personal hygiene and sanitation; breastfeeding and family planning; and non-communicable and communicable diseases, including TB, HIV, malaria, obesity, hypertension and diabetes).

Along with universal interventions, mothers with some nutritional risks were provided with an extra 15 minutes bedsides counseling and live demonstration sessions based on four local recipes. Many of these mothers also have other signs of underlying illness (such as TB), and such cases were directed to other departments for treatment. Obese mothers were provided with counseling about physical exercise and given a recipe book tailored to obesity. Very young mothers were given additional counseling on family planning, and very short mothers were counseled about diet and family planning.

A follow-up study, conducted at NRC, KSCH, New Delhi on the implementation of the package developed with the participation of 168 mothers from January to August 2019, reported that the nutrition counsellor found the MN package useful in the assessment, classification and management or referral of beneficiaries. They were also able to deliver services without any challenges, drawing on the available health workforce, logistics, drugs and supplies, and trainings. The nutrition counselor was able to screen and classify one mother within 30–35 minutes, provide group counseling to mothers in about 30–45 minutes, and offer individual counseling to one mother who is at risk in about 15–20 minutes. They found that all the mothers were provided with the hospital diet, group based nutrition education, and counseling for five days a week. Additionally, 89% who had any one nutritional or medical risk received extra interventions such as bedside individual needs-based counseling, and nine (5.4%) severely thin mothers (either with MUAC or BMI) received 350 ml of catch–up diet. All equipment such as weighing machine, stadiometer, MUAC tape, non-stretchable tape and blood pressure monitor was available and fully functional at the time of the interviews.[10]

"A package of services to identify and address nutritional risk for women can be integrated into existing platforms"

What more needs to be done?

Comprehensive maternal nutrition assessment to identify women at nutritional risk during ANC, HBNC and HBYC visits

There is a need to increase awareness of the importance of assessing the nutritional status of women in reproductive age groups. There is also a need to improve the availability of a standard algorithm and toolkit at facility and community level to screen, classify and supplement/counsel/treat women at nutritional risk; however, roll-out of the algorithm and counseling toolkit across all levels has not yet been undertaken in the country. The COVID-19 pandemic has disrupted maternal services in many states. Every attempt should be made to restore it and to provide a special service package for women with low BMI in the form of diet and food habit assessment, as well as counseling regarding the appropriate diets and food supplements.

Nutrition counseling

Nutritional education and counseling for all women may help in improving dietary diversity. It is important to use all existing government platforms and contact points to integrate nutritional counseling.

More research

To address maternal thinness, more implementation research is needed in order to facilitate the adjustment of the standard service delivery package promoting a combination of preventive and curative innovative interventions.

Experience has thus shown that a package of services to identify and address nutritional risk for women, including maternal thinness, can be integrated into existing platforms. Such an experience in facility-based care has been described. Such a package is now ready to be taken forward in multiple settings.

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What Can Be Done to Address Maternal Obesity?

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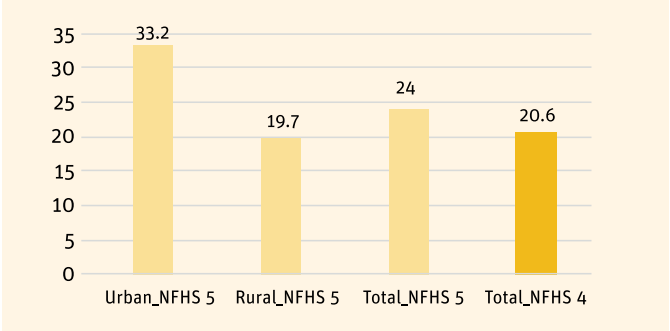
Background

Estimates suggest that 20% of all women will be obese by 2025 – an alarming statistic, particularly considering that obesity during pregnancy increases the risk of lifelong health problems in children, including obesity, type 2 diabetes, and heart disease,[1,2] feeding into the inter-generational cycle of malnutrition. In India, 24% of women were overweight or obese in 2019, up from 20.6% in 2015–16 **(Figure 1)**. The proportion is greater in urban areas at 33.2%, in comparison to 19.7% in rural areas. The obesity and overweight among all women in age-groups 20–49 years have increased too **(Figures 2a and 2b)**.

In obstetric populations, the Royal College of Obstetricians and Gynaecologists[3] defines maternal obesity as BMI ≥ 30 kg/m^2, similar to the general population. The National Institute for Health and Care Excellence (NICE), UK, antenatal care guidelines recommend that maternal height and weight should be measured for BMI measurement in pregnant women by 10 weeks of gestation.

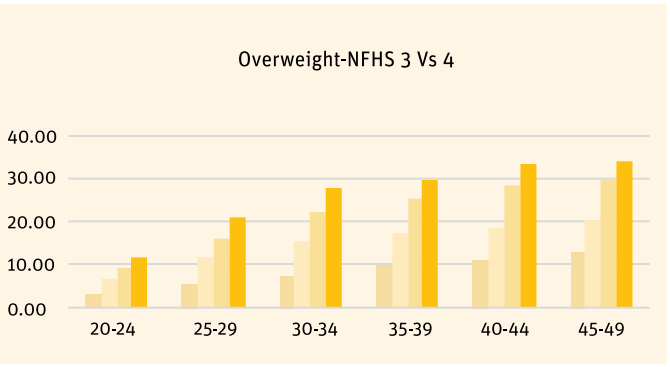
FIGURE 1: NFHS-5 Overweight or obese (BMI ≥25.0 kg/m^2)



NFHS, National Family Health Survey; NFHS-5 conducted in 2019–2021; NFHS-4 conducted in 2015–16

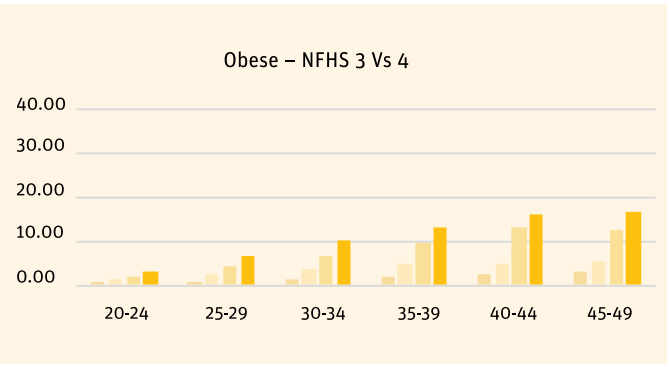
> **"Estimates suggest that 20% of all women will be obese by 2025"**

FIGURE 2a: Prevalence of overweight by age-group for NFHS-3 and NFHS-4 survey

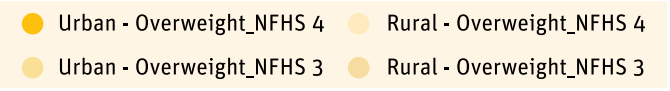


NFHS, National Family Health Survey; NFHS-4 conducted in 2015–16; NFHS-3 conducted in 2005–06

FIGURE 2b: Prevalence of obesity by age-group for NFHS-3 and NFHS-4 survey



NFHS, National family health survey; NFHS-4 conducted in 2015-16; NFHS-3 conducted in 2005-06



The determinants of maternal obesity

1. Sociodemographic and obstetric characteristics: Research shows that older and multiparous women as well as those belonging to ethnic minority groups are at a higher risk of becoming obese. These racial/ethnic and nativity inequalities manifest partially due to certain economic factors and living conditions, such as limited access to health-promoting environments like walkways, public transportation, and inexpensive healthy foods. Ethnic differences may also be attributed to variance in genetic predisposition and developmental factors. Socio-economic vari-

ables such as urban residence, higher education level, and wealth status had positive association with overweight/obesity.

2. Antenatal and postpartum physical activities: Most international and national bodies recommend that pregnant women get at least 150 minutes of moderate-intense activity per week throughout pregnancy. Physical activity and exercise have numerous benefits for pregnant women and their offspring including the prevention of excessive weight gain and postpartum weight retention.[4] Although the benefits of preconception weight loss remain to be established through clinical trials, observational studies indicate the likely effects of preconception weight loss on pregnancy outcomes. In a population-based study in Canada with 226,958 singleton pregnancies, a preconception weight loss of 10% was associated with clinically meaningful risk reduction in pre-eclampsia, gestational diabetes, preterm delivery, macrosomia, and stillbirth. Higher levels of preconception physical activity were associated with lower risk of gestational diabetes (OR 0.45, 95% CI 0.28, 0.75 in seven cohorts, 34,929 pregnancies) and pre-eclampsia (RR 0.65, 95% CI 0.47, 0.89, in five studies, 10,317 pregnancies). Walking at a brisk pace for four hours or more per week before pregnancy was also associated with lower risk of gestational diabetes.[5,6,7]

3. Dietary intake during pregnancy and the postpartum period: Obesity both results from and fuels poor eating habits. A low healthy eating index (HEI) has been shown to be associated with overweight and obesity during pregnancy, as well as obesity prior to pregnancy.[8] On the other hand, there is also some evidence to suggest that an overweight or obese woman is more likely to consume a poor-quality diet during pregnancy, which is likely to worsen throughout the pregnancy and the postpartum period.[9] Recent epidemiological and experimental studies suggest that the propensity to obesity and diet-related NCDs may be programmed during fetal development and early infancy, and that this susceptibility is partially determined by maternal nutritional status before and during pregnancy.[10] Suboptimal maternal nutrition – especially during embryogenesis, at which point extensive epigenetic reprogramming takes place – plays a key role in nutritional epigenetic changes. Such metabolic imprinting may have implications for nutrition policy and reinforces the need to consider a life-course approach to preventing obesity and diet-related NCDs.

4. Pre-pregnancy BMI, excessive weight gain, and postpartum weight retention: Gestational weight gain (GWG) can be defined as the amount of weight gained between conception and before the birth of the infant. In 2009, the Institute of Medicine (IOM) released guidelines[11] and recommendations for GWG based on pre-pregnancy BMI, as pre-pregnancy BMI is the strongest predictor of GWG. GWG is positively and significantly associated with postpartum weight retention regardless of pre-pregnancy BMI. Pre-pregnancy overweight and obesity are associated with impaired fertility, risk of preterm birth, comorbidities, and mortality. Investigations show an association between pre-pregnancy BMI and the offspring's increased risk of abdominal or generalized obesity across infancy and childhood, into adolescence and adulthood; related metabolic disorders; and asthma in predisposed children. In addition, a large case-control study suggests that obesity (BMI ≥30) before and during pregnancy may be related to the risk of the offspring developing type I diabetes mellitus.[12]

5. Knowledge and awareness among women: Studies[13,14] show that across regions, pregnant women often have a low awareness of the perinatal complications associated with excess maternal weight. In other research,[15] obstetric care providers have been shown to lack skills and confidence in counseling women around weight management. Future research into professional and lay sources of information, including low-cost, easily accessible technology such as mobile phones and web-based social networking, can help plan novel behavioral programs, especially for women entering pregnancy obese or overweight.

6. Breastfeeding practice:[16] A biological rationale supports the hypothesis that breastfeeding promotes postpartum weight loss, while a lack of breastfeeding contributes to weight retention and maternal obesity. Also, maternal pre-pregnancy obesity (BMI › 30) is associated with up to 13% lower rates of breastfeeding initiation, and 20% decreased likelihood of any breastfeeding at six months postpartum.

7. Hormonal contraceptives: Women who reported that they were using hormonal contraceptives during the survey period had increased prevalence of overweight/obesity compared to women who were not using hormonal contraceptives. In addition to the weight gain associated with hormonal contraceptive use, women who use hormonal contraceptives are more likely to be older, have children, or be married. These factors might have synergistic effects on the body weights of women using hormonal contraceptives.

> **"We need to urgently reduce health inequalities by improving maternal and infant nutritional status"**

Conclusion and recommendations

India's public health nutrition policies have a strong focus on tackling the eradication of hunger and undernutrition among children and women. The problem of overweight and obesity has seemed distant to most policymakers during the past few years but has recently started attracting some attention, especially after NFHS-4 and 5, noting the rise in obesity across most states.

India can learn from global examples and case studies about improving public health nutrition across all ages. We need to urgently:

- Develop and regularly update recommendations for national use, based on the latest scientific evidence and harmonized with the international recommendations, promoting a life-course, health-in-

all-policies, intersectoral approach; for example, Dr Bhutta's recent systematic review findings[17] may provide some basis to guide the replacement of iron and folic acid supplements with multiple micronutrient supplements for pregnant women residing in low- and middle-income countries.

- Reduce health inequalities throughout the country by improving maternal and infant nutritional status; for example, the inclusion of BMI-based screening for overweight/obesity (BMI ≥23) and obesity (BMI ≥25) for all pregnant women contacted within the first trimester by a healthcare service provider, and weight gain in excess of 3 kg per month after the first trimester as a high-risk indicator.
- Allocate sufficient funds in budgets to sustain maternal nutrition research, program and policy interventions.
- Ensure capacity-building for health professionals dealing with maternal and young child health (including nutrition and physical activity) as a continuing process. Innovative intersectoral strategies should be developed to counsel young girls and pregnant women, to provide examples of low-cost, nutrient-dense meals for managing weight gain, and to follow up with pregnant women with the aim of understanding the effect of counseling on weight maintenance.
- Regular mass-media campaigns using existing social media platforms of all stakeholders are needed to disseminate accurate and uniform information about the importance of healthy and balanced diets for pregnant women.

Given its complexity, maternal obesity requires multilevel and integrated solutions, from individual interventions through broad food policy to industry and agriculture initiatives. To conclude, we have summarized our recommendations as O-B-E-S-I-T-Y-G-O.

- O: Optimize research, policy and programs to arrive at sustainable solutions for public health and nutrition. Providing opportunities for deliberate family planning, healthy mothers before, during, and after childbirth, and the health and productivity of subsequent generations can catalyze a cycle of positive societal development. This will need interdisciplinary action and concerted policies. Joint accountability and shared ownership of these integrated interventions or initiatives may help pave the way to save lives, improve health, build resilience, increase economic productivity and advance development in the field of maternal nutrition.
- B: Bold leadership[19] is essential for pushing the agenda of maternal nutrition across sectors. This also includes the need for more women leaders to be nurtured and empowered to be the voice of other women around them. We also stress the need for regulation of the private sector and encourage further public-private partnerships and policies, along with a strong political will and enhanced management capacity for improving maternal health.
- E: Economic rationale.[19] The existing literature indicates that healthier women and their children contribute to the development of more productive and better-educated societies. Improved maternal nutrition may offer the dual benefits of fostering economic development through improved human capital accumulation, and improving the health of future generations.
- S: Screening and surveillance.[20] To address the maternal obesity issue, the public health community must develop systems that capture data at levels through which obesity prevention efforts are conducted. Current systems lack assessment of BMI, diet, and physical activity behaviors at the individual level, while environmental and policy-related data are also often lacking. Antenatal check-ups and nutrition counseling sessions for adolescent girls and young women planned under ICDS and other maternal health programs in India should incorporate screening, counseling, referral and follow-up for overweight and obese women too.
- I: Innovation, the engine for scientific progress, is necessary for improving health outcomes and for tackling the new health challenges. However, innovation through unidirectional and simple planning may not be efficient enough. Using a systems perspective to understand how health system building-blocks, contexts, and actors act, react and interact with each other is an essential approach in designing and evaluating interventions. Many such innovative community engagement interventions for improving maternal health[21,22,23] have been recently published by the World Health Organization (WHO) and may provide further ideas for this complex issue.
- T: Technology interventions. MOMTech, which made use of mobile phones, is an example[25] of an acceptable intervention in the UK to help women limit GWG, managing maternal obesity within a clinical setting. Information technology allows several options for portable, instantly accessible and private delivery of messages, and can be individually tailored. This has been incorporated in POSHAN Abhiyaan (more from the undernutrition lens) but needs further strengthening and the additional inclusion of overweight and obesity parameters.
- Y: Youth leaders. Young people have immense potential and power to impact communities and catalyze action. Institutions such as Atal Tinkering Labs[25] and other academic centers should help nurture leadership skills among young people so they can take the lead on raising awareness on maternal health and best practices.
- G: Generate high-quality evidence. The quality and timely use of nutrition data guides evidence-informed programs and policies when key decisions are being made. It plays an important role within monitoring and evaluation by helping to assess coverage and quality of program implementation. Additionally, and critically, it helps to keep us accountable by being able to measure and track impact and progress. We urge better reporting of maternal health, deaths (along with reasons), and implementation of evidence-based, focused strategies for obesity prevention, along with effective monitoring for rapid progress.
- O: Organize awareness-generation camps. Empowering women through knowledge- and skill-building will not only provide awareness and bring about educational and behavior change in themselves and their families but also help improve health outcomes for future generations.

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Tackling Maternal Micronutrient Deficiencies

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Introduction

Numerous anatomical, biochemical and physiological changes occur during pregnancy to maintain a healthy environment for the growing fetus and hence pregnancy is a critical period in the life cycle during which additional nutrients are required. In India, around 0.5% of total deaths in 2016 were attributable to nutritional deficiencies.[1]

Pregnant women from low- and middle-income countries (LMICs) are at increased risk of micronutrient deficiency. Global studies estimate that one third of pregnant women are anemic, 15% are vitamin-A-deficient, and up to 40% are iodine-deficient.[2]

A community-based cross-sectional survey in six villages in the district of Faridabad, Haryana, found that nearly 73.5%, 2.7%, 43.6%, 73.4%, 26.3%, and 6.4% of pregnant women were deficient in zinc, copper, magnesium, iron, folic acid and iodine, respectively. The highest concurrent prevalence of deficiencies in two, three, four and five micronutrients were:

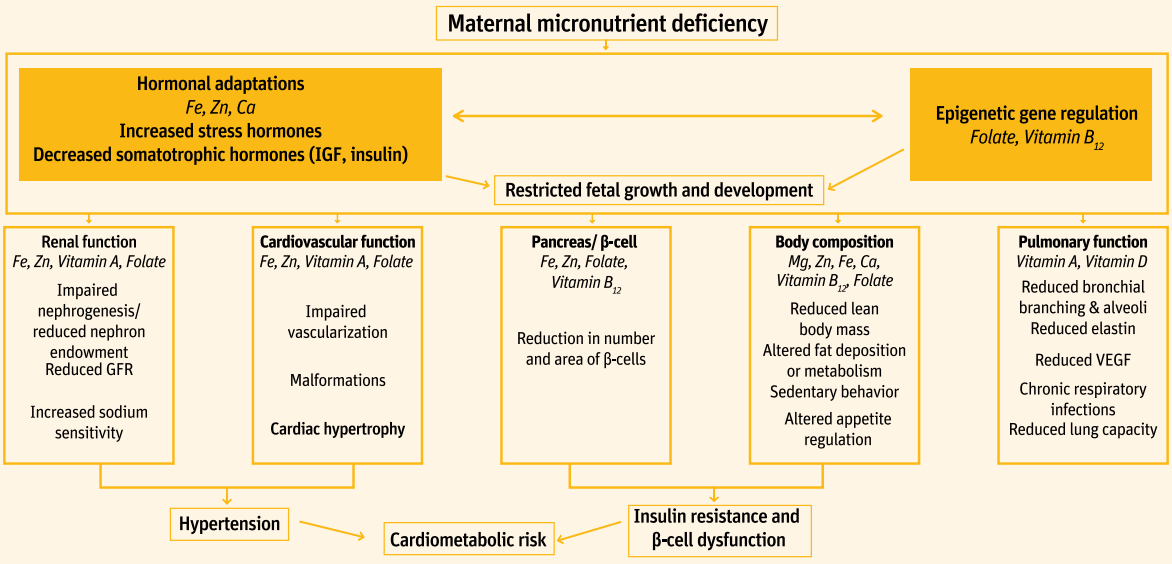
- zinc and iron (54.9%)
- zinc, magnesium and iron (25.6%)
- zinc, magnesium, iron and folic acid (9.3%)
- zinc, magnesium, iron, folic acid and iodine (0.8%).

Dietary intake data revealed an inadequate nutrient intake. More than 19% of pregnant women were consuming less than 50% of the recommended calories.[3]

The National Nutrition Monitoring Bureau Diet and Nutritional Status of Rural Population report stated that more than 80% of pregnant women consume only half of the dietary requirement for vitamin A and zinc, while more than 50% were deficient in iron, folic acid, vitamin C and riboflavin. Available literature on zinc levels has indicated high prevalence of zinc deficiency among children aged 6–60 months (43.8%), adolescents (49.4%) and pregnant women (64.6%). Similarly, the prevalence of zinc deficiency has been reported to be around 52% to 58% among tribal non-pregnant women in Central India.[4]

> **"Pregnant women from LMICs are at increased risk of micronutrient deficiencies"**

FIGURE 1: Conceptual framework for how maternal diet and micronutrient status may affect the development of chronic disease in the offspring



Source: *Christian P, Stewart CP. Maternal micronutrient deficiency, fetal development, and the risk of chronic disease. J Nutr. 2010; 140:437–45. Epub 2010 Jan 13.*

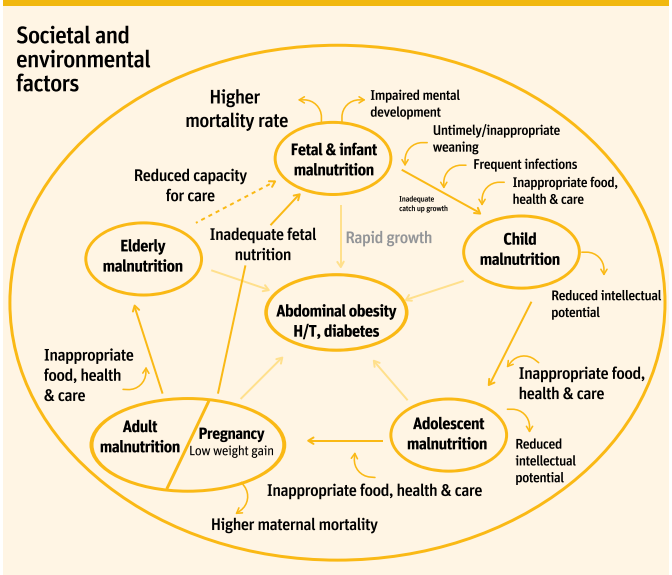
Consequences of micronutrient deficiencies

Nutritional status before conception and intake of macro- and micronutrients during pregnancy are both of utmost importance as they are known to affect pregnancy and birth outcomes. **Figure 1** illustrates how maternal micronutrient deficiencies may affect the development of chronic diseases in the offspring.

Yellow boxes represent hypothesized pathways through which various micronutrient deficiencies may influence the growth, development or function of the indicated systems.

In this context, it is important to recognize the continuum of maternal micronutrient status from the peri-conception period through lactation, and of fetal and infant dependency on adequate maternal status through this time. The challenges of poor nutrition are not restricted to pregnancy alone but continue throughout the life cycle. **Figure 2** illustrates the intergenerational effects of poor nutrition.

FIGURE 2: Life course: the proposed causal links



Source: Adapted from ACC/SCN, 2000

Iron deficiency anemia (IDA)

Moderate and severe IDA adversely affects immunity (resistance to fight infections), cognitive and motor development, physical performance (and hence productivity), and reproductive health (premature birth, low birth weight and perinatal mortality). It is estimated that anemia is the direct cause of maternal deaths in 20% of cases and a contributory cause in a further 20%.[5] Apart from dietary deficiency, helminthic infections (inhibitors of iron absorption in the diet) and repeated pregnancies (in women) are also contributing factors.

Iodine deficiency disorder (IDD)

Goiter is the clinical manifestation of IDD. The functional consequences of iodine deficiency are permanent brain damage (cretinism, mental retardation, and deaf mutism), reproductive failure, and decreased child survival. Milder deficiency also adversely affects mental development.

Vitamin A deficiency (VAD)

The earliest ocular manifestation of VAD is night blindness, and Bitot's spots on the white of the eye. Severe VAD leads to keratomalacia (ulceration and sloughing of the cornea) and total blindness.

B-complex deficiencies

Deficiencies in B-complex vitamins can cause megaloblastic anemia due to impaired red cell maturation. Folic acid deficiency has also been implicated in congenital malformation (neural tube defects). Folic acid supplementation in early pregnancy or even the prepregnant state has been shown to prevent this condition. Folic acid deficiency leads to raised levels of serum homocysteine – an independent risk factor for cardiovascular disease.

Approaches to address micronutrient deficiency

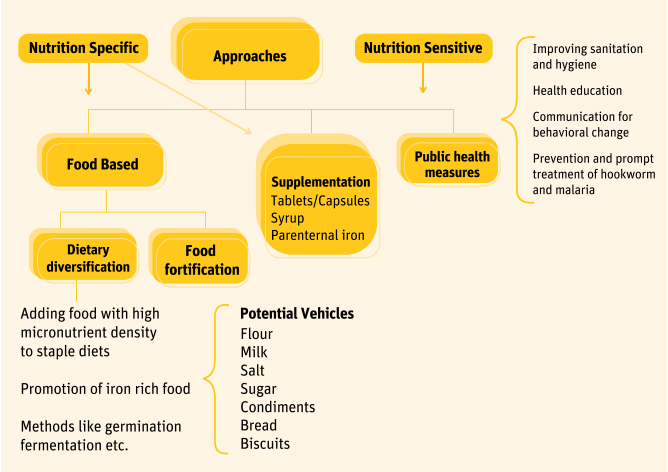
The most desirable approach to prevent micronutrient deficiencies in pregnancy is to assure a sustained diet of micronutrient-dense foods. As such a diet is often difficult and expensive to obtain, preventing adverse birth outcomes due to micronutrient deficiencies through supplementation represents a sound and effective strategy. One of the interventions most commonly adopted by many LMICs is that of daily iron and folic acid (IFA) supplementation as part of routine antenatal care to reduce the risk of low birth weight and maternal anemia. Other strategies currently being tested, but with potential impact on pregnancy outcomes, include dual-fortified salt (iron and iodine), iron-fortified flour, and the biofortification of staple crops such as rice and maize. **Figure 3** presents various nutrition-sensitive and nutrition-specific approaches to address micronutrient deficiency.

> **"The most desirable approach to prevent micronutrient deficiencies in pregnancy is to assure a sustained diet of micronutrient-dense foods"**

A balanced, diverse and nutritious diet is universally recommended to meet nutritional needs and maintain health during pregnancy. Daily antenatal multiple vitamin and mineral supplements are commonly taken prophylactically by women in the USA[6] and other high-income countries.

Fortification of staple foods with micronutrients is a promising strategy for improving micronutrient status during pregnancy. Globally and in India, salt fortified with iodine has been a public health success story. Folic acid fortification of wheat flour has helped reduce the occurrence of neural tube defects in many countries.

FIGURE 3: Approaches to address micronutrient deficiencies



Fortification of salt, rice and wheat flour with iron is being piloted successfully in many countries of the world. Improving diets and the adequate and diverse intake of various food groups continues to be a long-term goal for enhancing maternal micronutrient status, regardless of geographical location or income status. Multiple micronutrient supplementation (MMS) may be one of the strategies to address maternal micronutrient deficiencies.

In 2021, the World Health Organization (WHO) included MMS in the model Essential Medicines List (EML). WHO recommended the inclusion of MMS based on strong evidence that it is a cost-effective intervention that offers significant benefits compared to IFA supplementation in reducing the risk of stillbirth, low and very low birth weight, small for gestational age, and preterm births.

Gupta et al assessed the effect of MMS[7] (29 vitamins and minerals) compared to placebo among undernourished pregnant women (BMI < 18.5 and/or a hemoglobin level of 7 to 9 g/dL). The birth weight of newborns in the MMS group was 98g (95% CI: −16 to 213 g) more than in the placebo group. Low birth weight was 43.1% in the placebo group and 16.2% in the MMS group. Early neonatal morbidity was 28% in the placebo group compared to 14.8% in the MMS group. The authors concluded that the administration of MMS to undernourished pregnant women may reduce the prevalence of low birth weight and early neonatal morbidity.

Conclusion

Multiple micronutrient deficiency among all age groups of women, and especially among pregnant women, is a significant public health problem in India. Dietary diversification, multiple micronutrient supplementation and appropriate public health measures should be undertaken to address multiple micronutrient deficiency in the offspring.

"The authors concluded that the administration of MMS to undernourished pregnant women may reduce the prevalence of low birth weight and early neonatal morbidity"

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Micronutrients During Pregnancy for Improved Birth Outcomes

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Introduction

At the Diabetes Unit, KEM Hospital Pune, we have a special interest in understanding the high susceptibility of Indians to diabetes. Diabetes is considered a disease of overnutrition. India, however, shows a paradoxical situation: it is the world's capital of diabetes and also the world's capital of early life undernutrition (low birth weight and undernutrition below the age of 5 years). Indians develop diabetes at a younger age and at a lower BMI compared to the Western populations.[1] Indians are described to be 'thin-fat' i.e., they have higher body fat compared to Europeans at comparable BMI. Interestingly, this 'thin-fat' phenotype is found even at birth.[2] These observations led us to hypothesize that Indian babies are 'programmed' for increased susceptibility to diabetes in the womb.[3]

Fetal growth and development in utero are dependent on the maternal nutrition and intra-uterine environment (metabolism, pollutants, infections, etc.). Exposure to an adverse intra-uterine environment alters the structure and function of the developing fetal organs and may increase the risk of developing non-communicable disorders in later life ('programming').[4,5] Programming has a substantial epigenetic component in addition to the role of genes. The Developmental Origins of Health and Disease (DOHaD) paradigm further expands this window to include post-natal, childhood and pubertal influences. A mother's education and socioeconomic status influences her diet, nutrition and lifestyle. Improving maternal education and diet are two important modifiable factors to improve the health of the next generation.

> **"India is the world's capital of diabetes and also the world's capital of early life undernutrition"**

Maternal micronutrients: The role of maternal vitamin B_{12} and folate

Maternal malnutrition (macro- and micronutrients) and low birth weight continue to be important public health concerns in India. Evidence from systematic reviews lay emphasis on the crucial role of micronutrients (iron, vitamins B_{12}, C and D, folate, and pyridoxine).[6,7] Vitamins B_{12} and folate are of special interest due to their role in the one-carbon (1C) metabolism pathway. One-carbon metabolism supports important cellular processes such as DNA synthesis, repair, and methylation (epigenetic regulation of gene expression). The well-known association of folate and vitamin B_{12} deficiency with neural tube defects highlights the important role played by these vitamins in fetal development.

Maternal Vitamin B12 and Folate deficiency in Indian context

The prevalence of vitamin B_{12}deficiency in Indian women during pregnancy is high (50–70%).[7] Traditionally vitamin B_{12} deficiency is equated to pernicious anemia (a genetic-immunological condition involving intrinsic factor deficiency and leading to poor absorption of vitamin B_{12}), which is rare in India. Indians have a large prevalence of subclinical vitamin B_{12} deficiency due to poor intake of animal-origin foods, the religious and cultural practice of vegetarianism, and poverty. Though vitamin B_{12} deficiency is widely prevalent, current public health policy in India provides for only iron and folic acid supplements (no vitamin B_{12}) to adolescent children and pregnant women to combat anemia. This inadvertently promotes an imbalance between vitamin B_{12} and folate status during pregnancy, which has the potential to enhance the risk of adverse health outcomes in the offspring.[8]

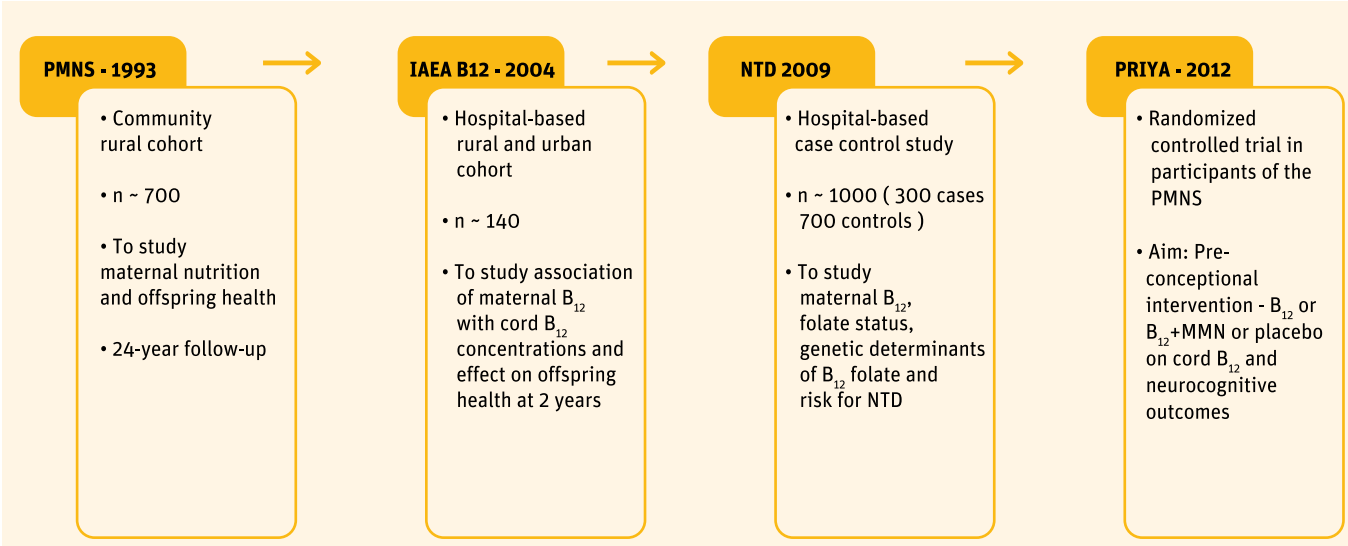
Our unit specializes in long-term follow-up of clinical and community-based birth cohorts[9] **(Figure 1)**. In one of our early clinic-based studies, we observed substantial prevalence of hyperhomocysteinemia, which was ascribable to vitamin B_{12} deficiency rather than folate deficiency. We soon confirmed the high prevalence of vitamin B_{12} deficiency in a community-based cohort, the CRISIS (Coronary Risk of Insulin Sensitivity in Indian Subjects.)[10] We found that middle-class urban men had much higher prevalence of B_{12} deficiency and hyperhomocysteinemia as well as higher adiposity, insulin resistance and systemic inflammation compared to urban slum-dwellers. We here summarize our community cohort studies, which have examined the role of maternal micronutrients on offspring health.

Pune birth cohorts

Pune Children's Study (PCS)

The PCS is an urban cohort of children born in the KEM Hospital, Pune between 1987 and 1989. In 4-year-old children,

FIGURE 1: Long-term follow-up of clinical and community-based birth cohorts at the Diabetes Unit, KEM Hospital Research Center, Pune, India



Pune cohorts examining maternal vitamin B_{12} folate and offspring health

we observed that insulin resistance was inversely associated with birth weight.[11] A follow-up study at 8 years of age showed that children born with low birth weight who had become heavier during childhood had the highest level of cardiometabolic risk factors.[12] These findings contributed to the expansion of the fetal programming hypothesis to include postnatal factors[13] and led to the 'developmental origins of health and disease' hypothesis (DOHaD).

Pune Maternal Nutrition Study (PMNS)

The PMNS is a pre-conceptional birth cohort, established in six villages near Pune in 1993 in collaboration with Profs Mary Barker and Caroline Fall. The study was designed to examine the effect of maternal nutrition during pregnancy on fetal growth and its relation to cardio-metabolic risk and neurocognitive functions in later life. More than 700 offspring born in the cohort have been followed up every 6 months for physical growth, and periodically for body composition, nutrition, cardiometabolic risk and cognition.[14,15] The children born in the cohort are now in their twenties and approximately 200 children have been born in the next generation. We are following up the cohort in young adulthood for cardiometabolic risk and neurocognitive outcomes (brain MRI and neurocognitive functions).[16] The PMNS is considered a unique resource in the world to examine the DOHaD paradigm.

IAEA B_{12} study

To study the association of maternal B_{12} and folate status in pregnancy in relation to cord blood concentrations of these vitamins and a baby's growth during the first two years of life, a cohort was established from among the women attending antenatal clinics in KEM Hospital, Pune (urban), and its Vadu Rural Healthcare Centre. Women were evaluated three times during pregnancy for body size and dietary intake, and micronutrient concentrations (vitamin $B_{12}$and folate) were measured in the mother and in the cord blood. Offspring anthropometry was measured at birth and at 2 years of age, and neurocognitive development was assessed at 2 years of age.[17] Findings from this study provided a rationale for planning pre-conceptional B_{12} intervention studies.

Neural Tube Defects (NTD) study

In this multicenter case-control study, we investigated the association of neural tube defects with maternal vitamin B_{12} and folate status.[18] We recruited approximately 300 NTD cases and approximately 700 controls from four centers (Pune, Chennai, Ahmedabad and Hyderabad). Diagnosis of NTD was made by antenatal ultrasound and sometimes at birth. Maternal B_{12}, Holotranscobalamin (HoloTC), folate and homocysteine concentrations were compared between cases and control pregnancies. Maternal genetic polymorphisms associated with vitamin B_{12} and folate status were used to support causality of associations of circulating micronutrient concentrations.

Pune Rural Intervention in Young Adults (PRIYA) trial

Based on our findings from previous studies, we embarked on a pre-conceptional randomized controlled trial to improve vitamin B_{12} and multi-micronutrient status the adolescent girls in the PMNS. In the preparatory phase, we had demonstrated that vitamin B_{12} in oral doses of 2 mcg and 10 mcg was well absorbed (resulting in an increase in plasma holoTC levels) in our rural participants.[19] We also conducted a pilot intervention in approximately 300 individuals which demonstrated that physiological oral vitamin B_{12} doses of 2 or 10 mcg/day reduced circulating homocysteine concentrations.[20] In the Pune Rural Intervention in Young Adults (PRIYA) trial in participants of the PMNS cohort at age 17 years,[21] 557 participants (266 females) were randomized

(after excluding 117 participants due to severe B_{12} deficiency or systemic illness) to receive either B_{12} alone (2 µg/day), B_{12} (2 µg/day) + multiple micronutrients (MMS, UNIMAPP formulation) or placebo. The participants were followed up serially to document vitamin B_{12} status pre conceptionally, during pregnancy, at delivery and in the cord blood. Offspring underwent a neurocognitive assessment between 2 and 4 years of age. The primary outcomes of the studies were improvement in pre-conceptional exposure to B_{12} and higher cord blood concentrations. The offspring born in the trial are being followed to assess the longer-term impact of maternal supplementation on their health outcomes.

An overview of findings from studies on maternal B_{12} and folate during pregnancy in India

We performed a systematic review of studies on B_{12} and folate during pregnancy and outcomes in mothers and offspring.[7] The purpose of the review was to build an evidence base to support the use of B_{12} and folate supplementation as a public health policy in India. A total of 67 studies were included and rated on the GRADE scale for quality of evidence.

Pregnancy and birth outcomes

The prevalence of B_{12} deficiency in Indian mothers during pregnancy ranged from 50% to 74%, suggesting that maternal B12 deficiency is a significant public health problem in India. Folate deficiency varied from 20% to 40%.

Through the PMNS, we defined the concept of the 'thin-fat Indian baby' that was 800 g lighter (2.7 kg) compared to English babies (3.5 kg) and had higher adiposity.[14] In the PMNS, lower frequency of maternal intake of micronutrient-rich foods such as green leafy vegetables, fruits and milk was associated with lower birth weight in the offspring.[15] Lower red cell folate concentrations were similarly associated. Higher maternal circulating homocysteine concentration was associated with fetal growth restriction. Association of maternal MTHFR C677T polymorphism with low birth weight in a Mendelian Randomization model enhanced the causality of this association.[22] It is of note that vitamin B_{12} deficiency makes a much bigger contribution to hyperhomocysteinemia than folate deficiency in this population.

Neural tube defects

Our large case control study identified low maternal holoTC and high homocysteine as risk factors for neural tube defects in India. Causality was supported by the association of maternal TCN2 polymorphisms with these outcomes.[18] This evidence suggests a role for maternal vitamin B_{12} supplementation in reducing the risk of NTD over and above the well-established role of maternal folate.

Metabolic and cardiovascular risk in offspring

In the PMNS, we found lower maternal vitamin B_{12} at 18 weeks and higher maternal erythrocyte folate at 28 weeks to be associated with greater insulin resistance in the offspring at 6 years. Higher maternal erythrocyte folate was additionally associated with higher offspring adiposity. Children born to mothers with a combination of high folate and low B_{12} during pregnancy were the most insulin-resistant.[23] These findings are supported by observations from Nepal and the Mysore Parthenon cohort.[24,25]

Neurocognitive outcomes

In the IAEA B_{12} birth cohort, we observed that lower maternal B_{12} and folate concentrations in the third trimester were associated with lower scores on mental and social development at 2 years of age.[17] In the PMNS, offspring of mothers in the lowest decile of maternal vitamin B_{12} levels at 28 weeks pregnancy (<77pM) had lower performance on tests for attention and executive functions at 9 years.[26] MRI brain imaging in young adulthood in these offspring has shown that low maternal B_{12} in pregnancy was associated with lower sub-cortical brain volumes and lower IQ in the offspring. Those exposed to a low B_{12}-high folate combination had the worst outcome.[27] In the PRIYA trial, pre-conceptional vitamin B_{12} supplementation in the mothers improved cognitive and language development in the offspring at 2 years, supporting a causal role of maternal vitamin B_{12} and folate for brain growth and function in the offspring.[28]

On rating quality of evidence of the GRADE, we found a high level of evidence for the effect of low maternal B_{12} and folate on higher risk for NTD and LBW, and a moderate level for adverse metabolic and neurocognitive outcomes in the offspring.

One-carbon metabolism: Pathway for vitamin B_{12} and folate in growth and development

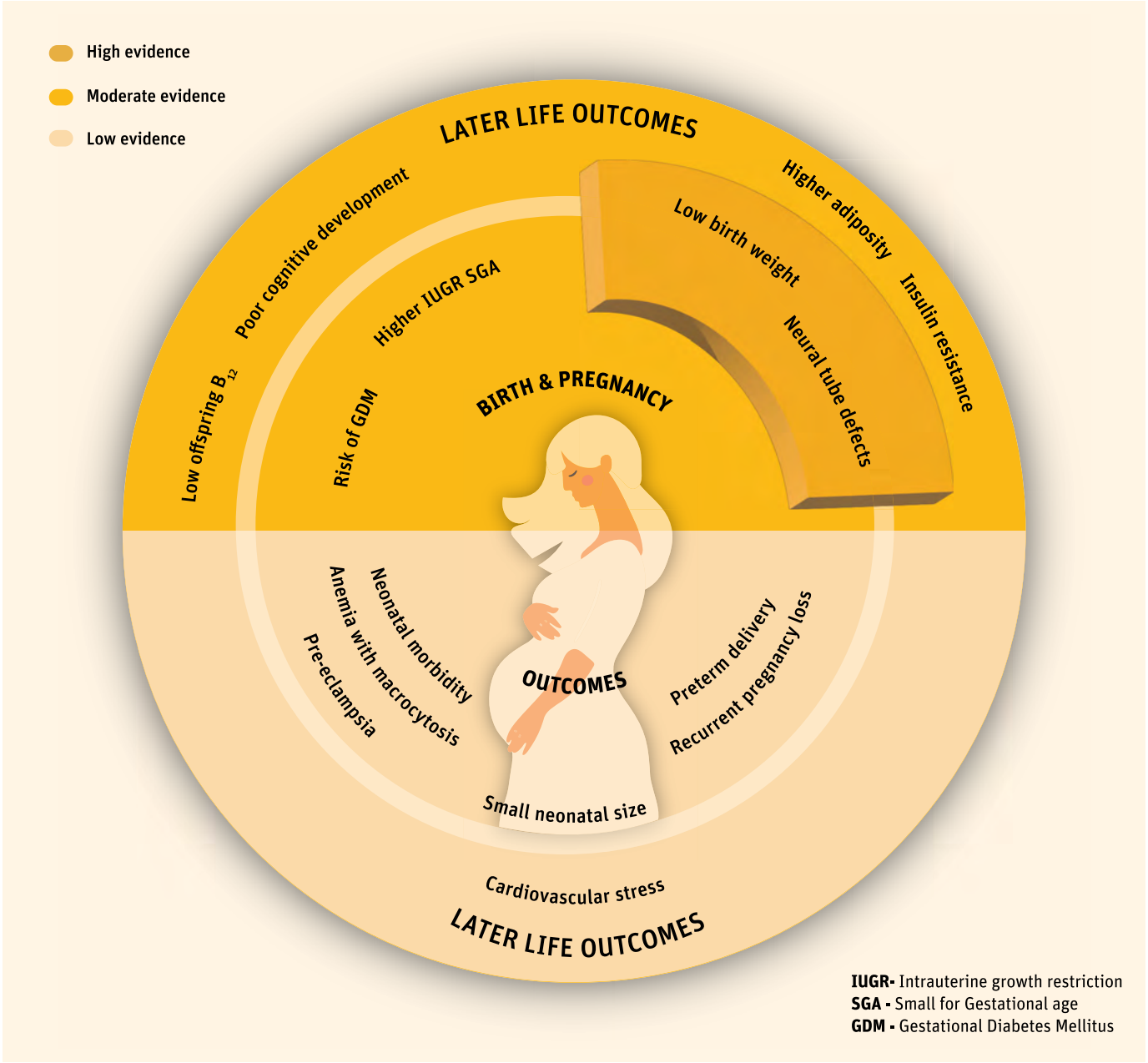
Vitamin B_{12} and folate are important for the regeneration of methionine from homocysteine through the action of methionine synthase. Methionine generates SAM (S-adenosyl methionine), which is a universal methyl donor and supports many metabolic processes (DNA synthesis, stability, and methylation, which is important in epigenetic regulation).[29] Vitamin B_{12} deficiency traps folate into an unusable methyl form, causing deficiency of methyl groups for metabolic cycles. In clinical practice, synthetic folic acid is used, which is more stable than natural folates and has higher bioavailability. Folic acid needs to be reduced by liver metabolism. Unmetabolized folic acid has a higher affinity for folate receptors and could competitively inhibit natural folates from binding with the folate receptors. This may be particularly detrimental in the presence of vitamin B_{12} deficiency. Accompanying hyperhomocysteinemia could have an independent adverse effect on vascular endothelial function and impact placental function and fetal growth.[30]

"We recommend adding vitamin B_{12} to existing nutritional programs in India"

Implications for public health policy in India

Overall, there is moderate-to-high-level evidence that maternal vitamin B_{12} and folate status are associated with the health and wellbeing of the fetus in the pregnancy and also in the long term **(Figure 2)**. The public health policy in India largely focused on the prevention of anemia in children, adolescents and during pregnancy and lactation. The national anemia control program (now called Anemia Mukt Bharat (AMB)) provides iron and folic acid but not vitamin B_{12}. Obstetricians use large-dose folic acid supplements (5 mg) for the prevention of neural tube defects and other purported benefits (though the recommended dose for prevention of the first occurrence of NTD is only 400 mcg). Given the high prevalence of vitamin B_{12} deficiency in pregnant Indian women, these measures inadvertently promote an imbalance of low vitamin B_{12} and normal-high folate status. The situation can be corrected by supplementing near-RDA doses of B_{12} beginning in childhood, going through adolescence and the pre-conceptional period and continuing into pregnancy and lactation. We recently reported two randomized controlled trials which demonstrated that vitamin B_{12} fortified foods (nutrient bar and yogurt) are effective in improving vitamin B_{12} status in Indian adults and children.[31] The Government of India's mandate under the 'Poshan Abhiyan' to use fortified wheat and rice (iron, folic acid, vitamin B_{12}) in foods served under Integrated Child Development Services (ICDS) and Mid-day Meal (MDM) schemes to address micronutrient deficiencies in children is a step in the right direction. We recommend adding vitamin B_{12} to existing nutritional programs in India for extended benefits on outcomes in pregnancy and offspring health besides the control of anemia.

FIGURE 2: Summary of evidence for the association of low maternal vitamin B_{12} status and different outcomes during pregnancy and later life



IUGR- Intrauterine growth restriction
SGA - Small for Gestational age
GDM - Gestational Diabetes Mellitus

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Learning from India's National Nutrition Social and Behavior Change Campaigns

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Introduction

For children to receive adequate nutrition for healthy growth and development, a first step is that mothers need to be aware of their own and their children's nutritional needs in the first 1,000 days of the life cycle. In India, the Prime Minister's Overarching Scheme for Holistic Nutrition, POSHAN Abhiyaan, or the National Nutrition Mission, is the government's flagship program for improving nutrition outcomes among children, pregnant women and lactating mothers. Launched in 2018, the program leverages social and behavior change communication (SBCC) to influence mothers' behaviors in a positive way.

> **"Since 2018, every September in India is observed as POSHAN Maah, national nutrition month"**

Connecting behavior with good nutrition

SBCC programs use communication strategies based on behavioral science to increase adoption of certain behaviors. These programs seek to positively influence knowledge levels, attitudes and social norms. Since 2018, every September in India is observed as POSHAN Maah (nutrition month), a period of intensive communication campaigning aimed at motivating mothers and communities to practice healthier nutrition behaviors. It leverages more than 20 platforms, including mass media, mid-media, and interpersonal communication. The campaigns disseminate nutrition-related messages with a focus on the first 1,000 days of life. Although a wide variety of platforms are deployed by partners across the country, it is hard to determine if women, especially mothers, heard or retained the nutrition messages. To what extent do the targeted women have the correct knowledge, and do they actually adopt the intended behaviors?

The SBCC campaign

To answer aforementioned questions raised by key policymakers and practitioners, IDinsight collaborated with the Government of India (GOI) to conduct three large-scale household surveys following the nutrition communication campaigns.

Driving behavior change with home visits

The first objective was to identify the platforms and nutrition messages to prioritize. The second, to provide state-specific recommendations by measuring state variation. The third objective was to track improvements over time and inform areas for further course correction.

Starting in September 2018, and then in 2019, when the POSHAN Maah and POSHAN Pakhwada (nutrition fortnight) campaigns were conducted for the months of September and March, respectively, IDinsight assessed key features of the SBCC

campaign. Phase I was conducted in November 2018 after the first POSHAN Maah, in 27 low-income districts. Phase II was conducted in July 2019 after POSHAN Pakhwada across four states (Gujarat, Andhra Pradesh, Bihar and Madhya Pradesh), and Phase III was held in November 2019 after the second edition of POSHAN Maah in 16 low-income districts. In all, the three surveys covered 10 states and around 10,000 pregnant and lactating women (PLW) in rural India. The findings from this pre-COVID-19 period encapsulate important lessons on SBCC in India, which are also relevant globally.

"The findings encapsulate important lessons on SBCC in India, which are also relevant globally"

Key findings

Platform reach

Based on the Phase II survey that covered four states, IDinsight found that of the 19 platforms examined, the top five that reached women were health facilities (84%), home visits (81%), television (69%), Village Health, Sanitation and Nutrition Day (VHSND) (66%), and community-based events (60%). The greatest number of women were thus reached by at least one interpersonal communication (IPC) platform, which involved face-to-face interactions between the beneficiaries and frontline health workers (FLWs). The lower reach of print, digital and mid-media platforms – such as print ads (33%), WhatsApp (29%), Facebook (21%), street plays (24%), and radio (11%) – could be primarily due to lower literacy rates, low access to technology and the low frequency at which PLW leave the house.[1] IPC platforms had a uniformly high reach across socioeconomic strata, suggesting this type of platform could reach the most socially disadvantaged women.

Moreover, for a change in nutrition behaviors, key members of the household that influence mothers must also be exposed to nutrition programming. While IPC platforms reached family members, overall levels remained low. According to the Phase I survey in low-income districts, only one in five mothers indicated that their mother-in-law had been reached by a home visit and less than one in 10 mothers indicated that their husband had been directly reached by a home visit.[2]

Recall

While findings suggest that certain platforms reached more women than others, this does not indicate effectiveness. IDinsight measured the recall rate of platforms by assessing the number of women who recalled at least one nutrition-related message from those reached by the platform. The top five platforms with high recall rates were: home visits (66%), health facilities (64%), television (57%), ASHA (FLWs) mothers' meetings (42%), and community-based events, the recall rate of which increased from 33% to 47% in low-income districts between 2018 and 2019.

For SBCC to really impact these women, strategies should be informed by both the reach and the recall of a particular platform. For example, delivering messages through home visits and television had both a high reach and recall rate. However, television was skewed towards sending messages about sanitation and hygiene as a platform. Sending more nutrition-themed messages via television could be an effective strategy to reach women. Furthermore, although VHSNDs had a high reach (66%), the recall of nutrition-related messages was significantly low (29%).[3]

"Strategies should be informed by both the reach and the recall of a particular platform"

Knowledge and practice levels

Understanding the levels of knowledge surrounding correct nutrition practices is critical to determining if SBCC has scope to further improve knowledge and also identify the behaviors that are most constrained by a lack of knowledge. According to the Phase III survey conducted in low-income districts, knowledge levels varied widely across behaviors. For example, about 72–76% of women had relatively high knowledge about preventing anemia, breastfeeding practices, and the importance of an antenatal check-up (ANC) within the first trimester. Knowledge of proper hygiene and sanitation, Oral Rehydration Solution(ORS)/zinc, the introduction of complementary foods at six months, and 4+ ANCs was lower (44–54%). Knowledge levels improved for certain behaviors by 8–11% in the one year of the surveys (2018–2019). For example, awareness of anemia prevention increased dramatically, with 10pp more women aware of the importance of taking iron-folic acid supplements, deworming tablets, or consuming nutritious foods, or of consuming nutritious foods to prevent anemia.

Knowledge levels remained low and unchanged for certain behaviors, such as introducing complementary foods. Further, practicing behaviors related to mother and child dietary diversity practices were also low, with one in three women not eating diverse foods and only one in 10 children receiving an adequate diet.[4] This is similar to National Family Health Survey-5 (2019-2021) data, where only about 10% of India's breastfed children between 6 and 23 months received an adequate diet.

While women may have been told to practice certain behaviors by FLWs, fewer reported being told 'how' and 'why' they should do so. For example, while some women were advised to introduce complementary foods or exclusively breastfeed, fewer were briefed on how to breastfeed, what types of foods to give, or the benefits of these behaviors.

A little more than a third of the mothers indicated that they are 'sometimes/seldom' given enough time to ask questions. Hence, women may not be getting all the support they need due to insufficient time for questions or quality counseling.

> **"Key pillars for greater success of SBCC campaigns include the right platform, the right messages and the right quality"**

Recommendations

Through the campaigns held just before the pandemic, India's POSHAN Abhiyaan program has demonstrated that the majority of PLWs can be reached if policymakers adopt an intensive social and behavior change communication campaign. For the road ahead, policymakers must ensure that we do not backtrack on the progress that has already been made. Key pillars for greater success of SBCC campaigns include the right platform, the right messages and the right quality.

Right platform: When emphasizing nutrition-themed messages, platforms with high reach and recall values such as home visits, community-based events and television should be prioritized. Additionally, communication strategies should build on platforms that already have high reach or high recall.

Right messages: The lowest level of knowledge and/or practice was for behaviors related to the first 1,000 days such as complementary feeding, 4+ ANCs and dietary diversity of mothers. FLWs can be trained to emphasize these messages, and content released through television or other media should focus on these too.

Right quality: Community-based events and VHSNDs should move beyond festivities and providing commodities to focus on connecting well with the beneficiaries and explaining the 'how' and 'why' of a behavior. This can be operationalized through capacity-building on how to deliver high-quality counseling.

Helping India move towards a better and more nutritious future

The GOI's flagship program for improving health and nutrition outcomes among children, pregnant women and lactating mothers, and its SBCC campaigns, perform critical roles in helping India move towards a better and more nutritious future. Its intensive SBCC campaign serves as a model for nutrition programs globally. We hope that the evidence generated from past campaigns will inform future SBCC campaigns, and that new campaigns will also be regularly assessed so that families receive the right messages, on the right platforms, and of the right quality.

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4. Statistics on knowledge, practices, and changes in one year: SBCC Phase III survey, conducted across 16 low-income districts.

Improving Maternal Nutrition Through Cash Transfers

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Introduction

The POSHAN Abhiyaan, launched in 2018, has an annual target for reducing stunting, wasting and low birth weight by 2% per annum (3% for anemia). However, between 1993 and 2016, India could only achieve a 0.6% annual reduction against these figures.[1] As per NFHS-5, in India, 35.5% of children under five are stunted, 19.3% are wasted, and 32.1% are underweight, while 52.2% of pregnant women are anemic.

A pivotal way to strengthen care in the first 1,000 days of life is by improving nutrition during pregnancy. The Integrated Child Development Services (ICDS) Scheme runs a large-scale Supplementary Nutrition Program (SNP) comprising take-home rations (THR) and hot cooked meals for women and children. However, its performance fluctuates based on the administrative design chosen by states. For example, Kerala has a captive market for the procurement of THR, whereas Rajasthan decentralises procurement to sub-district offices.

Further, the provision of THR is rife with challenges regarding the quality, reliability and efficiency of supply chains and distribution networks. Societal norms govern household decisions about food consumption, with women sharing the THR that eventually reach them with the entire family, or else being the last person in the household to consume them.[2]

This paper argues that the best way to reach pregnant and lactating women is through intensive counseling by incentivized front-line workers, supplemented by conditional cash transfers, delivered to mothers' bank accounts.

> **"A pivotal way to strengthen care in the first 1,000 days of life is by improving nutrition during pregnancy"**

Problem statement

Most low-birthweight (LBW) babies are born at term and are affected by growth restrictions that begin in the uterus. More than 80% of neonatal deaths are among LBW newborns, of which one-third are term, small-for-gestational-age (SGA) newborns. In 2015, nearly 20.5 million live births were LBW, with 48% reported in Southern Asia.[3] Nutritional supplementation programs for women during pregnancy can reduce the risk of SGA births by a third.[4]

Further, adequate diet from conception (through appropriate maternal nutrition) to infancy (ensured through age-appropriate infant feeding practices) is associated with numerous gains for children. A well-nourished child begins life with cognitive, motor, socioemotional and developmental advantages over other children.[5] The continuum of care between a mother and child begins with the early initiation of exclusive breastfeeding and reduces the chances of neonatal mortality.[6] Exclusive breastfeeding for six months reduces the risk of diarrhea[7] and growth faltering.[8]

Maternal nutrition in Rajasthan

Rigorous formative research was undertaken in Rajasthan between 2017 and 2019 to design a context-specific and actionable Social Behaviour Change Communications (SBCC) program for RajPusht – one that seeks to reduce LBW and wasting in Rajasthan. An Opti-foods study[9] conducted in Udaipur, Barmer, Baran and Bhilwara revealed that over 70% of the respondents were primarily vegetarians, while 27% reported meat, fish and poultry consumption. Overall, dietary diversity was low, and was limited by the available food choices.

The study also showed that families in Rajasthan typically consume just two meals a day and that there was no distinction in diet during or after pregnancy. Additionally, other qualitative studies revealed that a pregnant/lactating woman has the least access to food, based on the patriarchal power relations within the households.[10]

NFHS-5 showed that 46.3% of pregnant women in Rajasthan were anemic (IIPS and IFC, 2021).[11] Not limited to anemia, multiple micronutrients deficiencies have also been reported especially among adolescent girls: 69.2% with the low serum ferritin, 46.3% with folate deficiency, 45.4% with vitamin B12 deficiency, 29.4% with vitamin D deficiency, and 18.4% with zinc deficiency.[12]
These result from deeply entrenched myths and taboos and notions of 'purity' and 'food heat', which restrict women from consuming locally available nutritious food. This leads even non-vegetarian mothers to turn vegetarian during pregnancy and vegetarian mothers to spurn milk and related products during lactation.

> **"Myths and taboos abound in the field of child feeding practices"**

Infant and young child feeding (IYCF) practices

While there have been improvements in the early initiation of breastfeeding (40.7% in NFHS-5 versus 28.4% in NFHS-4), there is a significant risk of breach of exclusivity due to the general acceptance of prelacteal feeds such as: jaggery water, a traditional drink made of boiled and concentrated sugarcane juice (6%); gripe water, an over-the-counter liquid supplement of sodium bicarbonate and herbs (5%); honey (3%); and plain water (2%). This is compounded by the perception of inadequate lactation as per the Opti-foods study by IIHMR in 2018. The study also found that 34% of mothers started premature weaning or feeding complementary foods early. Cereal was the most common food fed to children (92.6%), followed by milk and milk products (86.3%), oil and fat (86.9%) and sugars (86.2%). The lowest consumption was observed in respect of nuts and oilseeds (1.2%), green leafy vegetables (2.1%), and meat, fish and poultry (0.3%). As a result, a high level of stunting (31.8%), wasting (16.8%), underweight (27.6) and anemia (71.5%) among children under five was reported in NFHS-5 (2019–21). The Comprehensive National Nutrition Survey (CNNS, 2016–2018) also revealed multiple micronutrient deficiencies among children aged 1–4 years.[13]

Myths and taboos abound in the field of child feeding practices. Moreover, the information, education and communication (IEC) material displayed at facilities is often in English.[14]

A rethink through RajPusht

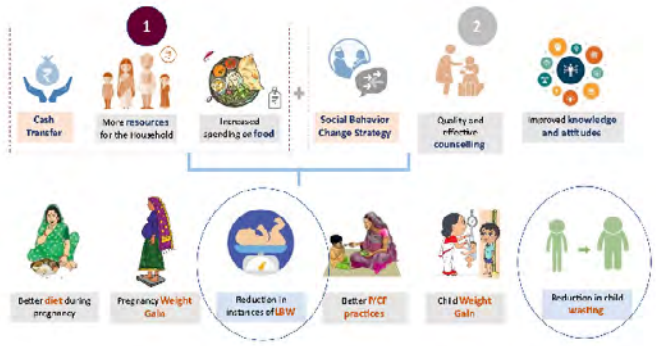
The World Health Organization (WHO) has set ambitious global targets of reducing the incidence of LBW by 30%, increasing exclusive breastfeeding by 50% for children under six months, and reducing stunting by 40% in children under 5 by 2025. Such shifts require a radical rehauling of maternal and childcare programs in India.

RajPusht aims to reduce the prevalence of LBW and wasting by 6% in five districts of south Rajasthan – Banswara, Baran, Pratapgarh, Dungarpur and Udaipur – in the course of five years (2020 to 2024). It focuses on two critical and complementary channels for improved maternal outcomes: on the one hand, providing multi-tiered behavior change communication to pregnant and lactating mothers and their families, and on the other, enhancing their incomes at the household level by means of cash transfers, shifting the onus and power of nutrition decisions from government functionaries to mothers **(Figure 1)**.

Expanding choice by means of cash transfers

RajPusht started by supporting the Government of Rajasthan in implementing the central sponsored Pradhan Mantri Matru Vandana Yojana (PMMVY) across the state for first-time mothers,

FIGURE 1: The RajPusht theory of change



providing them Rs 5,000 on complying with scheme conditions and submitting forms. This support, which ran from January 2018 to January 2020, saw over a million first-time mothers registered in the scheme, with 82% of these receiving due benefits.

Addressing the limitation of PMMVY being restricted to first-time mothers, RajPusht worked with the Department of Women & Child Development (WCD) to design and launch the Indira Gandhi Matritva Poshan Yojana (IGMPY), a state scheme for extending maternity benefits of Rs 6,000 to second-time mothers.

With the addition of IGMPY, two-thirds of the new mothers can potentially receive cash transfers in Rajasthan. As at March 2022, nearly 1.7 million mothers were enrolled in the two schemes in Rajasthan, with payments delivered to 80% of these.

Providing an enabling environment through SBCC

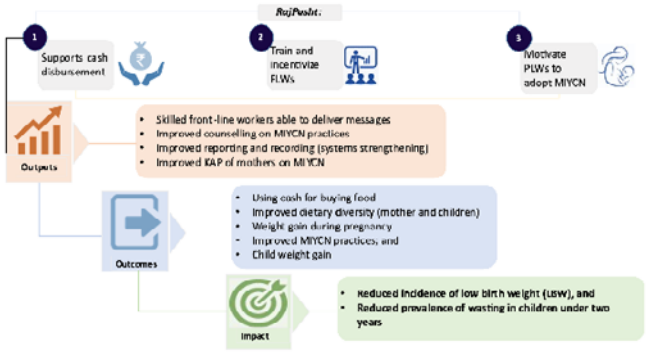
RajPusht focuses on a cash-plus design, coupling cash with an intensive SBCC strategy that brings together the departments of women and child development and medical, health and family welfare. It helps the implementation of cash transfer and SBCC in the five districts of Rajasthan by supporting the existing ICDS and health system and providing an additional cadre of community mobilisers, called POSHAN Champions (PC), who are placed through Civil Society Organization (CSO) partners. Each PC serves 40 to 50 AWCs and reports to the Block Program Manager programmatically. PCs are equipped with anthropometric measurement tools and deliver home-based counseling. The front-line trio at the forefront of the effort – the anganwadi workers (AWWs), auxiliary nurses and midwives (ANMs), and the ASHA workers – have been trained extensively in the concepts of maternal, infant, and young child nutrition, and provided with culturally appropriate and locally relevant job aids.

RajPusht is also reviving Village Health, Nutrition & Sanitation Committees (VHNSC) through a technique based on Participatory Learning and Actions(PLA). The program uses mass media and digital media routes to catalyze conversations about maternal nutrition among homes and community influencers.

The design and delivery of this program are data-driven and supported by a comprehensive monitoring, evaluation and learning framework **(Figure 2).** PCs collect beneficiaries' enrolment information, measure their pregnancy weight, and counsel them

at different stages. They also take their children's anthropometric measurements to track wasting. This is coupled with biannual rounds concurrent monitoring to gauge shifts in knowledge, attitudes and practices among the mothers, their families and front-line health workers. A third-party agency is externally evaluating RajPusht.

FIGURE 2: The RajPusht monitoring framework



Preliminary findings

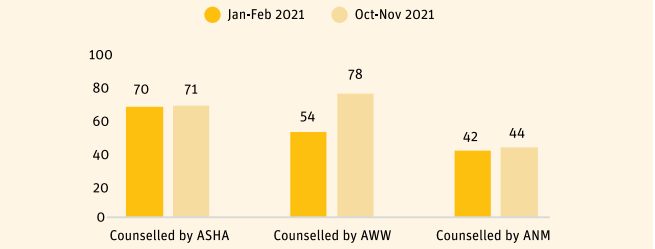
The results reported in this section are from the monitoring data collected by the program since January 2021.

Counseling by FLW

The training of ASHAs (on PLA-based VHSNC meetings) and ANMs (on MIYCN counseling) was started in November 2021 and is being delivered in modules. A comprehensive nutrition training for AWWs was completed in September 2021.

Early results show that counseling by front-line workers improved between January 2021 and November 2021. The most considerable improvement (54% to 78%) was observed in counseling by AWWs, who are typically restricted to delivering early informal education in non-intervention districts **(Figure 3)**. The counseling reach of ASHAs and ANMs reflects the training-in-progress status and is expected to improve in subsequent monitoring rounds. Up to and including February 2022, 220 PCs engaged under RajPusht reached close to 60,000 pregnant women in the five implementation districts.

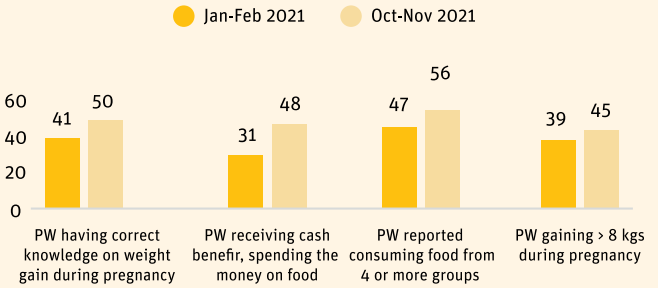
FIGURE 3: Pregnant women counselled in last 3 months



Knowledge and practices among pregnant women

There were positive improvements in care practices among pregnant women between January 2021 and November 2021. There was a 17 % increase in cash usage for food, a 9% increase in women consuming diverse diets, and a 6% increase in weight gain greater than 8 kg during pregnancy **(Figure 4)**. The average weight gain during pregnancy was initially 7 kg and is currently 7.7 kg. However, 46.5% of women share the THR with their families.

FIGURE 4: Knowledge, behavior, and weight gain among pregnant women



Awareness of IYCF practices in the implementation districts varied across age groups in the monitoring round of November 2021. Breastfeeding within one hour was initiated in the case of 86.3% of newborns, and 77.6% of them were exclusively breastfed for six months, but only 36.7% received complementary feeding from the seventh month onwards. Only 30.6% of children between 6 and 23 months received the minimum dietary diversity, while only 7.7% received a minimum acceptable diet.

A digital weighing machine

Accurate tracking of low birth weight

RajPusht has developed a unique digital weighing machine (DWM) that uses Internet of Things technology to capture birthweight and automatically takes their photos for triangulation. The DWMs are operational in 175 high-load labor rooms of 143 government facilities in the RajPusht districts.

Close to a million newborns have been weighed on these DWMs

by trained labor-room staff. This intervention has successfully demonstrated that the LBW burden was more than 30% in Raj-Pusht districts, almost 10% higher than the Health Management Information System (HMIS) data (reported as approximately 20%) or other past estimates from large-scale surveys such as the NFHS.

"The crucial lesson is how Rajasthan has adopted cash transfers as an innovative approach to nutrition programming"

Conclusion

Fully fledged implementation of the cash-plus programming under RajPusht stabilised by March 2022, with a plan for further implementation over the next three years in five districts of Rajasthan. The program will curate evidence to inform policymaking and the design of maternal nutrition cash transfer strategies. However, the crucial lesson at this stage is how Rajasthan has adopted cash transfers as an innovative approach to nutrition programming for improved maternal and child nutrition status.

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The missing 'P' in Perinatal Care: Integrating Psychosocial Issues with Nutrition

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"Systematic reviews from India have shown that around one in six and one in five women experience depression during pregnancy and postpartum, respectively"

Introduction

The concept of maternal psychosocial well-being (MPW) includes two aspects of motherhood: psychological (which includes mental health, distress, anxiety, depression, coping, and problem-solving) and social (such as family and community support, empowerment, and culture).[1] A woman may need psychosocial support starting from preconception, through pregnancy and up to the first two years of a child's life. This is particularly important when mothers are of a young age, face multiple psychosocial adversities, and live in vulnerable circumstances.

Systematic reviews from India have shown that around one in six and one in five women experience depression during pregnancy and postpartum respectively. Poverty, the birth of a daughter, past trauma, a previous mental health problem, past pregnancy loss, relationship difficulties, adverse life events and stress during pregnancy, and lack of physical and emotional support are some of the risk factors for perinatal depression.[2,3,4]

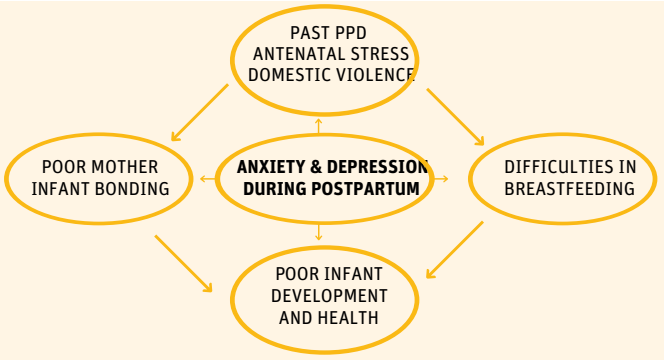
An 'elephant in the room' often neglected in the perinatal period is domestic violence. Rates of violence in the perinatal period have been found to range from 16% to as high as 46%.[5] There is also a strong link between male gender preference of the infant and maternal depression. These factors are rooted in the social and cultural fabric of society and mere biomedical interventions are insufficient to address them.

Emerging evidence is expanding our understanding of the potential role specific nutrients (such as vitamin D, fish and PUFA intake, calcium, zinc, and selenium) play as risk or protective factors for maternal depression.[6]

Impact of poor maternal mental health

Antenatal mental health problems are associated with poor nutrition, inadequate weight gain and irregular antenatal appointments, and act as a risk factor for postpartum depression.[3] Evidence from India has shown that symptoms of anxiety and depression in pregnancy can impact the birth weight of infants,[7,8] and postpartum depression can lead to infants becoming underweight in early childhood.[3,4] Mothers with depression have higher odds of not indulging in responsive breastfeeding [9] **(Figure 1).** And infants of mothers with depression in low- and middle-income countries (LMICs) have high rates of malnutrition, diarrhea, infections, hospital admissions and incomplete immunization schedules. In addition, postpartum depression is a strong predictor of parenting stress, negatively impacting mother-infant bonding and leading to cognitive, emotional and behavioural problems in children.[10]

FIGURE 1: Maternal mental health issues lead to poor infant outcomes: a pathway



Interventions for perinatal depression in LMICs

There have been several interventions addressing perinatal depression in LMICs, including studies in South Asia **(Table 1)**.

- A systematic review of best practices for community-based

management of postnatal depression in developing countries found that interventions involving a combination of cognitive behavioral therapy, infant stimulation and problem-solving can improve outcomes. Challenges to the implementation included: dependence on specific cadres of health workers, motivation and capacity of delivery agents for additional responsibilities, high level of supervision required, and lack of structures and mechanisms to ensure fidelity.[11]

- A trial from South Asia demonstrated that cognitive behaviour therapy delivered by community health workers to depressed women in the third trimester of pregnancy reduced the incidence of major depression in the postpartum period.[12]
- A systematic review and meta-analysis on interventions for common perinatal mental disorders in women in LMIC reported that interventions involving supervised, non-specialist health workers for detection, treatment and referral for perinatal mental disorders have helped improve mother-infant interaction, fostered cognitive development and growth, reduced diarrheal episodes, and increased immunization rates.[13]
- Participatory interventions with women's groups in rural and largely tribal areas of Jharkhand and Odisha demonstrated a 57% reduction in moderate depression among mothers in the intervention clusters. This is likely to have occurred through improvement in social support and problem-solving skills.[14]

TABLE 1: Studies on maternal mental health interventions in India

Intervention	Study area	Methodology	Findings
Thinking Healthy Program Peer-delivered (THPP) [17]	Goa	Randomized control trial, 280 pregnant women	Moderate effect on diminution of perinatal depression at 6 months postpartum and was found to be relatively cost-effective to deliver.
Program for Improving Mental health care (PRIME) [18]	Sehore district Madya Pradesh	Three components of these packages were: a) program management, b) capacity building and c) community mobilization. On service delivery front, packages were inclusive of awareness creation, detection, treatment, follow-up on mental disorders, depression (including maternal depression), psychosis and alcohol use disorder (AUD).	1. Monitoring/tracking requires 'process maps' of clinical interventions and implementation steps. 2. Implementation support from an external team is essential to provide clinical supervision and address the implementation barriers. 3. Validated intervention package is essential for system strengthening. 4. Engagement of key community stakeholders and incentivization of community health workers are necessary for the delivery of services.
Amma Manasu (Mother's mind) [19]	Kerala	Mothers undergo assessment during their antenatal and postnatal visits by Junior Public Health Nurses (JPHN), who are trained to provide first-level interventions. Referral pathways are established for stepped care and include doctors in primary care and the District Mental Health Program.	A randomized controlled study (RCT) done in the state of Kerala found a community-based depression intervention program implemented in the public health setting to be effective in reducing severity of depression in women.
Management of Depression in Pregnancy (BIND-P) study conducted by Indian Council of Medical Research (ICMR) [20]	Delhi	Brief module for nurses to be used in ANC settings for screening depression and providing brief psychological intervention for mild to moderate depression.	Brief psychological intervention (BIND-P) can be implemented through ANM (auxiliary nurse midwife)-based stepped-care model for perinatal depression (PND).

A review of psychological interventions for maternal depression by non-specialist health workers in LMICs found the following key features working across all the studies.[15]

1. Care beginning in the prenatal period and ending postnatally.
2. Involvement of extended family members, especially the husband.
3. Attention to social problems with focus on women's empowerment.
4. Delivery in the context of already existing maternal and child services.
5. Assessment of mental health and psychosocial issues at least once during pregnancy and once within three months postpartum **(Figure 2)**.

FIGURE 2: Perinatal psychosocial assessment grid for front-line workers

Past history of depression, self-harm, treatment	Current level of stress and major life events	Social and emotional support avaiable Domestic violence
Nutrition Food insecurity Male gender preference	Quality of partner relationship and involvement in her care	Current depression, anxiety Mother-infant bonding

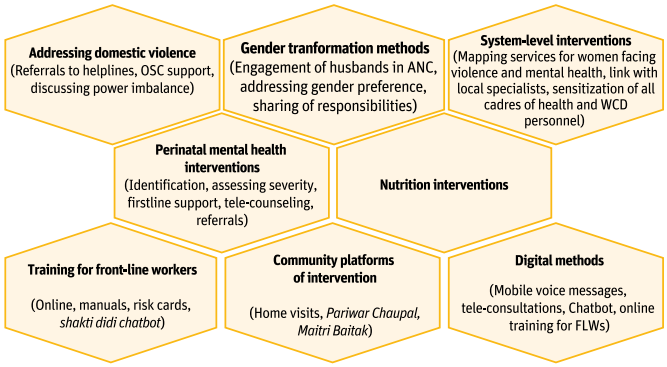
While there have been several epidemiological and clinical studies highlighting the high prevalence of perinatal mental health problems, this has not led to systems change in assessment and interventions. The integration of prevention, detection and treatment of psychosocial health in the maternal and child health programs across many LMIC including India has been suboptimal.

However, some recent developments hold promise: the increase in coverage of the District Mental Health Program and inclusion of perinatal mental health in the training modules of primary-care doctors, the Mental Healthcare Act 2017, which mandates mother-infant joint care even when a mother has a severe mental illness, and the integration of maternal mental health into the Reproductive and Child Health Program in states like Kerala and Telangana highlight the growing recognition of addressing maternal psychosocial needs **(Figure 3)**.

The need for integrated interventions

The way forward seems to be by developing models that integrate psychosocial care within the existing ANC and PNC platforms. This is important for several reasons: first is the strong bidirectional link between maternal nutrition and mental health and the relationship between infant nutrition and mental health of mothers; second, an integrated intervention whereby psychosocial issues and nutrition are addressed together will be more acceptable to mothers and families and less stigmatising; and finally, training

FIGURE 3: Multicomponent intervention for psychosocial wellbeing in the perinatal period



front-line workers (FLWs) to deliver psychosocial care alongside their training in nutrition and obstetric care makes it less daunting for them.

The role of gender

Gender-intentional interventions aim at reducing the gender gaps in access to resources (for example, providing mobile phones to women to allow them to access health information). Gender-transformative (GT) programs, however, go beyond that and focus on changing gender power relations and reducing gender gaps in agency over resources (for example, working with women, husbands and families to enable privacy for the woman to talk with the health worker on the mobile phone).

A recent review[16] by the Bill & Melinda Gates Foundation identified 49 gender-intentional interventions for maternal and newborn health and found that 50% of interventions used a gender-transformative approach and strived to change gendered power dynamics, norms, and inequalities.

However, there were only three interventions that explicitly addressed maternal mental health, and only one that addressed adolescent pregnant women. The review recommended that all interventions for maternal and child health need to use a GT approach, especially in countries where gender equity and power imbalance exists. They need to go beyond male participation and approach difficult-to-handle issues such as power imbalance in the household, domestic violence, mental health and male infant preference. Interventions should also ensure that outcomes related to gender disadvantage, mental health and violence are measured. One strong recommendation is to have more interventions that address perinatal mental health and adolescent pregnant girls, as well as the mental health and agency of women between pregnancies.[16]

A final recommendation was to use digital technologies in a manner that empowers the woman to access information about her health and seek support. Digital methods are also encouraged to increase the capacity and agency of FLWs.

The pandemic and the inception of Tele-Swabhimaan

The Swabhimaan ('self-respect', 'self-pride' or 'self-esteem')

"Maternal mental health needs to be integrated into ANC platforms for identifying at-risk women"

program is a package of nutritional interventions delivered through Women Collectives in Bihar, Chhattisgarh and Odisha since 2016. The four primary target groups include adolescent girls, newlywed women, pregnant women, and mothers of children under two years of age. (Secondary target groups include husbands, mothers-in-law and farmer-producer groups.) [17]

The challenges faced by pregnant and postpartum women during the pandemic led to a reconceptualization of the Swabhimaan program. Studies conducted among pregnant women attending antenatal services in Chhattisgarh, Odisha, Uttarakhand and Delhi showed elevated anxiety and depression symptoms. These were related to fears of the virus and concerns about stigma as well as inadequate prenatal care. The adverse economic consequences because of the pandemic and food insecurity, coupled with an increase in domestic violence, added to the vulnerability of women.[18]

These learnings highlighted the importance of using an integrated approach to ANC. The current intervention as part of Tele-Swabhimaan seeks to integrate obstetric care, nutrition interventions and mental health support by training FLWs in two sites (rural Chhattisgarh and urban Telangana). FLWs will provide information on nutrition and mental health as well as engage mothers, husbands and families in microplanning, participatory learning and action meetings; identify 'at-risk' groups at different community platforms such as Maithri Baithak, Pariwar Chaupal and Kishori Baithak; conduct home visits; mobilise to access services from AHD / VHSND (Village Health, Sanitation and Nutrition Day); and link vulnerable groups to soft loans from SHGs.

The 'Tele' in Tele-Swabhiman focuses on the use of digital technology for delivering messages on nutrition, mental health and pregnancy in two forms: (1) outbound mobile voice messages targeted at adolescent girls and pregnant women, mothers and their partners, and (2) a call-center approach for connecting women with doctors and mental health professionals when needed. Digital technology is also being used to provide online integrated modular training to all FLWs, and a chatbot – Shakti Didi – will provide ongoing interactive learning, resources and referrals in perinatal mental health and mental health support for women facing violence.

Conclusion

Maternal mental health is too important to be left to mental health professionals alone, especially when it is rooted in various social and cultural factors. The pandemic has taught us to think innovatively and to collaborate, connect and coordinate, to look at risk and protective factors and to think of system changes. Shifting away from a traditional clinical view toward a broader approach to interventions may lead to improved perinatal mental health services.

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Experience from the Field

Small Beginnings, Big Learnings

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In 2016, based on the findings of the National Family Health Survey (NFHS)-4 and the high maternal mortality ratio (MMR) in the state, the Government of Karnataka carried out a detailed review of its direct and indirect nutrition interventions. The chief lacunas observed in the supplementary nutrition program for pregnant and lactating women (PLW) were: program leakages, lack of quality control, the division of the take-home rations (THR) packet among the family, or merely insufficient quantity. The results demanded a redesign and realignment of the supplementary nutrition delivery mechanism.

> **"Karnataka's Mathrupoorna program provides hot cooked meals, including egg and milk, to PLWs"**

The *Mathrupoorna* hot meal program

The Government of Karnataka decided to pay special attention to maternal nutrition and focused on the first 1,000 days of the life cycle. In December 2016, a pilot was conducted in five taluks (administrative subdivisions) of the state. This pilot became the Mathrupoorna hot meal program, which introduced a daily hot meal of dal, vegetables, a boiled egg, a glass of milk and a chikki (a traditional Indian sweet) for PLW at the anganwadis (rural childcare centers), six days a week. To provide this meal at a unit cost of Rs21, the state added Rs14 per meal per day over and above the Integrated Child Development Services' cost norm of Rs7 per beneficiary.

The daily hot meal was only the first step in the program. The other interventions included counseling about iron-folic acid (IFA) tablets, calcium supplementation, anti-tetanus injections, and regular deworming, antenatal and postnatal check-ups.

A program of information, education and communication with a catchy anthem was rolled out, too. Through primary healthcare (PHC) doctors, local elected representatives and anganwadi staff, rural women were advised to come to the anganwadis for the hot meals. An exemption of 30 days was given before the expected date of delivery, and 45 days thereafter, during which a family member could collect the hot cooked meal from the anganwadi.

The pilot helped in the understanding of local operational issues, which made it possible to roll out the program at scale at nearly 66,000 anganwadis in October 2017.

> **"An independent impact evaluation found noticeable improvements"**

Impact evaluation

An independent impact evaluation[1] by the Public Health Foundation of India found noticeable improvements in gestational weight gain, reduction of anemia, improvement in birth weight, plus an unexpected benefit – improved mental health – among women who attended the program regularly.

Mathrupoorna is only one among several direct and indirect interventions that have formed part of the state of Karnataka's life-cycle approach to reduce malnutrition. Other initiatives include the provision of eggs and milk to all children, clean drinking water as well as toilets for anganwadis, the prevention of child marriage, and a focus on the retention of girls in secondary school. In 2019, NFHS-5 reported a drop in all the four parameters of child stunting, wasting, severe wasting and underweight in Karnataka.

Anganwadis in Karnataka have reopened since the COVID-19-induced lockdowns. Several districts have added eggs to the midday meals in schools. While the road ahead on this journey is still long and full of challenges, at least the state seems to be moving in the right direction.

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Adequate Allocation for Maternal Nutrition in Health Sector Budgets

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Introduction

In India, despite the reductions in maternal mortality ratio (MMR) from 167 (2011–2013) to 113 (Sample Registration System, 2016–2018) deaths per 100,000 live births, women continue to enter pregnancy with one or more nutritional risks. The World Health Organization (WHO) recommends a set of 14 maternal nutrition (MN) interventions (WHO, 2016), 12 of which are delivered through the health sector.

Monitoring of financial allocations and outlays toward nutrition services through various sub-programs within the health sector are critical to ensure optimal investments; however, this has remained a rather neglected aspect in maternal nutrition (Bhutta et al., 2013, SPRING, 2018, Global Nutrition Report, 2021, Kapur et al., 2021). Further absence of budgeting guidelines for MN does not allow measurement of adequacy of these efforts.

This paper assesses the maternal nutrition budget within annual plans of health sector for India from Financial Year (FY) 2019–20 to FY 2021–22. We present three-year trends and component-wise insights that help inform the effective planning of maternal nutrition interventions.

"WHO recommends a set of 13 MN interventions (WHO, 2016), 12 of which are delivered through the health sector"

Methods

The WHO MN interventions are embedded in India's national health programs. We listed them to see which interventions are missing in health sector budgets. For those which do exist, we mapped the unit cost and budget line items. In India, health budgets planned by states are called Program Implementation Plans (PIP), which after approval by Ministry of Health and Family Welfare (MOHFW), Government of India are called Record of Proceedings (RoP). These documents enlist specific Finance Management Report (FMR) codes that are used for planning, allocating and booking expenditure. There are 18 major budget heads under which all activities and minor budget heads are classified according to their relevance. Year-wise PIP and RoP for each state are available on the National Health Mission (NHM) website.

Using PIP and RoPs of FY 2019–20, a list of FMR code-wise maternal nutrition activities or minor budget heads was prepared. These belong to six major budget heads:

1. Procurement of drugs and supplies
2. Community volunteers' incentives
3. Strengthening of services
4. Information Education Communication (IEC) / Behavior Change Communication (BCC)
5. Printing
6. Innovation.

Based on the above, relevant denominators and cost norms were devised from state-specific PIPs and ROPs. Additionally, for arriving at adequate estimates, a spreadsheet to calculate a state-specific MN budget targeting 100% coverage of beneficiaries was developed. The planned and allocated budgets were compared in order to understand resource requirements for functioning at full capacity and with universal coverage of all interventions. This process was repeated for FY 2020–21 and FY 2021–22 to observe yearly trends.

Since FY 2019–20, the findings were regularly shared by the research team at the Anemia Mukt Bharat (AMB) technical support unit placed at the Institute of Economic Growth (IEG) with state and national planners and policy makers during review meetings and trainings. State-wise budget sheets and budget highlighters specifying the components that need to be budgeted in midterm or next budget cycle were made available on the data dashboard of AMB (https://anemiamuktbharat.info).

In 2022, MoHFW changed the budget planning cycle to biennial. Also, the budget format was revised with new list of activities, new budget heads and FMR codes. Now, FMR codes are assigned to schemes/ programmes and budget for all activities under a particular scheme/programme is cumulatively allocated. The budget for a particular activity may be or may not be deciphered through details given in remarks section of the concerned scheme. We found that most of the maternal nutrition activities were now part of maternal

health schemes and budget heads like IEC/BCC, printing and innovation could not be separated. We were able to disaggregate budget of eleven MN activities in the new format out of 26 activities/budget heads that were identified earlier. These were procurement of iron and folic acid (IFA) supplements, Albendazole, Calcium, Iron Sucrose, Ferric Carboxymaltose (FCM), Glucose Sachet, Folic Acid; incentive to ASHA (frontline worker) for mobilizing pregnant and lactating women for IFA, line listing of severely anaemic women, diet during hospital stay (JSSK diet), and blood transfusion. A separate analysis of budget allocated in FY 2022-24 for maternal nutrition activities was done and is presented in this report.

Result

Three-year analysis of planned and approved NHM budgets reveals that in FY 2019–20, a total of INR 8,900 million was planned by states for MN interventions, and that they received approvals for INR 7,942 million, which amounts to 89% of the planned budget **(Table 1)**. In FY 2020–21, states planned INR 8,504 million, which was 4% less than the previous year. Of this, INR 8,302 million was approved (98% of the planned figure). In FY 2021–22, there was a 7% increase in the planned budget: INR 9,155 million was proposed, of which INR 8,694 million was approved (95% of the planned figure). These changes vary by state **(Table 2)**.

TABLE 1: Major and minor budget head-wise planned and allocated budget for maternal nutrition interventions, National Health Mission, FY 2019–20 to FY 2021–22, India (INR million)

Major and Minor Budget Heads	P	A	% P/A	P	A	% P/A	P	A	% P/A
Total MN	**8900**	**7942**	**89**	**8504**	**7942**	**8900**		**7942**	**95**
Procurement	**3613**	**3249**	**90**	**3505**	**3249**	**3613**		**3249**	**97**
IFA tablet	1064	849	80	769	765	99		813	96
Folic acid tablets	152	118	78	107	105	98		376	100
Calcium tablets	1262	1242	98	1614	1613	100		1633	100
Albendazole tablets	38	38	100	15	14	91		16	100
Iron sucrose	74	67	90	124	124	100		111	93
FCM	72	72	100	129	129	100		134	100
Other (OGTT)	89	84	94	84	83	99		183	100
Hemoglobinometer	705	660	94	508	462	91		367	84
Consumable for hemoglobinometer	157	119	76	155	131	85		406	99
ASHA Incentives	**118**	**111**	**94**	**134**	**134**	**100**		**46**	**62**
National Iron Plus	54	47	87	47	47	100		45	61
Other	64	64	100	87	87	100		1	100
Strengthening service delivery	**4199**	**4140**	**99**	**4266**	**4151**	**97**		**4104**	**93**
Antenatal screening for blood disorder	152	145	96	258	250	97		106	69
Outreach camps	47	47	100	34	34	99		23	100
Monthly village Health and Nutrition Days	345	344	100	412	412	100		354	100
Line listing and follow-up of severely anemic women	43	43	100	73	69	95		23	70
Line listing of the women with blood disorders	14	14	100	0	0	100		0	100
Follow-up mechanism for severely anemic women and women with blood disorders	16	16	100	1	1	100		0.3	2
Diet services for Janani Shishu Suraksha Karyakarm beneficiaries	2899	2908	100	2855	2820	99		3234	94
Blood transfusion for Janani Shishu Suraksha Karyakarm beneficiaries	400	400	100	275	273	99		224	95
Operational cost for impregnation of bed nets	283	223	79	358	293	82		138	94
IEC/SBCC	**185**	**105**	**57**	97	97	99		6	100
Media mix of mid media / mass media	180	100	56	**91**	**91**	**100**		**4**	**100**
Interpersonal communication	1	1	100	6	5	92		2	100
Other	4	4	100	0	0	100		0	100
Printing	**785**	**336**	**43**	**497**	**489**	**98**		**494**	**96**
Printing of Mother Child Protection cards, safe motherhood booklets, etc.	777	328	42	451	443	98		488	96
Any other	8	8	100	46	46	100		6	79
Innovation	**1**	**1**	**100**	**5**	**5**	**100**		**8**	**59**
Various innovations*	1	1	100	5	5	100		8	59

Budget Items	FY 2022-2023				FY 2023-2024			
	P	A	% P/A	% of total	P	A	% P/A	% of total
Procurement of IFA red for pregnant women	1209	1209	101	13		1250	101	13
Procurement of IFA red for Women in reproductive age	445	445	100	5	475	475	100	5
Albendazole tablets for Pregnant women	30	30	100	0	30	30	100	0
Calcium tablets	2104	2104	100	23	2217	2217	100	24
Iron sucrose	107	107	100	1	110	110	100	1
FCM injection	271	271	100	3	287	287	100	3
Folic Acid	147	146	99	2	149	148	99	2
Glocuose strips and Sachets	149	149	100	2	150	150	100	2
ASHA incentives for mobilizing lactating mother	44	44	100	0	44	44	100	0
Line Listing of severely Anemic pregnant women	13	13	100	0	14	14	100	0
JSSK diet	4421	4371	99	48	4472	4420	99	47
JSSK (Blood transfusion)	235	235	100	3	260	260	100	3
Total	9,174	9,132	100	100	9,448	9,404	100	100

P = Planned, A = Approved

In terms of contribution to total MN budget **(Figure 1)**, strengthening of services and procurement of drugs and supplies contributed 47% and 46%, respectively, and were the replacement components. ASHA incentives account for 6% of the budget, while other components such as IEC/BCC, printing and innovation jointly receive less than 1% of the budget. Also, five out 26 minor budget heads constitute 80% of the MN. These minor budget heads are: diet services for pregnant women (37%), procurement of calcium tablets (19%), IFA tablets (9%), hemoglobinometers and consumables (9%), and printing activities (6%) **(Figure 2)**.

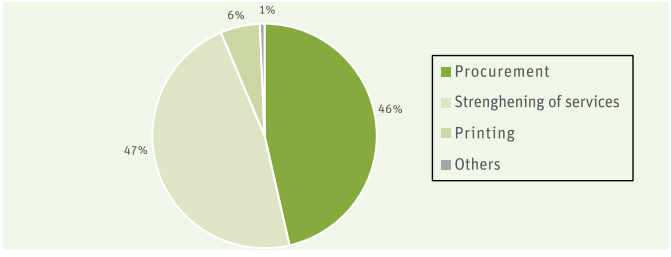
While most of the planned budget for MN interventions is approved, there are some notable changes (reductions of more than 10%) in the approvals process. In FY 2019–20, these pertained to budgets for folic acid tablets (22% reduction), consumables such as hemoglobinometers (24% reduction), ASHA incentives (13% reduction), and incentive to community volunteers for distributing insecticide-treated bed-nets (21% reduction), IEC/BCC (44% reduction) and printing activities (58% reduction).

In FY 2020–21, these reductions were only observed in allocation for hemoglobinometers (15% reduction) and incentives for distributing insecticide-treated bed-nets (18% reduction). In FY 2022–21, these were for hemoglobinometers (16% reduction), ASHA incentives (39% reduction), antenatal screening of pregnant women with blood disorder (31% reduction), follow-up of women with severe anemia (98% reduction), printing (31% reduction) and innovation (41% reduction).

TABLE 2: State-wise change in planned and allocation in maternal nutrition, National Health Mission, FY 2019–20 to FY 2021–22, India (INR million)

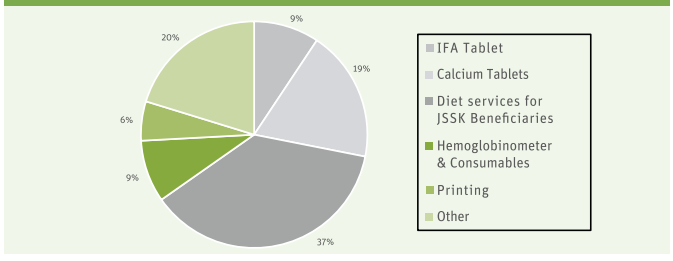
SN	States	Budget planned					Budget approved					Budget planned			Budget approved		
		FY 2019-20	FY 2020-21	% Change	FY 2021-22	% Change	FY 2019-20	FY 2020-21	% Change	FY 2021-22	% Change	FY 2022-23	FY 2023-24	% Change	FY 2022-23	FY 2023-24	% Change
1	A&N Island	2	2	↓ 25	2	↑ 4	2	2	↓ 14	2	↓ 3	0	1	100	0	1	100
2	Andhra Pradesh	268	385	↑ 43	950	↑ 147	332	385	↑ 16	940	↑ 144	619	619	0.0	619	619	0.0
3	Arunachal Pradesh	15	19	↑ 24	28	↑ 45	15	18	↑ 16	22	↑ 25	51	53	3.2	51	53	3.2
4	Assam	158	182	↑ 15	228	↑ 25	158	174	↑ 10	218	↑ 25	356	369	3.6	356	369	3.6
5	Bihar	899	555	↓ 38	653	↑ 18	756	555	↓ 27	653	↑ 18	1472	1472	0.0	1472	1472	0.0
6	Chandigarh	0	12	↑ 100	9	↓ 27	0	12	↑ 100	8	↓ 38	0	0	0	0	0	0
7	Chattisgarh	278	299	↑ 7	225	↓ 25	218	286	↑ 32	222	↓ 22	177	182	2.7	177	182	2.7
8	Dadar and Daman & Diu	7	6	↓ 11	6	↑ 1	6	6	↓ 3	6	↓ 3	5	5	0.0	5	5	0.0
9	Delhi	92	84	↓ 9	30	↓ 64	86	59	↓ 32	11	↓ 81	9	9	0.0	9	9	0.0
10	Goa	17	7	↓ 58	7	↓ 3	10	7	↓ 30	7	↓ 2	3	3	0.0	3	3	0.0
11	Gujarat	319	342	↑ 7	325	↓ 5	314	342	↑ 9	369	↑ 8	238	242	1.7	238	242	1.7
12	Haryana	47	110	↑ 133	105	↓ 4	47	103	↑ 117	98	↓ 5	73	73	0.0	73	73	0.0
13	Himachal Pradesh	92	56	↓ 40	26	↓ 53	80	56	↓ 31	26	↓ 53	6	6	0.0	6	6	0.0
14	Jammu and Kashmir	166	162	↓ 2	116	↓ 28	141	162	↑ 15	116	↓ 28	122	122	0.0	122	122	0.0
15	Jharkhand	247	742	↑ 201	317	↓ 57	171	735	↑ 331	265	↓ 64	888	931	4.8	888	931	4.8
16	Karnataka	233	153	↓ 34	204	↑ 33	208	153	↓ 27	204	↑ 33	158	216	36.9	158	216	36.9
17	Kerala	131	104	↓ 20	40	↓ 62	111	104	↓ 6	40	↓ 62	181	181	0.0	181	181	0.0
18	Ladhak	0	8	↑ 100	7	↓ 11	0	7	↑ 88	7	↓ 6	1	1	4.2	1	1	4.2
19	Lakshdweep	0	1	↑ 261	1	↑ 31	0	1	↑ 334	1	↑ 31	778	810	4.0	782	814	4.0
20	Madhya Pradesh	1365	936	↓ 31	1062	↑ 13	1122	890	↓ 21	893	↑ 0	591	674	14.0	591	674	14.0
21	Maharashtra	515	614	↑ 19	544	↓ 11	514	614	↑ 19	402	↓ 34	42	44	6.6	42	44	6.6
22	Manipur	36	41	↑ 16	55	↑ 33	32	39	↑ 22	48	↑ 23	63	67	6.1	63	67	6.1
23	Meghalaya	55	56	↑ 3	86	↑ 52	39	56	↑ 45	86	↑ 52	21	21	1.4	21	21	1.4
24	Mizoram	23	14	↓ 39	26	↑ 91	22	14	↓ 36	14	↑ 2	25	26	1.8	25	25	1.8
25	Nagaland	47	44	↓ 6	38	↓ 13	44	44	↑ 2	36	↓ 18	310	322	3.8	310	322	3.8
26	Odisha	654	380	↓ 42	431	↑ 14	567	380	↓ 33	419	↑ 10	25	25	0.0	25	25	0.0
27	Puducherry	21	9	↓ 57	21	↑ 132	21	9	↓ 58	20	↑ 126	122	122	0.0	122	122	0.0
28	Punjab	128	214	↑ 67	204	↓ 4	121	210	↑ 73	178	↓ 15	474	474	0.0	490	490	0.0
29	Rajatsthan	610	424	↓ 30	506	↑ 19	502	424	↓ 15	497	↑ 17	2	2	0.0	2	2	0.0
30	Sikkim	4	4	↓ 12	4	↑ 3	2	3	↑ 67	4	↑ 33	154	154	0.0	154	154	0.0
31	Tamil Nadu	125	265	↑ 112	258	↓ 3	83	265	↑ 219	258	↓ 3	426	426	0.0	426	426	0.0
32	Telangana	274	570	↑ 108	437	↓ 23	266	570	↑ 114	436	↓ 23	17	20	17.8	17	20	17.8
33	Tripura	65	76	↑ 17	33	↓ 56	65	41	↓ 37	33	↓ 19	1694	1697	0.2	1635	1635	0.0
34	Uttar Pradesh	1848	1271	↓ 31	1931	↑ 52	1587	1229	↓ 23	1929	↑ 57	52	61	17.7	50	61	21.9
35	Uttarakhand	56	116	↑ 109	83	↓ 29	47	109	↑ 130	76	↓ 30	17	17	0.0	17	17	0.0
36	West Bengal	103	238	↑ 130	156	↓ 35	103	238	↑ 130	150	↓ 37	1	1	0.0	1	1	0.0
Total		8900	8504	↓ 4	9155	↑ 8	7792	8302	↑ 7	8694	↑ 5	9,174	9,448	3.0	9,132	9,404	3.0

Figure 1: Contribution of major budget heads in maternal nutrition budget, FY 2021–22, India



Source: Authors, based on PIP and RoP, FY 2021–22

Figure 2: Contribution of major budget heads in maternal nutrition budget, FY 2021–22, India



Source: Authors, based on PIP and RoP, FY 2021-22

Further, if we look at the changes in allocated budget **(Table 3)** for FY 2020–21 and FY 2021–22, budget for procurements increased consistently (by 5% and 18%, respectively), while budget for strengthening of services remains almost same. However, change in all the components varies by greatly state. Research and innovations have not received much attention in planning or approvals. In FY 2022, overall a total of INR 18536 million were approved for two years i.e. FY 2022-24. For FY 2022-23, INR 9,132 million was approved for eleven activities related to maternal nutrition as mentioned in method section. This was 99.5% of the proposed budget which was INR 9,174 million. Further for FY 2023-24, INR 9,404 million was approved against INR9,448 million (99.5% of proposed). The largest component of this budget was diet for pregnant women during hospital stay (~50%), followed by procurement of calcium tablets (~24%) and procurement of IFA for pregnant and lactating women (~13%). The biggest component which comprised of 70% of total biennial MN budget was JSSK diet and procurement of calcium tablets. This was followed by procurement of IFA tablets for pregnant, lactating and women in reproductive age which was 17% of the total MN budget.

Table 3: Change in allocation under each major budget head in maternal nutrition, National Health Mission, FY 2019–20 to FY 2021–22, India (INR million)

SN		2019–20 (in 100,000)	2020–21 (in 100,000)	Change %	2021–22 (in 100,000)	Change %
1	Procurement	3249	3426	5.4	4038	17.9
2	ASHA incentive	111	134	21.1	46	-66.0
3	Strengthening of services	4140	4151	0.3	4104	-1.2
4	IEC/SBCC	105	97	-7.7	6	-94.3
5	Printing	138	489	71.8	494	1.0
6	Innovation	0	5	100.0	8	64.3
	Total	**7,743**	**8,302**	**7.2**	**8,694**	**4.7**

Discussion

The salient findings from the tracking of MN budgets within health sector plans are as follows:

1. Six major budget heads and 26 minor budget heads are available for planning at district, state and national level.
2. Most of the planned budget was received viz. INR 7,942 million (89% of planned) in FY 2019-20, INR 8,303 million (98% of planned) in FY 2020-2, INR 8,694 million (95% of proposed), INR 9132 million (99.5% of planned) in FY 2022-23 and INR 9404 million (99.5% of planned) in FY 2023-24.
3. Procurement and strengthening of services makes up 93% of the MN budget and drives the overall budget. Furthermore, demand generation and innovation are insufficiently used for planning.

These findings, however, are not devoid of certain limitations. First, any maternal interventions funded by state budget, or any other source, are not included in the study due to unavailability of data. Second, demarcating budget for routine activities such as program management, drugs and warehousing, and human resources is difficult, and hence was not included.

The analysis draws attention to interesting patterns. In particular, it is commendable to note a consistent increase in MN budget in the three-year period (increase of 7% in FY 2020–21 and 5% in FY 2021–22). This increase may be attributable to the uptake of the AMB program (2018) that specifically focuses on addressing anemia in a holistic manner.

The study period coincided with the pre- and post-COVID periods. Reduced mobility, disruptions in supply chain mechanisms, and restrictions may have an impact on the reduction in planned funds in certain community-based components such as incentives, demand generation, and hemoglobinometer procurement from FY 2020–21 onwards. These adjustments, however, differ by state, and other factors such as the availability of unspent balances or drugs and supplies from the previous year may not be disregarded (Berman et al., 2017, Chaudhary et al., 2020). With the available data, no direct link between these changes can be found.

The majority of the required MN interventions are apparently covered by NHM plans; however, budget for three major areas is left out. First, a weighing machine (weight), a stadiometer (height), hemoglobinometer, and mid upper arm circumference (MUAC) tapes are used to measure the nutritional health of pregnant women. Only anemia testing information is readily available. Although it is likely that these are covered by state government budgets or through untied funds (flexible funding for local action) granted to health facilities (MoHFW, 2006), but these cannot be discerned through the PIP/RoP financing documents. Such disaggregated data would be useful in identifying gaps and making policy decisions. Second, no training or courses on MN components are planned for frontline workers, service providers, or program administrators. Third, resources and job aids relating to nutrition instruction and counseling are absent. State level Maternal Nutrition Mission implemented in Madhya Pradesh has demonstrated that additional funds are required in training and supplies, apart from routine MN activities (NHM, MP, 2020, RoP 2020–21).

These findings were shared on a regular basis with union and state health teams and received positive feedback. While such analysis identifies areas for improvement, no direct causal association can be claimed because budgets are influenced by many other factors, including the state's own capacities, policies and priorities (Rajan et al., 2016, Barsa et al, 2021, William et al., 2021).

Conclusion

Maternal nutrition needs more strengthening in terms of the provision of guidelines, the relevant technical package, and the necessary resources, including finances, to improve coverage and outcomes in India. Tracking of these in health sector budgets has offered valuable insights by providing planning and allocation patterns and highlighting under-utilized components. Sharing these regularly with state and national planners has the potential to cre-

ate opportunities for bridging gaps and plan adequately. In addition to referencing the health system, the tracking of budgets with similar methodologies within other sectors (e.g., Women and Child Development, National Rural Health Mission) is recommended for developing an understanding of all-inclusive MN financial outlays.

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Delivering Preconception Nutrition Services in India

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Background

Most Indian women enter pregnancy with poor nutrition: 19% of the women of reproductive age group (15–49 years) are thin (body mass index, BMI <18.5 kg/m2) and 24% obese (BMI ≥ 25 kg/m2), 57% anemic (Hemoglobin <12 g/dL) and 7% became mothers in adolescence. There is not always enough time to correct poor nutrition during pregnancy, especially if a woman is suffering from one or more nutrition deficits (anemic, underweight, obese, micronutrient deficient or adolescent) before she becomes pregnant or receives care too late in pregnancy. Formation of fetal organs is initiated soon after conception and much before the woman arrives for the first antenatal checkup. Some micronutrient deficiencies, including folate deficiency, have severe consequences on foetal development very early in pregnancy, before a woman seeks preconception care or even realizes she is pregnant.

Although improved preconception care has attracted academic and policy attention in recent years, but still falls far short of being provided routinely. Programs in India have traditionally focused on delivering nutrition services to women 'during pregnancy' through antenatal care delivery platforms. Provision of a basket of nutrition services to women before they enter pregnancy has been a challenge owing to huge numbers and no robust delivery platform. among other factors. In high fertility districts, married women are targeted for family planning services albeit with limited reach, but no nutrition services are provided. Unmarried adolescents are covered under weekly iron folic acid supplementation program, but once married, often times, they are also left out of both family planning and weekly iron folic acid supplementation programs.

There has also been evolving global guidance on nutrition intervention package for women in preconception. In 2013, World Health Organization laid out a list of recommendations on preconception care, including nutrition. Soon after, WHO regional office for South-East Asia hosted a regional expert group consultation to seek expert guidance on a regional agenda. More recently, in 2022, UNICEF published a UNICEF programme guidance on maternal nutrition which includes recommendations for preconception nutrition. For India, key constraints in taking preconception nutrition interventions to-scale have been evaluations on efficacy and effectiveness of intervention packages on women's nutrition itself.

Efficacy of the preconception intervention package to reduce low birth weight and small-for-gestational-age was highlighted through the Women and Infants Integrated Interventions for Growth Study (WINGS) longitudinal community-based South Delhi trial. This trial tested the delivery by providing nutritional care during preconception and continuing the nutritional care through pregnancy which showed improved birth weight, length and reduced risk of low birth weight by 24%, more than half of which was attributed to preconception interventions. The package was not only a nutrition intervention, but also included screening and treatment of medical conditions, provision of iron and folic acid and multiple micronutrients, providing egg or milk if BMI was less than 21 kg/m2, promoting positive thinking and problem-solving skills, personal, menstrual and hand hygiene.

However, WINGS trial was a RCT trial. Integrating preconception nutrition interventions in regular programmes requires robust platforms that reach newly-wed women. Opportunities are available through the National Rural Livelihood Mission which has largest membership of women's self help group (SHG) networks, of women of reproductive age that meet on a periodic basis as part of the savings group. Opportunities are also available through the family planning platforms (such as Mission Parivar Vikas) as well as where possible, in expanding antenatal clinics' packages to include preconception care as well at facility level.

Layering nutrition for newly-wed women via the National Rural Livelihood Missions has been demonstrated through the Swabhimaan programme effectiveness trial across Bihar, Chhattisgarh and Odisha, which aimed to develop a programmatic know-how to reach newly-wed women through the State Rural Livelihood Mission promoted women SHG platform, which anyway meets on a weekly basis and integrates some of the nutrition services in the village health and sanitation day service delivery platform. Some of the activities undertaken through the State Rural livelihood platform to reach newly-wed women with a package of services are depicted in **Box 1**.

BOX 1: Swabhimaan programme package for newly-wed women

1) SHG members keep tab on newly-wed couple in their neighbourhood.
2) SHG members motivate newly-wed women to join the SHG as members.
3) Once they become members motivate them to register their marriage

4) As an incentive to, the new entrant is provided a welcome suitcase with the following
   a. Soap
   b. Iodized salt packet
   c. Folic acid tablet strip
   d. IFA tablet strip for 7 days
   e. Condom
   f. Pregnancy testing kit
   g. Bed net
   h. Calcium
   i. Sanitary napkin
   j. A pictorial aid explaining the benefit of each of these
5) The new entrant is also told the SHG rules and that she should be coming on weekly basis for the savings meetings
6) SHG member motivates the newly-wed to attend the village health sanitation and nutrition day. Here her height, weight, clinical signs of anemia are checked and her MUAC is be taken. BMI calculator charts are provided and those with BMI <18.5 or with MUAC less than 21 or height less than 145 cms are requested to come for a monthly counseling and cooking demonstration session. These sessions follow a topic-wise calendar with an overall aim to prevent pregnancies too early, too many and too soon, addressing social norms in a gentle way to prevent women from eating last and least and more to focus on delay inpregnancy to 20 years and preventing repeated pregnancy. topics will be based on problems in that area.
7) The newly-weds are also encouraged to either during the village health and nutrition day if the services are available get the
   a. UTI check-up
   b. Malaria testing
   c. Screening and discussion on any reproductive health problems and how to tackle any infections
8) Setting up women reproductive health check-ups, entitlement and information dissemination camps during the annual women self-help group meets at block and district
9) Encouraging biannual newly-wed couple meetings, on biannual basis
10) SHG members raising issues of violence in gram sabhas
11) Newly-wed encouraged to make toilets in their homes.

This is one of the few impact evaluations which tests the impact of women's nutrition interventions on women's nutrition themselves rather than childbirth outcomes alone. The results of the endline impact evaluation will be forthcoming.

Another programme research 'healthy parents, healthy child initiative' layering the preconception nutrition interventions through health platforms has been initiated in Nashik district, Maharashtra, which tested the effectiveness of the WHO preconception care model in real time programme settings. For this programme indicators are - women below 19 years of age counselled for postponing pregnancy, women having body mass index (BMI) < 18.5 Kg/m2 counselled for increasing the body weight through dietary intervention, women having BMI ≥ 25 Kg/m2 counselled for weight reduction through dietary intervention and exercise guidance, women having mild/moderate anemia given IFA for 3 months and the resulting change in their Hb level, women having tobacco and alcohol use reporting cessation before conception, women received folic acid three months before pregnancy, women receiving albendazole every six months, Women reporting symptoms suggestive of STI/RTI treated adequately, women having diagnosed chronic medical conditions receiving care by specialist, women accepting contraception for postponing pregnancy until the risk is managed and women receiving behavior change counseling for general health and pregnancy.

Then, coupling family planning and nutrition interventions is needed for both age-groups considering the lower BMI among adolescents and young women wanting child later. The recently launched Anemia Mukt Bharat (Anemia free India) aimed to tap the Mission Parivar Vikas Platform, which is a family planning platform, to reach basic weekly iron folic acid supplementation services to the newlywed and young married women (20–24 years) as target beneficiaries. However, little is known about whether this platform was effective at-scale or the system challenges associated with it.

Overall, the triple burden of malnutrition (thinness, obesity, anemia) in preconception is well-known as also the additional additive effects preconception nutrition interventions have on birth outcomes. While several efforts are underway testing various platforms (expanding antenatal platforms to include preconception, family planning platform, SHG platform), taking them to scale is required through government systems, workforce and budgets. This will require understanding the delivery challenges and addressing them.

In order to initiate the dialogue, the author proposes the below algorithm to reach preconception women with nutrition services through health platforms.

Universal nutrition services for all women in the preconception period

All women in the preconception phase, irrespective of nutritional status, should be provided the following four services:

1. Screening for nutritional risk.
2. IFA (weekly, 60 mg iron, 500 mcg folic acid) and folic acid (daily, 400 mcg) supplementation (latter if couple is planning to conceive).
3. Deworming (400 mg albendazole; not to be given if couple

is planning to conceive; to be followed up after first trimester of pregnancy in these cases).

4. Counseling on: healthy eating and supplementation; consumption of iodized salt/double-fortified salt; restriction of caffeine intake; avoiding tobacco, alcohol and harmful substances; lifestyle; personal hygiene; oral health; family planning; emotional health and domestic violence; the role of the male/husband in preconception care; food subsidy schemes such as Public Distribution Scheme (PDS); and social security entitlements for pregnant women.

ANM is the primary service provider for the universal package. There is also potential in linking SHG members in counseling activities.

Management of preconception malnutrition

Management of preconception malnutrition will be based on type of risks and initially led by the ANM **(Box 2).**

BOX 2: Management approaches

Short (Height <145 cm)
Individual counselling on diet and family planning

Young (Age <20 years)
Individual counselling on diet and family planning

Thin (BMI <18.5 kg/m² or MUAC <23 cm)
Individual counselling on diet and family planning

MUAC <21 cm
Additional food supplementation and fortnightly home visit by ASHA or self-help group member

Obese (BMI >=25 kg/m²)
Counselling on diet, physical activity and risks of maternal obesity

Confirmed cases of malaria, diabetes, hypertension, anemia and other underlying conditions
Management as per Government of India (GoI) guidelines

Current use of tobacco, alcohol, drugs and excessive caffeine
Intensive behavioral counselling services, relevant therapies as per GoI guidelines

To conclude, integrating preconception interventions into current health systems and taking care of those by nutritional risk should be a priority and hence defining the packages and demonstrating them at-scale through government systems and machinery is critical.

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Test, Treat and Talk Approach for Anemia: What Can Work?

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Introduction

Anemia is one of the key factors that impedes the optimal well-being of individuals, especially women and children, all over India. The National Family Health Survey-5 (NFHS-5, 2019–2021) revealed high prevalence of anemia (>40% prevalence) in all age groups. Approximately 67% of children aged 6–59 months, 57% of non-pregnant women aged 15–49 years, 52% of pregnant women aged 15–49 years, 59% of women aged 15–19 years, 25% of men aged 15–49 years, and 31% of men aged 15–19 years were found to be anemic.[1]

Nearly 50% of the anemia identified is due to iron deficiency, especially in women and children. Other causes include infections such as malaria and tuberculosis, hemoglobinopathies – blood-disorders that affect red blood cells, such as thalassemia – and deficiencies of other nutrients such as vitamin B_{12}, folate and vitamin A.[2] Anemia affects the cognitive development, behavior, and physical growth of infants, preschool, and school-aged children. It weakens immunity in all age groups, and adversely impacts the capacity for physical work in adolescents and adults. During pregnancy, anemia increases the risk of maternal mortality, preterm birth, and infant mortality.

> **"Nearly 50% of the anemia identified is due to iron deficiency"**

Approaches under Anemia Mukt Bharat

The National Anemia Prophylaxis Program was launched in the 1970s, focusing on distributing iron and folic acid (IFA) tablets to pregnant women and children under five years of age. In 2013, India launched the weekly IFA supplementation program for adolescents. Overall, the reported compliance in respect of IFA tablets across various studies ranged from 64% to 77%.[3,4] Supply chain disruptions leading to frequent stock-out of tablets at various levels of healthcare facilities has been identified as a key factor for poor compliance and low IFA coverage.

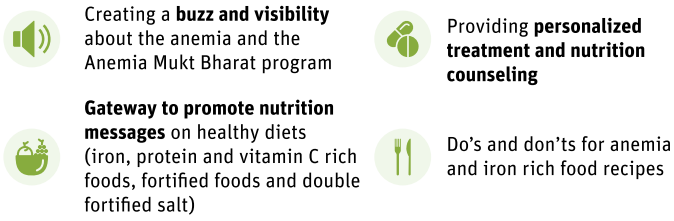
Taking into account the failure of previous approaches, a comprehensive new life-course and inter-sectoral approach to anemia control was adopted. In March 2018, the Government of India launched Anemia Mukt Bharat (AMB), a flagship program of the Ministry of Health and Family Welfare (MoHFW) under the Prime Minister's Overarching Scheme for Holistic Nutrition (POSHAN) Abhiyaan.

The AMB has adopted a strategy of six interventions, six target beneficiaries and six institutional mechanisms (6*6*6). The beneficiaries of its life-cycle approach are pregnant women, lactating mothers, women of reproductive age, adolescents, children under five, and schoolchildren. The six target interventions include prophylactic supplementation with IFA; deworming; a year-round behavior change communication (BCC) campaign; point-of-care testing and treatment of anemia using digital methods; the mandatory provision of IFA-fortified foods in government-funded public health programs; and intensifying awareness, screening and treatment of non-nutritional causes of anemia. One of the most well received and most successful interventions for increasing awareness, screening and treatment of anemia was Test, Treat and Talk (T3).

Test, Treat and Talk (T3) camps

Organizing day-long T3 camps **(Figure 1)** is an integral component of AMB's demand generation, social, and mass mobilization strategy. On average, 500 beneficiaries, irrespective of any specific group, are covered, based on the manpower available and the estimated time required for carrying out the three components of T3 for each person.

FIGURE 1: The key pillars of Test, Treat and Talk (T3) camps



Source: *Government of India. Ministry of Health and Family Welfare. Child Health Division. Test, Treat, and Talk anemia camps: Guidance note for state program manager. September. 2019. T3-Guideline.pdf [Internet]. [Accessed 2021 Nov 27]; available on: https://anemiamuktbharat.info/wp-content/uploads/2019/09/T3-Guideline.pdf*

A typical T3 camp consists of three parts: i) testing for anemia using a digital hemoglobinometer (invasive), ii) dose-appropriate treatment with IFA tablets, and iii) talks on iron, protein, vitamin-C-rich food and healthy lifestyle by doctors, nutritionists and/or dieticians. Persons identified with severe anemia are referred to the nearest government health facility for treatment.

In a span of three years, from 2018 to 2020, approximately 5 lakh (500,000) T3 camps catered to almost seven crore (70 million) beneficiaries in various government schools, colleges and institutions.

> **"The usefulness of T3 camps as a high-level advocacy tool has been well documented"**

Importance of T3 camps

T3 camps served as an important proof of concept, especially for point-of-care testing for anemia. Initial camps were held at the headquarters of key government ministries in Delhi, such as the MoHFW, Women and Child Development, and NITI Aayog. T3 camps were also held across all states. Screening of officials of these key ministries and real-time proof of the feasibility and effectiveness of these T3 camps provided a huge thrust to the roll-out of the AMB program. The usefulness of T3 camps as a high-level advocacy tool, above and beyond their value for BCC among the target population, has been well documented during POSHAN months and fortnights celebrated over the last three years.

The Honorable Ministers of Health and Women & Child Development inaugurate the T3 Camp at Nirman Bhawan, New Delhi

The T3 camp is an excellent platform for evidence-based intervention and creating awareness at one go **(Box 1)**. These camps will help in the early diagnosis and management of anemia. They can also be an effective platform for IEC/BCC interventions, especially interpersonal communications, apart from being venues for counselling, focus group discussions and information dissemination activities by means of group media such as nukkad natak (street theater) and folk theater.

BOX 1: Requirements for a T3 camp

		Quantity
Manpower		
1	Medical officer/resident/intern	1
2	ANM/lab technician	1
3	Dieticians/nutritionists	2
4	Volunteers	2
Equipment		
5	Digital hemoglobinometers	2
6	Consumables: Microcuvettes/strips lancets, alcohol swab, biomedical waste disposal bag, IFA tablets, gloves	As per requirement

Testing is the gateway for the prevention of anemia. For this purpose, the role of point-of-care testing devices such as digital hemoglobinometers is very important. Quality control of point-of-care testing is essential for ensuring accurate test results. The diagnostics in combination with IFA supplementation, food fortification, parenteral (non-oral) means of administration of iron for moderate to severe anemia and data integration are the key to achieving AMB targets.

BOX 2: Timelines and preparations needed for organizing a T3 camp

20 days before camp	Meeting between state NHM AMB nodal officer and Department of Education, partner Medical and Nutrition college and Development partners
15 days before camp	State-level senitization of district AMB nodal officers
10 days before camp	District-level sensitization
1 day before camp	Setting up of a camp
Camp day	Organize a T3 camp and record the information and upload it on the Jan Andolan website

Challenges in organizing a T3 camp

One of the challenges in organizing a T3 camp is the lack of awareness among health personnel. The resources and logistics required for T3 camps are not readily available at the proposed site. T3 camps have been so far organized at sites inaccessible to marginalized populations. Hence, although the MOHFW has provided funds to states for conducting T3, there is a lack of a platform to aggregate the data to assess the reach of AMB T3 camps. Additionally, availability of qualified skilled nutrition counselor is another challenge because of which follow up with anemic individuals during the T3 camps is often neglected.

Pandemic and T3 camps

The COVID-19 pandemic has disrupted preventive and treatment services targeting anemia. Besides loss of income due to lockdowns, COVID limited people's ability to access the health system. The high rate of COVID-related morbidity among health care workers was another reason for staff shortages and disruptions to health services. Organizing T3 camps in India declined after the SARS-CoV-2 outbreak, due to lockdowns, the suspension of health services (particularly non-emergency services), and massive mobility restrictions.

> **"T3 camps need to be scaled up, integrated with routine health care, and held more regularly"**

Conclusion

As per the NFHS-5, more than half of the children, adolescents and women are anemic in India. The AMB program, with its 6*6*6 strategy, focuses on the prevention and control of anemia across all age groups. Point-of-care diagnostics are critical for identifying and treating anemia so as to achieve targets laid out in AMB. The T3 camps are highly effective as an advocacy tool for AMB overall, and specifically for the diagnosis and treatment of anemia and for BCC interventions. T3 camps need to be scaled up, integrated with routine healthcare, and held more regularly in order to achieve control of anemia at state and national level.

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Management of Severe Anemia in Pregnancy Using IV Iron Sucrose

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Maternal anemia and maternal mortality

There is strong epidemiological evidence linking maternal anemia to maternal mortality.[1] Severe anemia is singularly associated with increased risk of maternal mortality.[2] According to a World Health Organization (WHO) analysis of 3,12,281 women across 359 health facilities in 29 countries, the risk of maternal mortality is higher in those with severe anemia (defined as Hb concentrations of <7 g/dl) compared to the ones without severe anemia (odds ratio [OR] 2.36; 95% CI 1.60–3.48).[2] These estimates, however, are conservative.[3] A linear association between maternal anemia and death suggests that with each 1 g/dl increase in maternal Hb, there is a 29% reduction in maternal mortality (OR 0.71; 95% CI 0.60–0.85).[4] It is reported that there is a two- to three-fold increase in perinatal mortality rate when maternal hemoglobin levels fall below 8.0 g/dl, and an 8–16-fold increase when it falls below 5.0 g/dl.[5,6]

In India, the prevalence of severe anemia in pregnancy dropped from 2.2% to 1.3% between NFHS 3 (2005–6) and 4 (2015–16) **(Figure 1)**.[7]

According to Health Management Information System (HMIS) data, more than 60% of the total obstetric complications are treated with blood transfusion **(Table 1)**.[8] A previous report by Perewusnyk[9] has suggested that the use of IV iron sucrose (IVIS) could reduce the rate of blood transfusion to below 1% of pregnant anemic women per year. Due to the perils associated with blood transfusion, this is considered a last resort for the management of severe anemia.[10]

> **"IV iron sucrose (IVIS) could reduce the rate of blood transfusion to below 1% of pregnant anemic women per year"**

Use of IV iron sucrose

The use of IVIS to treat iron deficiency anemia was first demonstrated in the 1940s.[11] Subsequently, numerous observational and experimental studies have been conducted on IV iron sucrose in pregnant mothers globally.[12,13] Studies have demonstrated the safety and efficacy of IVIS in increasing Hb levels and replenishing iron stores among pregnant and post-partum women in India.[14,15]

Figure 1: Prevalence of severe anemia in pregnant women (15–49 years) in different states in India

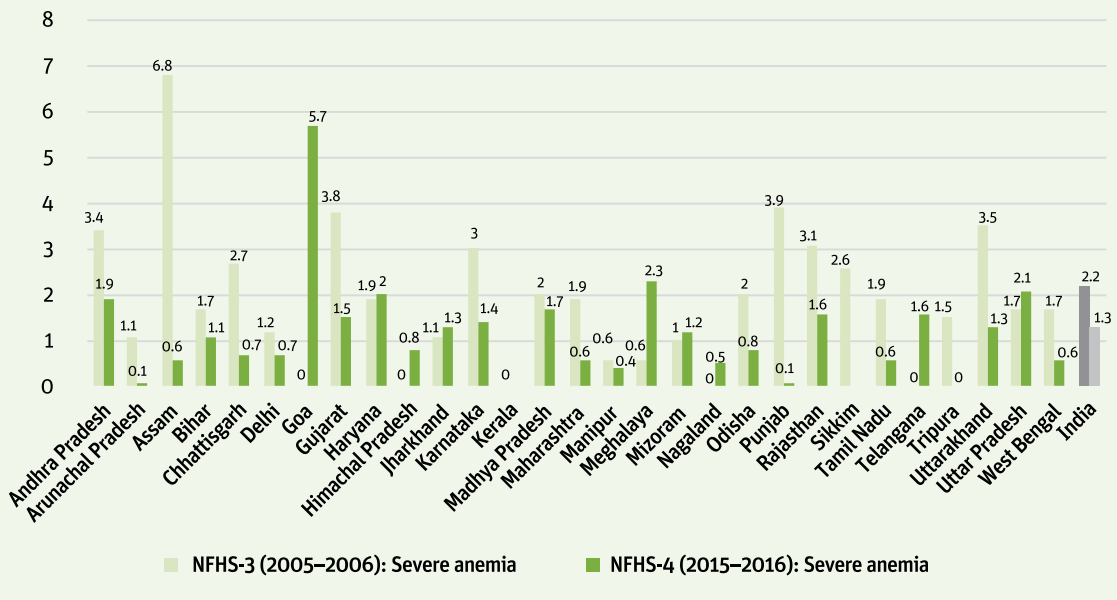

Table 1: Proportion of complicated pregnancies treated with blood transfusion to total women with obstetric complications attended

	States and UTs	FY 2018–19	FY 2019–20	FY 2020–21
1	All India	53.9	60.3	61.6
2	A&N Islands	37.8	96.2	64.8
3	Andhra Pradesh	59.7	90.5	69.4
4	Arunachal Pradesh	34.8	63.4	75.7
5	Assam	35.9	48.6	50.7
6	Bihar	36.5	40.0	43.8
7	Chandigarh	93.3	92.7	97.8
8	Chhattisgarh	78.7	89.3	80.4
9	Dadra& Nagar Haveli and Daman and Diu	100.0	100.0	78.3
10	Delhi	63.3	75.9	86.6
11	Goa	75.6	90.7	84.5
12	Gujarat	88.3	93.6	91.1
13	Haryana	72.2	70.3	69.7
14	Himachal Pradesh	60.9	63.4	51.8
15	Jammu & Kashmir	64.8	64.0	97.2
16	Jharkhand	44.7	65.6	66.6
17	Karnataka	52.1	61.5	68.5
18	Kerala	52.7	51.6	67.6
19	Lakshadweep	84.8	NA	100.0
20	Ladakh	NA	NA	37.0
21	Madhya Pradesh	51.3	57.7	59.9
22	Maharashtra	85.0	91.6	94.9
23	Manipur	47.3	50.0	75.8
24	Meghalaya	53.9	54.1	59.2
25	Mizoram	23.6	45.2	28.5
26	Nagaland	46.8	76.6	67.7
27	Odisha	84.9	91.2	92.0
28	Puducherry	94.6	75.0	67.5
29	Punjab	69.6	64.4	63.5
30	Rajasthan	74.1	78.6	73.3
31	Sikkim	73.2	54.9	63.3
32	Tamil Nadu	33.3	34.4	37.0
33	Telangana	36.9	40.5	45.8
34	Tripura	65.4	81.8	69.1
35	Uttar Pradesh	35.4	44.9	94.3
36	Uttarakhand	55.7	69.1	40.8
37	West Bengal	78.4	76.8	71.2
	0–24.99%			
	25–49.99%			
	50–74.99%			
	75–100%			

Source: Health Management Information System, Indian Ministry of Health and Family Welfare (MoHFW)

According to global guidelines, IV iron should be used in people who are intolerant of, or do not respond to, oral iron treatment, or those in the range of moderate to severe anemia (Hb < 9.5 g/dl). Escalation to specialist medical care is required if anemia is severe (Hb<7.0 g/dl) and/or associated with significant symptoms or advanced gestation (> 34 weeks), or if the Hb is failing to respond after 2–3 weeks of oral iron correctly taken.

In India, a multi-centric, open-label, two-arm randomized controlled trial (RCT) was conducted on 2,018 pregnant anemic women to demonstrate the effectiveness of IVIS over oral iron in improving clinical outcomes. The RCT was supported by WHO and the Indian Ministry of Health and Family Welfare (MoHFW). The study could not provide sufficient evidence to demonstrate the superiority of IVIS over standard (oral) therapy in reducing adverse maternal outcomes during peri-partum and post-partum period (adjusted OR 0.95; 95% CI 0.70–1.29). However, the requirement for blood transfusion during delivery and post-partum period was significantly less in the IVIS arm as compared to the standard arm, specifically among those with severe anemia (subgroup adjusted OR 0.31; 95% CI 0.10–0.98). The study concluded that IVIS is a safer and cost-effective alternative treatment of severe anemia in pregnancy in comparison to oral iron.[16,17]

Looking at states

Tamil Nadu (TN) has successfully implemented the administration of IVIS in primary healthcare settings since 2009. Women with Hb less than 7 gm/dl were given two doses (400 mg in total) of iron sucrose. The success of the TN practice motivated other states to implement it in their healthcare facilities. Prescription of this medication was common in both public and private sectors. Some states also included IVIS in their Program Implementation Plans (PIP). However, documents revealed that the majority of women receiving IVIS had mild to moderate anemia with no standardization in prescription patterns.[18] There was also variation in the dose, mode of administration (slow infusion or bolus), and the duration of infusion. This pointed to the pressing need for standard guidelines to ensure rational use of this preparation.[18,19]

The RCT findings in India and a review of operational regulations were used to formulate guidelines for the country.[16] Anemia Mukt Bharat recommends the use of IVIS during weeks 13–34 of pregnancy among those with severe anemia (Hb 5.0–6.9 g/dl). In cases of moderate anemia (Hb 7–9.9 g/dl), IVIS is advised only if oral iron is not tolerated; compliance is likely to be poor or improvement is less than 1 gm/dL after one month of oral IFA treatment.

Current status

HMIS data from 2020 shows that more than 75% of severe anemic women in 14 states / Union Territories (UTs) have received treatment. The IVIS data, compiled from the PIPs for 2019–20, 2020–21 and 2021–22, shows that only three of these 14 states (Jammu & Kashmir, Maharashtra and Gujarat) have received funding for IVIS procurement since 2019 **(Table 3)**. Likewise, of the total 16 states/UTs treating 50–75% of severe anemic women in 2020, five have been procuring the IVIS since 2019, two since 2020, and one since 2021. Out of 36 states/UTs, 19 have not even proposed the procurement of IVIS since 2019.

TABLE 2: Excerpt from Anemia Mukt Bharat guidelines on management of severe anemia in pregnancy

If Hb is 5.0–6.9g/dl (severe anemia)	
First level of treatment	Management of severe anemia in pregnant women to be done by the medial officer at District Hospital (DH) /Comprehensive Emergency Obstetric Care (CEmONC) Centers. Treatment using IV iron sucrose by the medical officer. *Immediate hospitalization recommended in the third trimester of pregnancy at a health facility where round-the-clock specialist care is available.
Follow-up after first level of treatment	After the first level of treatment, monthly or as prescribed by the medical officer.
Treatment protocol if no improvement	As prescribed by the medical officer.
Severe anemia – women with Hb <5g/dl	
First level of treatment	Immediate hospitalization irrespective of period of gestation where round-the-clock specialist care is available. This is to be done till normal level of Hb is achieved.

Source: Anemia Mukt Bharat , Operational guidelines for Programme Managers, Ministry of Health and Family Welfare, April 2018.[20]

TABLE 3: State-wise status of procurement of IV iron sucrose

	States/UTS	Budget allocated for IVIS (Yes/No)	Year	Quantity	Unit cost
1	A&N Island	N			
2	Chandigarh	N			
3	D&NH and D&D	N			
4	Delhi	N			
5	Ladakh	Y	2020	100	Rs 100/injection
6	Lakshadweep	N			
7	Puducherry	Y	2019	32000	Rs 90/injection
8	Arunachal Pradesh	N			
9	Manipur	N			
10	Mizoram	N			
11	Meghalaya	Y	2019	12500	Rs 200/unit
12	Nagaland	N			
13	Sikkim	N			
14	Tripura	N			
15	Andhra Pradesh	N			
16	Goa	N			
17	Karnataka	Y	2019	600000	Rs 15/ampoule
18	Kerala	N			
19	Punjab	Y	2020	187500	Rs 18/ampoule
20	Tamil Nadu	Y	2020	1044628	Rs 14.86/ampoule
21	Haryana	Y	2021	213663	Rs 14.10/IVIS
22	Himachal Pradesh	N			
23	Jammu and Kashmir	Y	2019	9000	Rs 100/IVIS
24	Uttarakhand	Y	2020	27960	Rs 20/IVIS vial
25	Bihar	Y	2020	340212	Rs 13.29/ampoule
26	Chhattisgarh	N			
27	Gujarat	Y	2019	465546	Rs 14.5/injection
28	Jharkhand	Y	2019	12000	Rs 500/set
29	Madhya Pradesh	Y	2020	900000	Rs 13.41/unit
30	Maharashtra	Y	2019	77500	Rs 30.9/set
31	Odisha	N			
32	Rajasthan	N			
33	Telangana	Y	2019	90000	Rs 16/ampoule
34	Uttar Pradesh	N			
35	West Bengal	N			
36	Assam	Y	2019	290638	Rs 14.13/ampule

Personal communication – Institute of Economic Growth, New Delhi, India
Source: Anemia Mukt Bharat Dashboard. As at 25 January 2022.

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Health Systems Strengthening Approach for Anemia Reduction in Jharkhand

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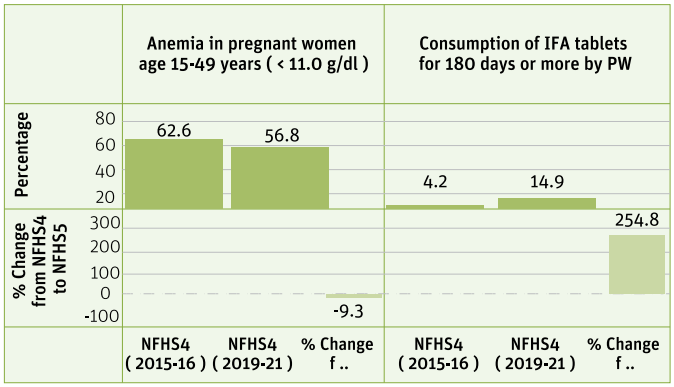
Anemia increases the risk of adverse maternal and neonatal outcomes, as well as impairing a child's development and learning for life.[1] The Government of India's National Nutrition Strategy aims to reduce the prevalence of anemia by at least 3% annually.[2]

According to the National Survey of 2019–21, Jharkhand saw a 9.3% drop in the prevalence of anemia among pregnant women aged 15–49 years. This happened over the course of six years, between the national surveys of 2015 and 2021. During the same period, the consumption of iron and folic acid (IFA) tablets for 180 days or more by pregnant women increased from 4.2% in 2015–16 to 14.9% in 2019–21 **(Figure 1)**.[3]

FIGURE 1: Trends in the prevalence of anemia among pregnant women and consumption of iron-folic acid (IFA) tablets between 2015–16 and 2019–21



Since 2019–20, the state has focused on the delivery of anemia reduction interventions under Anemia Mukt Bharat (AMB) (Government of India's Anemia-Free Strategy).[4] One of the key beneficiaries under AMB is the pregnant woman. There is mounting evidence that health systems that can deliver services equitably and efficiently are critical for achieving improved health status.[5]

According to the World Health Organization (WHO)[5], the health system 'consists of all the organizations, institutions, resources and people whose primary purpose is to improve health'.[1] The WHO framework outlines six building blocks of health systems: 1) service delivery, 2) health workforce, 3) information, 4) medical supplies and technologies, 5) financing, and 6) leadership/governance. The Government of Jharkhand has systematically assessed bottlenecks and invested in each of these system components in order to deliver the anemia reduction strategies as outlined below.

> **"Strengthening health systems that can deliver services equitably and efficiently are critical for achieving improved nutrition and health status"**

1. Service delivery: For combating maternal anemia under AMB, interventions are layered within the health systems. Prophylactic and treatment doses of IFA supplementation, deworming, maternal nutrition counseling, and testing using digital hemoglobinometer are interwoven into the routine ante-natal check-ups. Even during the pandemic, adaptations of the national Social Behaviour Change Communication (SBCC) package of 'Solid Body, Smart Mind' in six local languages were disseminated through the use of LED-equipped vans and WhatsApp messaging during POSHAN Maah (National Nutrition Month) and POSHAN Pakhwada (Nutrition Fortnight). The state prioritized the procurement of the revised formulation of IFA from 100 mg to 60 mg of elemental iron and 500 µg of folic acid. Even during the onset of the COVID-19 pandemic, when most services were either suspended or disrupted heavily, the Village Health, Sanitation and Nutrition Day (VHSND), a community-based platform to deliver essential health and nutrition services in India, was reinstated within a month of the lockdown and the provision of

IFA tablets, testing of hemoglobin using digital hemoglobinometers, provision of deworming tablets, and nutrition counseling continued.

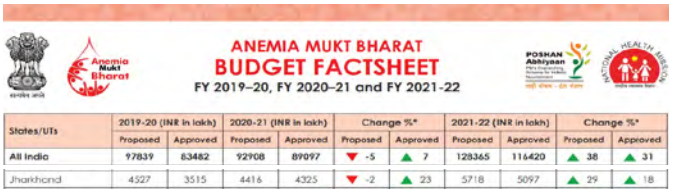
2. Health workforce: The roll-out of AMB interventions for pregnant women requires building the capacities of community-based frontline workers such as Auxiliary Nurse Midwife (ANM), ASHA (Accredited Social Health Activist, an incentivized trained female community health worker in India) and anganwadi worker (rural childcare center). In January 2020, the Jharkhand Government Health Department, with the support of development partners such as UNICEF and IPE-Global/WeCan, started conducting offline training to create master trainers across districts. Between 2020 and 2021, the state further conducted thematic training for all stakeholders; for example, warehouse managers were trained in supply chain management.

3. Information: Routine data on the receipt of ANC services are manually entered by field functionaries in prescribed registers. These data are compiled digitally at the block level in the Government Health Management Information System (HMIS). The national AMB Annual Report of 2018–20[6] clearly highlighted that the roll-out in states/UTs had been slow but that the roll-out of the AMB strategy in Jharkhand gained pace in the third quarter of 2019–20, with the assigning of a state nodal officer and 24 district nodal officers. On the national scale, a maternal nutrition scorecard is generated every quarter, based on data from the Government HMIS. Jharkhand was ranked seventh in January 2022.[7] It was also one of the few states to generate district-wise Maternal Nutrition ranking Score Cards (covering anemia, high-risk pregnancy, and postnatal service delivery). These can be accessed from the dashboard of AMB (https://anemiamuktbharat.info/).

4. Medical supplies and technologies: Program experiences have shown that lack of proper storage and transportation, combined with frequent stock-outs, has been a constant impediment to the effective management of public health supply chains in India.[7] The Centre has listed the strengthening of the supply chain and logistics as one of the six institutional mechanisms under AMB. In 2019, Jharkhand conducted a supply assessment in four blocks of two aspirational districts using standard tools.[8] This highlighted that the state was procuring a much lower quantity of IFA than the actual requirement. The findings were acknowledged by the Government of Jharkhand, and appropriate measures were introduced to fill the gap. For the first time, with support from the national team and UNICEF, the national Health Ministry published target/denominators in the public domain, which facilitated efficient calculation of the supplies needed for each district. Since 2021, none of the districts have had supply stock-outs, as is evident from the data available on government portals such as E-Aushadhi and HMIS.

5. Financing: Jharkhand adopted the Track and Act Strategy to improve financial efficiency under AMB wherein relevant budget lines were tracked, based on identified gaps; supportive action including sharing information on planning gaps and through meetings, training and sharing of a budget tracking tool was undertaken. While the compilation of the findings is in the pipeline, key highlights show no major delay in the release of funds from the national to the district health bodies. A comparison of proposed and approved budgets reflected the key gaps and a review of the best practices by the state. One of the key outcomes of the various financing processes followed by Jharkhand was the significant progress in bridging the financial gaps between 2019 and 2022 **(Figure 2)**.[9]

FIGURE 2: Jharkhand health sector budget for Anemia Mukt Bharat (all age groups including maternal anemia) from 2019 to 2022[9]


ANEMIA MUKT BHARAT
BUDGET FACTSHEET
FY 2019–20, FY 2020–21 and FY 2021-22

States/UTs	2019-20 (INR in lakh)		2020-21 (INR in lakh)		Change %*		2021-22 (INR in lakh)		Change %*	
	Proposed	Approved	Proposed	Approved	Proposed	Approved	Proposed	Approved	Proposed	Approved
All India	97839	83482	92908	89097	▼ -5	▲ 7	128365	116420	▲ 38	▲ 31
Jharkhand	4527	3515	4416	4325	▼ -2	▲ 23	5718	5097	▲ 29	▲ 18

6. Leadership and governance: Successive national health and nutrition surveys have shown the high prevalence of anemia across life stages and gender. Jharkhand took cognizance of this fact and conceptualized a comprehensive strategy called SAAMAR – Strategic Action for the Alleviation of Malnutrition and Anemia Reduction. SAAMAR was launched in December 2021. It complies with the operational guidelines of AMB, with higher Coverage, Continuity, Intensity, and Quality (C^2IQ). The state also received additional human resources as one AMB Fellow from NITI Aayog, the public policy think tank of the Government of India, for five districts: Bokaro, Gumla, Godda, Simdega and West Singhbhum of the Jharkhand state.

Results of systematic system-strengthening

Systematic investment in each of the six health system pillars resulted in strengthening of systems in 15 districts out of total 24 districts that reported an improvement in the percentage of pregnant women consuming IFA tablets for 180 days **(Figure 3)**. Further, prevalence of anemia was reported to decline in 15 districts.

FIGURE 3: Change in the prevalance of anemia among pregnant women: from NFHS-4 (2015-16) to NFHS-5 (2019–21)[10]

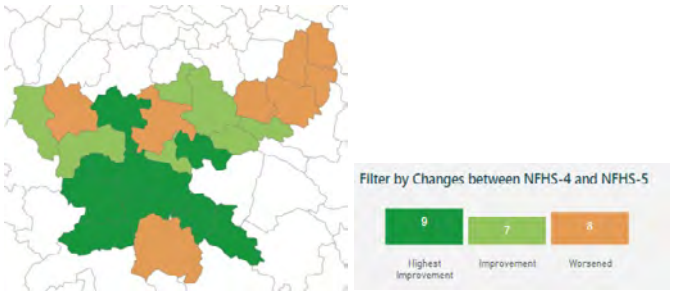
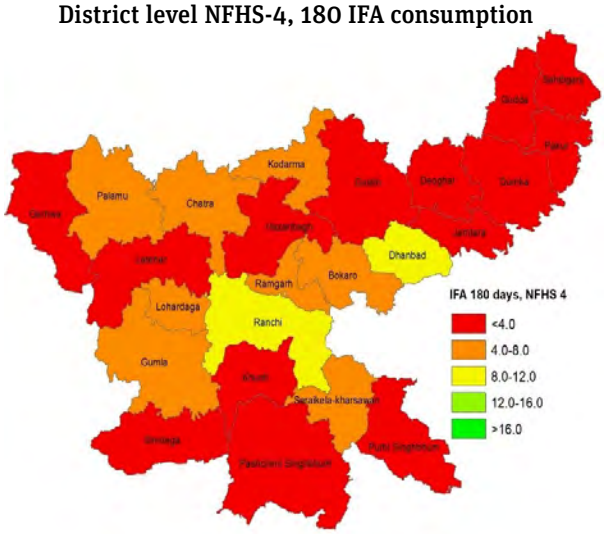


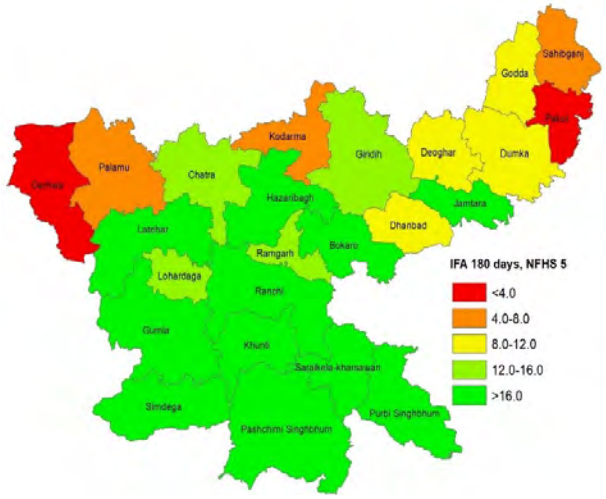
FIGURE 4: Spatial distribution of the percentage of pregnant women aged 15–49 years who consumed IFA for 180 days, Jharkhand NFHS- 4 and 5 (2015–16 and 2019–21)[3]

District level NFHS-4, 180 IFA consumption



Anemia Mukt Bharat Dashboard: https://anemiamuktbharat.info

District level NFHS-5, 180 IFA consumption



Data source: NFHS 4 (2015-16) and NFHS 5 (2019-21) Fact Sheets

What worked for Jharkhand

- Strengthening each of the 6 pillars of the health systems to deliver interventions under the 6x6x6 strategy of AMB with increased coverage, C2IQ.
- Thematic capacity-building of all stakeholders, like program mangers, nursing staff but also warehouse managers, doctors, data entry operators, and so on.
- Efforts to understand and strengthen the financing exercise, including planning, allocations, disbursements and expenditure.
- Ranking-based Scorecards on the district-wise progress of AMB and maternal nutrition (including high-risk pregnancy).
- Support from the National Center of Excellence and Advance Research on Anemia Control (in All India Institute of Medical Sciences, government medical college of national repute) and Institute of Economic Growth, Delhi (housing the National Anemia Technical Support Unit (TSU) and AIIMS, Delhi,) as well as from development partners UNICEF, IPE-Global/WeCan and Evidence Action.

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Integrating an Algorithmic and Health Systems Thinking Approach

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Background

Most Indian women enter pregnancy with poor nutritional status: 19% of women of reproductive age are thin for their height (body mass index or BMI less than 18.5 kg/m^2); 24% are obese (BMI greater than 25 kg/m^2 and 57% are anemic (hemoglobin (HB) levels <12.0 g/dL); and prevalence of anemia is up to 59% among pregnant women. Additionally, 15% of pregnant women are adolescent mothers.[1]

An estimated 30 million pregnant women in India are eligible to receive antenatal nutrition services, delivered through two national schemes: the Integrated Child Development Services and the National Health Mission.

Although state governments may have additional state-funded schemes for improving maternal nutrition services, coverage of antenatal nutrition services in India remains constrained by programmatic challenges. To address these challenges, in 2017, a national-level task force developed simplified flow charts designed to guide healthcare providers in systematically delivering nutrition services to pregnant women. In 2018, Madhya Pradesh (MP) decided to adopt and test the use of these flow charts, starting with Vidisha District and then expanding it to seven others. In addition, a health systems strengthening (HSS) approach was adopted to reinforce the delivery of nutrition services through the six HSS building-blocks: service delivery, health workforce, supplies, information systems, financing and leadership/governance.

In this paper, we describe the processes for developing and testing the use of flow charts and the HSS approach. We also analyze the changes that took place in the Vidisha District between 2016 (prior to the initiative) and 2021 (after the initiative).

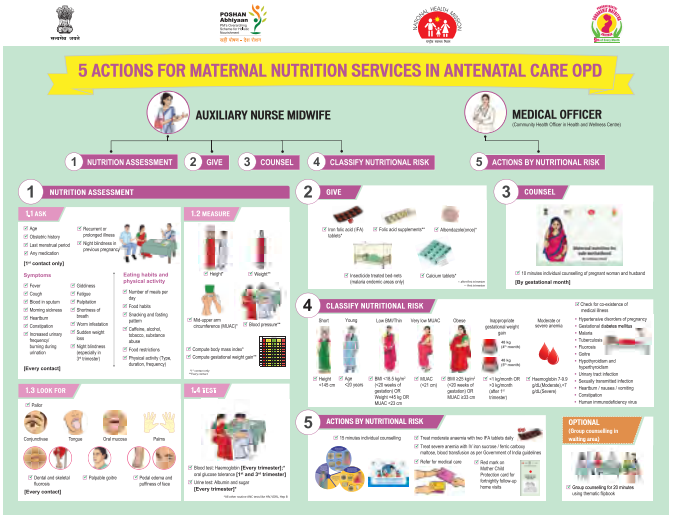
> **"Most Indian women enter pregnancy with poor nutritional status"**

Delivery and testing tools and ways of delivering

Arriving at flowcharts

In 2017, after the release of the World Health Organization (WHO) 2016 guidelines[2] for positive pregnancy experience and of the results of the fourth National Family Health Survey,[3] the Government of India's maternal health task force hosted a series of expert consultations to review the evidence on strengthening nutrition services in antenatal care (ANC). A sub-committee within this task force developed two sets of flow charts. The first set is for use during ANC at facility level **(Figure 1)** and the other is for community-health workers at a community level **(Figure 2)**. This accompanied a set of counseling cards for gestational months, and a second set for nutrition risk-specific counseling.

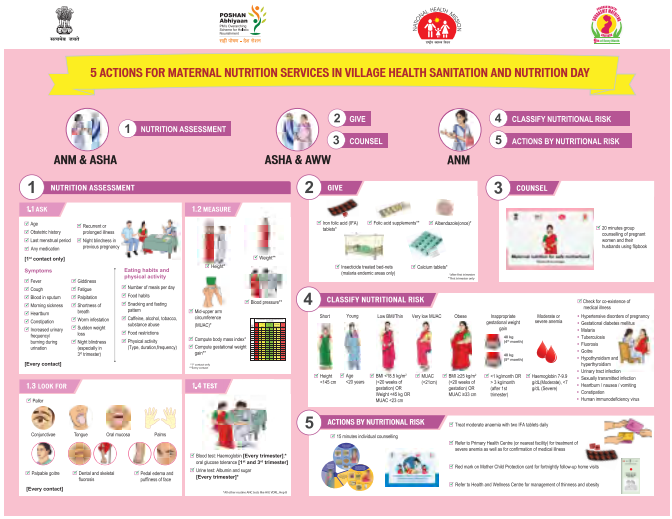
FIGURE 1: Flow chart for delivering maternal nutrition services for antenatal care in outpatient departments/clinics



Applying an HSS approach

In April 2018, MP government officials convened local partners (UNICEF and Nutrition International) to conduct a gap assessment of health systems to adequately deliver nutrition interventions.

FIGURE 2: Flow chart for delivering maternal nutrition services for community-based care at village level



The pilot and expansion phases

In the pilot test, conducted between January and December 2019, we assessed the feasibility of implementing both interventions, i.e., flow charts and HSS, in Vidisha. Services were provided to an estimated 54,100 pregnant women, through 31 antenatal clinics and 206 village health and nutrition day outreach centers, by 206 auxiliary nurse midwives (ANMs) and 35 staff nurses.

With this intervention, the ANMs / staff nurses now also conduct and record nutrition assessment (height, mid-upper arm circumference, or MUAC, and BMI), give micronutrient supplements (iron-folic acid, or IFA, and calcium tablets), deworm, and provide gestational month-wise counseling. They also identify those who are at nutritional risk (short, thin, young, anemic, obese). As follow-up, community level workers such as Accredited Social Health Activists (ASHA) and/or Anganwadi workers (AWW) conduct monthly visits and provide nutritional risk-based counseling. Any pregnant woman at severe nutrition risk is referred to a medical officer at the nearest health facility.

To ensure this workflow, each HSS block had to be strengthened. First, six master trainers and 226 health personnel were trained through cascade training on the flow charts and the gap assessment methodology. Routine communication efforts were used to spread awareness with a view to improving the uptake of antenatal services. Mothers who were at nutrition risk were provided with monthly counseling by health workers during and later in the COVID-19 pandemic.

From January 2020 to December 2021, this program was extended to seven more aspirational districts. In 2022, the initiative continues in a total of eight districts, covering a work force of 2,163 health workers. In the expansion phase, cascade training up to district level was conducted by master trainers online, due to the pandemic.

Methods for assessing change

To assess the changes in the health systems, we compared the evolution of the six HSS pillars between 2018 and 2021. ANMs were interviewed to assess the uptake of using flow charts and their perceived feasibility.

To assess the uptake of nutrition services within the ANC services, we looked at several indicators, as summarized in **Table 1**.

TABLE 1: Indicators used to assess changes

Indicator	Definition	Source of data
Process indicators		
Reporting	Districts that submitted their program reports in the previous month (%)	HMIS
Receipt of services	Pregnant women who were given the recommended dose of IFA in the previous month by a health worker in any platform (community/facility) (%)	HMIS
	Pregnant women who were given the recommended dose of calcium in the previous month by a health worker in any platform (community/facility) (%)	
Nutrition risks (program)	Of the pregnant women who were measured for nutrition risks during their antenatal visit, those who had: • Weight < 35 kg • BMI < 18 • BMI > 23 • Hb < 7 g/dL • Age < 19 years	Program registers (RCH)
Output indicators		
Antenatal care in first trimester	Women who had an antenatal check-up in the first trimester, in their last pregnancy (%)	NFHS surveys
4+ antenatal care	Women who had at least 4 antenatal care visits, in their last pregnancy (%)	NFHS surveys
IFA 180+	Women who consumed IFA for 180 days or more during their last pregnancy (%)	NFHS surveys
Outcome indicators		
Anemia (survey)	Pregnant women 15–49 years who had anemia – Hb <11 g/dL (%)	NFHS surveys
Maternal nutrition status (survey)	Women who are thin (BMI <18.5 kg/m²) (%)	NFHS surveys
	Women who are overweight or obese (BMI ≥25.0 kg/m²) (%)	

Results

Changes in health systems

Table 2 shows the various elements that were put in place with this program, comparing the level of implementation between 2018 and 2021.

Changes in the delivery of maternal nutrition services (process)

Data from the health management information system (HMIS) showed that there were no stock-outs of micronutrients (IFA tablets, albendazole, and calcium tablets) in the district drug store between 2018 and 2022. Vidisha District showed improvement in receipt of IFA (from 79.9% to 90.4%) and calcium tablets (from 66.0% to 69.4%) between 2018 and 2020. However, a decline in the coverage of both micronutrient supplements was observed in 2021, which could be attributed to the pandemic and associated service restrictions **(Table 3)**.

Uptake of antenatal maternal nutrition services (outputs)

Baseline and endline comparisons for Vidisha District show significant improvement for the receipt of ANC in the first trimester (from 29.5% to 84.9%) and receipt of four antenatal visits (from 16.9% to 54.4%). Compliance in the consumption of IFA tablets

TABLE 2: Applying HSS to assess preparedness of Vidisha District to deliver maternal nutrition services

Health systems pillar	2018	2021
Leadership and governance		
• Operational guidelines in place for strengthening maternal nutrition	✗	✓
• Nutrition risk assessment (thinness and overweight), classification and counseling included as part of antenatal care	✗	✓
• MUAC and BMI as part of nutrition assessment	✗	✓
• Iron-folic acid supplement formulation (sugar coated, 60 mg iron and 500 mcg folic acid)	✗	✓
• State-level thematic technical working group / committee for maternal nutrition	✗	✓
• Joint planning, monitoring, review and feedback to government	✗	✓
Capacity-building		
• State-specific comprehensive ANC*	✗	✓
• Training of field staff**	✗	✓
Supplies		
• Availability of digital hemoglobinometers	✗	✓
• Availability of MUAC tapes	✗	✓
• Supply managers supported in planning and monitoring stock-outs	✗	✓
Financing (US$)		
• Maternal nutrition trainings	0	657,000
• Maternal nutrition counseling materials	0	20,950
• Overall maternal nutrition budget	8.53 million	17,800,000
• Nutrition services monitoring and handholding support	0	20,000
Information systems – Indicators tracked		
• Pregnant women 'at nutrition risk / medical risk'	✗	✓
• Pregnant women with any nutritional risk counseled	✗	✓
• Pregnant women with MUAC < 23 cm	✗	✓
• Pregnant women with BMI <18.5 kg/m² (up to 20 weeks)	✗	✓
• Pregnant women with night blindness/fluorosis/goiter	✗	✓

* Including maternal nutrition training module and counseling material gestational month-wise and nutrition-risk -specific cards, recipe book for maternal severe thinness and obesity
**Face-to-face in 2019 and online in 2020–2021

TABLE 3: Process indicators: maternal services delivered in Vidisha District (source HMIS)

	2018	2020	2021
Reporting	82.8	78.9	69.0
Receipt of IFA	79.9	90.4	78.4
Receipt of calcium tablets	66.0	69.4	65.3

for 180 days or more during pregnancy significantly improved during the program in both intervention (from 4.0% to 24.9%) and district areas **(Table 4)**.

TABLE 4: Output indicators: uptake of maternal services in Vidisha District

	Baseline	Endline
Women who had an antenatal check-up in the first trimester (%)	29.5	84.9
Women who had at least 4 antenatal care visits (%)	16.9	54.4
Consumption of iron-folic acid for 180 days or more in pregnancy (%)	4.0	24.9

Changes in maternal nutrition status (outcomes)

The percentage of women who were thin declined in both intervention and control districts during implementation **(Table 5)**. The prevalence of anemia decreased from 44.2% to 38.5% in Vidisha District.

Lessons learned

In terms of processes, the intervention enabled state teams to add missing maternal nutrition indicators, ensure funding for the essential previously missing items, and initiate training in a systematic way, while expanding the program to other districts.

Despite some successes, several challenges were observed.

TABLE 5: Outcome indicators: anemia and maternal nutrition status in Vidisha District

	Baseline	Endline
Women of reproductive age who are thin (BMI <18.5 kg/m²) (%)	28.0	23.1
Women of reproductive age who are overweight or obese (BMI ≥25.0 kg/m²) (%)	11.3	19.8
Women who are anemic (%)	44.2	38.5

These included high caseload at facilities, limited human resources, gaps in the routine reporting system, and lack of motivation, leading to poor adherence to directives.

In terms of output, building health systems for nutrition service also significantly affects utilization – such as the receipt of ANC in the first trimester, the receipt of at least four antenatal visits, and the consumption of IFA tablets for at least 180 days during pregnancy in Vidisha District.

These gains, however, were affected by the pandemic, as the HMIS data indicates a decline in the coverage of both micronutrient supplements **(Table 3)** and reporting efficiency of districts from 2018 to 2021.

> **"This integration shone new light on the importance of routine ANC"**

Limitations

There are a few caveats to this study. First, only the pregnant women covered by the government ANC program received this intervention. Also, lack of unit-level NFHS data prevented us from establishing the association between service utilization and changes in outcomes. Third, the HMIS data for the recent period is not available; this could have provided insights about resumption of services. Although in this study we do not evaluate the impact directly, previous studies indicate that counseling-based services are associated with improvement in maternal and child health outcomes.[4]

Conclusion

The study offers an important contribution to implementation science focused on strengthening the provision of nutrition services integrated within ANC services. The flow-chart-based protocol seemed to be programmatically feasible, as it led to visible improvements in increasing the uptake of the program and lightening the workload for ANMs, which ensured targeted delivery of services and counseling. This integration shone new light on the importance of routine ANC, including the necessity of a functioning supply chain, adequate financing, robust information systems, and systematic training to improve service delivery and monitoring systems.

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This is a synthesis of the article that was published in https://www.ennonline.net/fex/68/chartsystemsantenatalindia

Developing a Maternal Nutrition Services Package

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Background

In India, antenatal care (ANC) guidelines are limited in their scope in screening and management of nutrition risks in pregnancy. Since 2016, efforts have been made to develop, test and integrate a multi-stakeholder and consensus-driven nutrition services package for the prevention and management of malnutrition in pregnancy in community and facility settings.

Methods

This initiative was conducted in four phases. The first two phases included an evidence review and consultations with expert groups to finalize the maternal nutrition services package, which consisted of a community-based and facility-based algorithm and a communication tool kit for testing in real settings. Phase three involved the creation of a technical support unit for testing proof of concept, convening consensus meetings, and finalizing the maternal nutrition services package. In the fourth phase, the maternal nutrition services package was tested for operational feasibility across eight states.

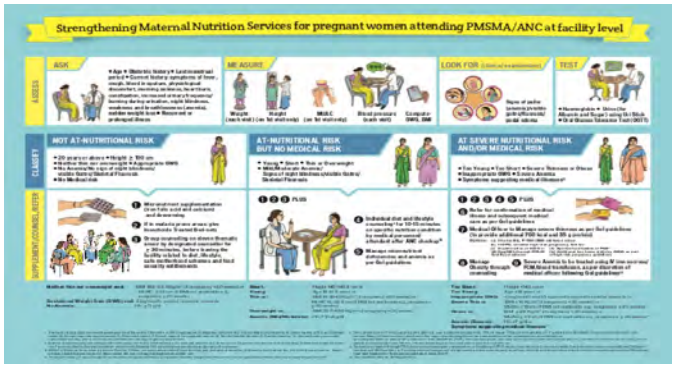
In this paper, we discuss the operational feasibility of the service package as tested at 14 antenatal care facilities in four states in north and south India – Delhi, Haryana, Karnataka and Telangana – covering 1,469 pregnant women. Appropriate counseling, supplementation or referral for treatment was provided to pregnant women based on the categorization. The algorithm and toolkit were simplified for the purposes of integration into existing government services. Data collection was carried out by health workers (Auxiliary Nurse Midwives [ANM], Staff Nurses [SN] and Medical Officers [MO]) available at the facility and/or nutritionists/researchers. Data collectors underwent two-day training on the maternal nutrition services package prior to data collection. Roles and responsibilities among data collectors were clearly defined to facilitate seamless implementation and integration of the package into routine ANC. At each facility, a nodal officer or site coordinator was present for supervision. Information received from the assessment of pregnant women was used to classify them according to nutritional and/or medical risk. Site coordinators conducted two monitoring visits, one external and one internal check during data collection. A pretested monitoring checklist was used to assess the operational feasibility of implementing the maternal nutrition package in routine ANC facilities. Staff skills in taking anthropometric measurements, clinical examination and counseling were directly observed. Each site shared the compiled monitoring checklists with National Centre of Excellence and Advanced Research on Diets (NCEARD) for further analysis. Experiences from using the maternal nutrition package were collated through follow-up visits two to three months after the data collection for testing was completed. A pretested questionnaire to understand the strengths and operational bottlenecks of implementing the maternal nutrition algorithm and toolkit was administered on the health workers available at the field sites by site coordinators.

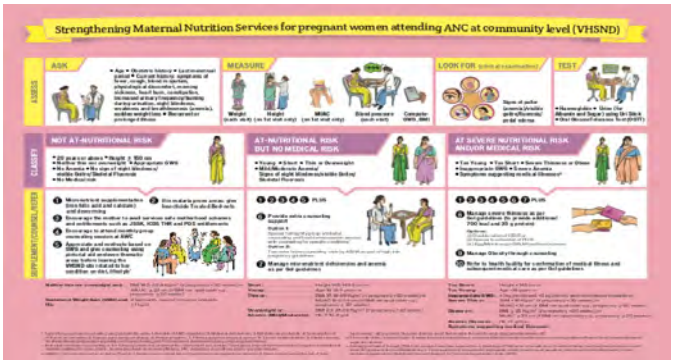
> **"Comprehensive maternal nutrition services can be delivered through existing government health platforms once health staff have been trained"**

Results

The three-step algorithm that emerged after first three phases is presented in **Figure 1.**

Figure 1: Three-step algorithm for facility and community level before field testing

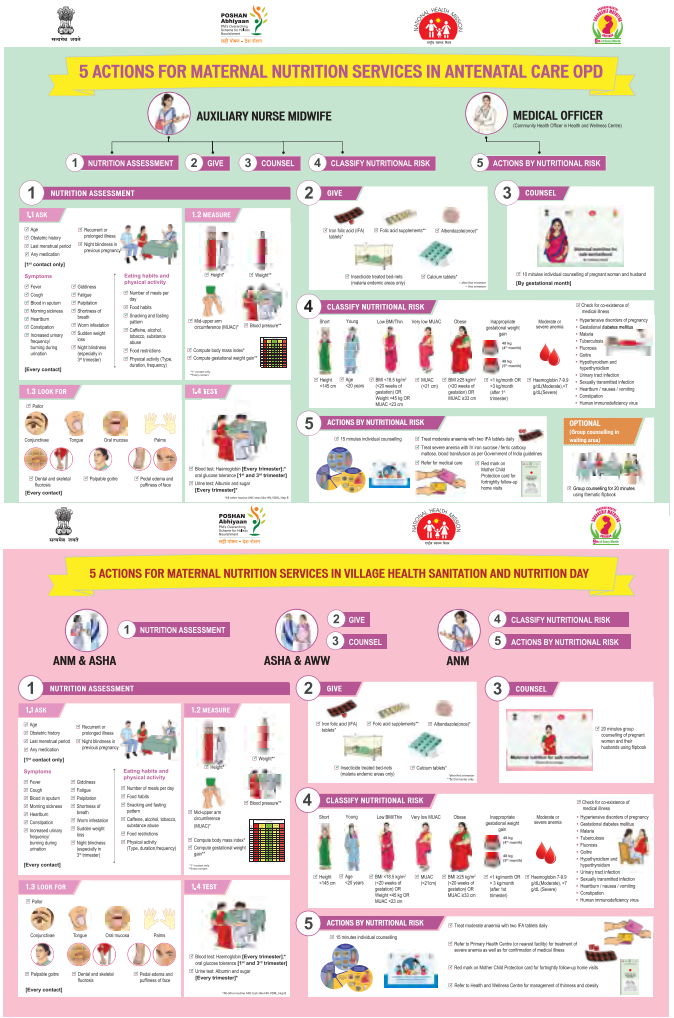




Simplification of algorithm and toolkit and integration into routine ANC

The algorithm was modified from its earlier three-category classification *(not at nutritional risk, at nutritional risk and at severe nutritional risk)*, to a simpler method for identifying only pregnant women at nutritional risk **(Figure 2)**. In order to reduce the repetitiveness of messages, the flipbook with thematic cards was replaced by month-specific message cards. Considering the challenge in delivering counseling messages, especially at secondary and tertiary level facilities, and the opportunity of using the long waiting times in Outpatients, thematic cards were used in the Outpatients waiting area only.

Figure 2: Five actions for maternal nutrition services in routine ANC at facility and community level



The consensus-building on this service package involved 96 experts across the health, nutrition, social sciences and communication sectors. The technical support unit developed partnerships with complementary institutes and agencies in the fields of statistics, economics and communication to deliver all the requisite skills for finalizing the maternal nutrition services package. Both national and small-group expert consultations were undertaken over the course of 18 months to develop, test and finalize the services package. The feasibility testing resulted in the integration of the nutrition services package into routine ANC services. It identified opportunities for practice by health care service providers as well as challenges that need to be addressed for scale-up. Thinness (mid-upper arm circumference: MUAC<23 cm) and moderate to severe anemia (Hb<10g/dl) emerged as most prevalent at 34% and 45%, respectively. The use of waiting times at health facilities (which ranged from 97 minutes to 250 minutes at primary to tertiary level facilities) for counseling of pregnant women and those at nutritional risk was unequivocally recommended by all experts. At secondary and tertiary level facilities, the coverage and provision of all services to pregnant women required additional human resources.

> **"Scale-up and integration of the package into routine ANC platforms is possible"**

Discussion and conclusion

Provision of comprehensive maternal nutrition services through eight contacts as proposed in our package is aligned with global recommendations, and can be delivered through existing government platforms once health staff have been trained in the package. All health facilities required changes in antenatal patient flow and the procurement of MUAC tapes, stadiometers and uristicks, and also needed to address delays in the procurement of deworming tablets. The ease of implementing the package at the primary tier was more than at the higher levels of healthcare due to the lower caseload involved. At the secondary and tertiary level of healthcare, task-shifting with the involvement of dieticians/counsellors may be considered and counseling provided, utilizing the Outpatient Department waiting time for integration into routine ANC.

In summary, the proposed maternal nutrition services package can be used to assess, classify, counsel, supplement or refer pregnant women by risk classification in facilities at the primary tier of the health system. At the secondary and tertiary levels of healthcare, while staff managed to assess and classify pregnant women in terms of nutritional risks, the provision of counseling services was challenging. In such facilities, task-shifting with the involvement of counsellors, dieticians or other trained staff instead of ANM should be considered, and counseling should be provided

utilizing the waiting time in Outpatients. The maternal nutrition algorithm and communication tool kit are ready for roll-out; however, the HMIS should include indicators on nutrition assessment and counseling before roll-out in order to build and retain focus on maternal nutrition services in the public health care system. Scale-up and integration of the package into routine ANC platforms is possible, as most of the services proposed are already a part of existing government schemes at primary level facilities having adequate logistics, human resources and supply of micronutrients and deworming tablets.

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Gestational Weight Monitoring: Experience from Telangana

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Maternal nutrition status in India

Maternal nutrition status, both under- and obesity, is a proximate determinant of fetal and, later, child nutrition status. Maternal malnutrition is a significant cause of low birth weight (LBW),[1] and it influences wasting at birth and stunted growth at two years. In India, in deprived settings, 50% of growth failure in height by 24 months occurs in the womb.[2] At least 20% of maternal mortality is attributed to short maternal stature and iron deficiency anemia.[3] Both maternal stunting and wasting are associated with full-term and preterm births of children that are small for gestational age (SGA)[4] and LBW.[5] High pre-pregnancy weight or excessive gestational weight gain have negative implications on pregnancy outcomes, too, and amplify the burden of chronic diseases, putting the health of mother and infant at risk. As pre-pregnancy body mass index (BMI) is associated with the birth weight of the newborn, women who are overweight or obese have a higher chance of developing pre-eclampsia and gestational diabetes mellitus. The weakest links in this cycle of malnutrition are adolescents and women in the pre-conception period; hence initiating early intervention is essential.

> **"State aims to promote and ensure gestational weight gain monitoring of >80% of pregnant women"**

Unfortunately, there is still no technical strategy in the public health system in India that can prevent and manage all facets of malnutrition for women of reproductive age, pregnant women, and postnatal mothers. However, in Telangana, state flagship programs such as Arogya Lakshmi (spot feeding platform) are in the process of integrating various components of maternal nutrition assessments. These critical interventions are designed to establish linkages to treat the causes of malnutrition, improve supplementation compliance, and provide concerted dietary advice and counseling.

Nutritional scenario in Telangana

Telangana is among the youngest states in the country, with the Gross State Domestic Product at the level of middle-income countries. However, the economic development is skewed and masks inequities. This becomes visible in the nutrition indicators related to stunting, wasting, and anemia: 53% of pregnant women in Telangana are anemic; 19% of women of reproductive age are thin (BMI <18.5 kg/m²); and 32% women are overweight or obese (BMI >=25 kg/m²). Telangana also has a high prevalence of diabetes and hypertension among population groups of reproductive age.

According to the latest National Family Health Survey, 88% of pregnant women in Telangana register for antenatal care (ANC) during the first trimester, but only 70% avail themselves of all four check-ups, and only about half have their weight regularly monitored. The diversity in data from rural and urban terrains is skewed, and district-level variations are high. The delivery of health and nutrition services has shown minimal improvement, especially in urban areas, where the reach of Anganwadi Centers (AWC) and Urban Primary Healthcare Centers (uPHC) is limited. COVID-19 led to further disruptions, including converting Arogya Lakshmi into take-home ration delivery for a period of 24-26 months.

Regular weight check at ANC by Anganwadi Worker

Urban programmatic context in Telangana

Arogya Lakshmi is one of the oldest state flagship programs. In this program, the State attempts to reach all pregnant women with hot cooked meals through AWCs, 300 days a year. The meals are expected to contribute 40–45% of the recommended dietary allowance requirement of energy and protein as per the National Food Security Act (2013). In the past two years, the layering of non-food components such as iron, folic acid, calcium supplementation, deworming, gestational weight monitoring (GWM), and thematic counseling has been attempted along with Arogya Lakshmi. UNICEF has attempted to strengthen routine GWM in pregnant women of Telangana in 20 urban wards of Secunderabad, reaching around 1,600 pregnant women. The aim was to promote and ensure gestational weight gain monitoring of >80% of pregnant women, along with thematic and customized monthly counseling on appropriate weight gain, diet diversity, rest, ANC, and breastfeeding practices. The GWM scheme in these urban slums ensured seven mandatory visits **(Table 1)**.

TABLE 1: GWM scheme in Secunderabad, Telangana

Trimester	Frequency	Area of importance
First trimester: 1 data point	Once between 1st and 3rd month of pregnancy	Resonates with pre-pregnancy weight. Defines the range that pregnant women should gain throughout pregnancy.
Second trimester: 3 data points	Once every month	Weight gain starts. This will define how pregnancy proceeds, and is indicative of the weight and height of the child at birth and maximum weight gain during this trimester.
Third trimester: 3 data points	Once every month	This will define the child's birth weight and allow birth preparedness and guidance on early breastfeeding initiation.

Results and observation

Active GWM has been ongoing since May 2021, reaching 1,600 pregnant women through the 'assess – classify – counsel' model. Data on the age and height of the pregnant women, as well as gestational age and weight, is collected, along with their obstetric history and other ANC details that are captured from the mother-child protection card. Based on this, nutritional risk classification is adopted **(Table 2)**.

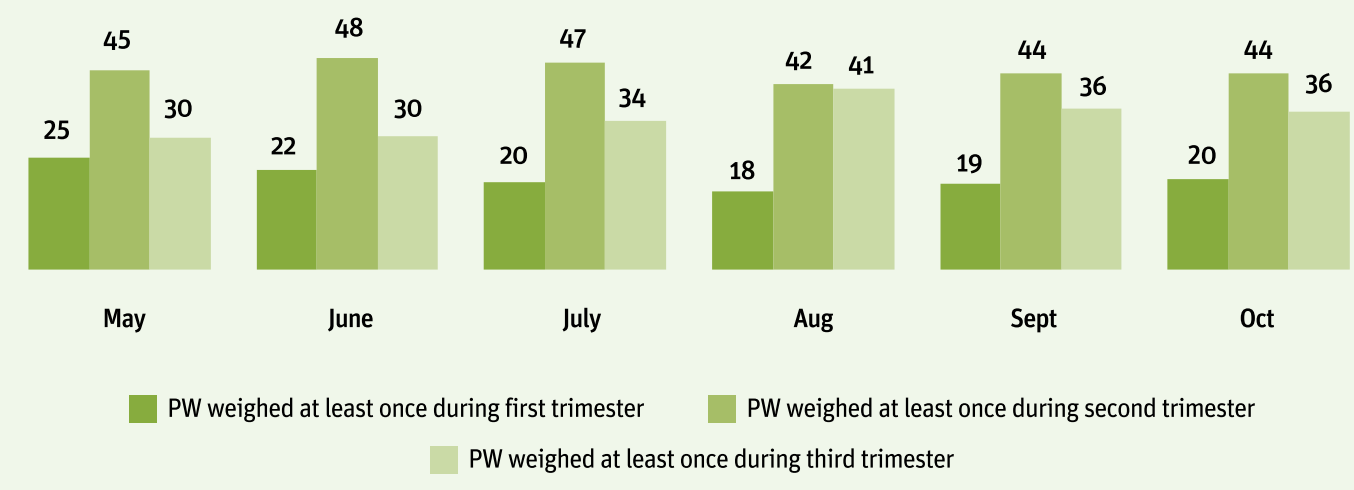
TABLE 2: Classification categories based on GWM

Not at Nutritional Risk	At Nutritional Risk
Age above 20 years	Age <20 yrs or > 35 years
Height >145 cm	Height <145 cm
BMI in first trimester: 18.5- 22.9 kg/m²	BMI in first trimester: <16.5- 18 kg/ m² (thin) or >24-25 kg/m² (overweight)
No anemia, Hb> 11 gms/dl	Anemia, Hb< 11 gms/dl
Gestational weight 2 kg/ month (second trimester onwards)	Gestational weight: <1 kg / month or >3kg/ month (second trimester onwards)
Diet Adequacy: Diet Frequency (3M+1/2 S) & (>4 FG/ day)	Diet Adequacy: Diet Frequency (< or > 3M+1/2 S) & (<4 FG/ day)
No other symptoms/ complications	With other symptoms/ complications

The Anganwadi workers create a vulnerability assessment map at the community level, identifying anemic, underweight and overweight pregnant women in their catchment areas. Women at nutritional risk receive additional counseling sessions as a group at AWCs, or else during home visits by front-line health workers, to monitor their eating behavior and discuss critical aspects with spouses.

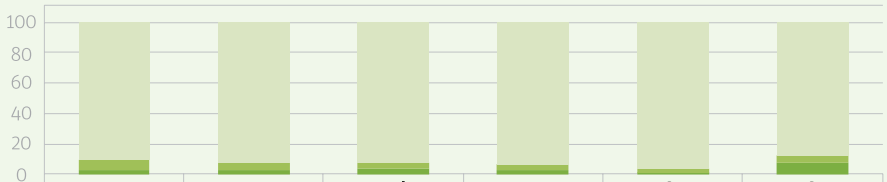
Over six months, the status of weight monitoring is recorded, although gestational weight measure in the first trimester is only recorded for 1 in 5 pregnant women. In the second trimester, the likelihood of regular weight monitoring is higher **(Table 3).**

TABLE 3: GWM over trimesters (in %)



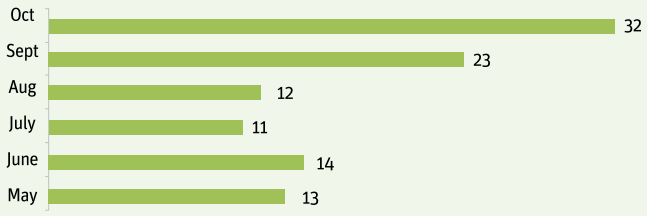
Weight gain over the pregnancy period is highest during the second trimester **(Table 4)**. In around 90% of cases, the weight gain is in the normal range, roughly 2 kg/month between the 20th and 40th week of gestation; only about 10% of pregnant women either gain less (<1 kg/month) or more (>3 kg/month) during the second and third trimesters. Specialized counseling for these women is organized at the AWC or during home visits. Over the months, GWM for pregnant women receiving seven mandatory visits has increased, and further streamlining is done **(Table 5)**.

TABLE 4: Weight gain during pregnancy (in %)



	May	June	July	Aug	Sept	Oct
PW gained 1.1–2.9 kg of weight/month of gestation in second trimester and third trimester	91	93	93	93	96	88
PW gained >3 kg of weight/month of gestation in second trimester and third trimester	6	5	4	4	3	5
PW gained <1 kg of weight/month of gestation in second trimester and third trimester	3	3	4	3	1	8

TABLE 5: Pregnant women who received the mandatory visits during gestational period (in %)



When home visits were not possible due to the COVID-19 pandemic, digital counseling sessions were organized.

Conclusion

Avenues for streamlining GWM in Telangana are plenty. Arogya Lakshmi provides one of the most robust platforms for routinely observing the weight and diet of women and reaching out to them on subjects such as diet diversity, frequency of food intake, and the importance of keeping active during pregnancy. Beyond the urban project supported by UNICEF, active advocacy is done with the state to reach women across the state for the purpose of weight monitoring, and relevant counseling is provided. A monthly average of 100,000 pregnant women are reached for whom GWM is done, but among these, <10% are reached seven times during the pregnancy period, and only 40% receive appropriate counseling. There is scope to make Arogya Lakshmi a workable mechanism at scale for identifying nutrition at risk in pregnancies and facilitating priority referral to next level of health care. Relevant and perseverant efforts are necessary to ensure efficient convergence with the health system and functionaries, especially in the context of the COVID-19 pandemic and its effects on the delivery of maternal nutrition services.

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Tuberculosis-induced Malnutrition in Pregnancy: What We Know

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Background

Until the outbreak of COVID-19 in 2020, tuberculosis (TB) was the most infectious disease in the world, in terms of both prevalence and mortality.[1] India, while being home to 18% of the world's population, accounted for 26% of the global TB incidence in 2019 and 38% of global deaths due to the disease.[2] The pandemic has adversely affected the progress the country had previously made in providing essential TB services and reducing the burden of the disease.

The most obvious impact has been the large drop in the number of people with newly diagnosed TB and reported cases globally – from 7.1 million in 2019 to 5.8 million in 2020, a steep 18% decline. Among the 16 countries that accounted for 93% of the drop in the number of people newly diagnosed with TB, India was one of the worst affected.[3] The India numbers fell from 2.4 million in 2019 to 1.8 million in 2020, a 25% decline.[4]

TB and maternal health

In 2011, India accounted for 20.6% of the global burden of TB among pregnant women.[4] Clinicians report challenges in diagnosing TB during pregnancy largely due to overlap of symptoms such as weakness or breathlessness. Loss of weight due to TB can be masked by the variation in weight that occurs during pregnancy. Further, clinicians are hesitant to perform radiographs for diagnosis of TB during pregnancy, even though the exposure to ionizing radiation from the chest radiograph is well below the estimated threshold levels for adverse fetal effects.[5] A higher incidence of TB has been reported in the postpartum period than during pregnancy. This is due to the immunologic changes that occur during pregnancy, which not only increase susceptibility to the infection by suppressing the T-helper inflammatory response but also mask symptoms during pregnancy. In the post-partum period, this is reversed, and the symptoms are exacerbated.[6]

The global systematic review and meta-analysis of studies involving pregnant women with active TB disease show that maternal and perinatal outcomes were consistently poorer than in those without. There were higher odds of maternal death, antenatal admissions, maternal anemia, caesarean birth, miscarriage, perinatal death, preterm birth, acute fetal distress, and low birth weight.[7]

> **"There is a bi-directional interaction between nutritional status and active TB disease"**

TB and nutrition

Among the various sociocultural, demographic, economic and environmental factors predisposing to TB, nutritional status plays a critical role. There is a bi-directional interaction between nutritional status and active TB disease. Undernutrition is a risk factor for TB, which in turn worsens nutritional status, generating a vicious cycle that can lead to adverse outcomes. This interaction is particularly important in the Indian context, where food insecurity and undernutrition co-exist with a large burden of TB. A total of 18.7% women enter pregnancy thin, i.e., women between 15 and 49 years whose body mass index (BMI) < 18.5 kg/m^2, and 52.2% of pregnant women between 15 and 49 years were anemic (Hb <11 g/dl).[8]

TB and government action

The National Strategic Plan for TB 2017–25 calls for the elimination of TB by 2025 and seeks to achieve a rapid decline in the burden of TB and morbidity and mortality, while working towards the elimination of the disease. These objectives are more ambitious than the relevant SDG targets.

Government of India (GOI) guidelines call for intensive case-finding among pregnant and lactating women (PLW) and those with undernutrition who are considered to be clinically vulnerable risk groups for TB. Further, the guidelines call for prioritizing access to nutritional counseling and social welfare schemes, as well as exploring health cover for the management of complications due to TB among PLW.[9]

According to these guidelines, individuals with active TB, including PLW, should receive:

- an assessment of their nutritional status;
- appropriate counseling based on their nutritional status at

diagnosis and throughout treatment;
- management of malnutrition if identified, and linkages with extra nutritional support to be extended with existing government schemes such as the Public Distribution System or applicable food security schemes; and
- linkages with existing interventions for managing undernutrition such as Nutrition Rehabilitation Centers.

Undernutrition is a huge risk factor

One of the strategic interventions for nutrition support that encourages completing treatment and covering the cost is the Nikshay Poshan Yojana. This is a scheme with Direct Benefit Transfer of Rs 500 per month to TB patients notified in Nikshay – a national, case-based and web-based surveillance system. This payment is available for the entire duration of the treatment. A key challenge to its rollout is the delay in the transfer of benefits, which are made available much later than when they are most needed.[10] Further, the amount received by the beneficiary is perceived as insufficient, given the low availability of food in the households of TB patients as well as current food prices.

The GOI has multiple schemes that directly and indirectly address the nutritional needs of PLW. Under the National Food Security Act of 2013, PLW are entitled to a nutritious take-home ration of 600 calories and a maternity benefit of Rs 5,000 as part of the Pradhan Mantri Matru Vandana Yojana. Examples of other such schemes include Janani Suraksha Yojana, a cash assistance scheme for institutional delivery, and Janani Shishu Suraksha Karyakram, an initiative to provide free and cashless services to pregnant women and sick newborns in government health institutions. While the coverage of these schemes is gradually improving, it will take much more for them to function smoothly, notably in the areas of awareness, human resources, processes during enrolment, stakeholder coordination, software, monitoring, and redressal mechanism.[11]

"GOI guidelines call for intensive case-finding among PLW and women suffering undernutrition, considered to be clinically vulnerable risk groups for TB"

A noteworthy initiative of GOI is the release of the National Framework for Joint TB and Maternal Health collaborative activities.[12] This framework articulates the collaborative activities needed to ensure early detection and timely management of TB among pregnant women and proposes an implementation strategy that covers joint planning, reviews, service delivery protocols, training, monitoring and evaluation, Information Education Communication (IEC), and operational research. While the proposed collaborative activities were released just prior to the second wave of the COVID-19 pandemic in early 2021, and are aspirational, much more needs to be done on the ground for these initiatives to have any significant impact.

Recommendations

In order to achieve impact at scale, India needs to:
- deliver at high coverage – so that every pregnant woman is screened for TB and linked to TB treatment services if needed;
- deliver on a continual basis – which is possible when the same is mainstreamed within the antenatal care (ANC) practices, and not just implemented as a drive or a campaign;
- deliver with high intensity – so that pregnant women need to be screened for TB at every ANC visit and through every platform available such as VHSNDs, HWCs or PMSMAs;
- deliver with high quality – so that pregnant women are supported throughout the treatment to ensure full adherence to the recommended protocols;
- improve recording and reporting of TB status in ANC records and pregnancy status/details in TB records. This can be best done by integrating MCTS and Nikshay, followed by monitoring.

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Fluorosis-induced Maternal Malnutrition: What We Know

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High concentrations of fluoride in drinking water

Water contamination is an environmental problem that is also responsible for several human health issues. Specifically, certain toxins from water can cause disruptions in nutrient absorptions within the body. The Government of India reports that 220 districts of India have high concentrations of fluoride in drinking water. More than 66 million people have been reported to be exposed to drinking water contaminated with high levels of fluoride[1,2] since 1937. The National Jal Jeevan Mission (JJM) program attempts to address this and other water contamination problems.

> **"More than 66 million people have been reported to be exposed to drinking water contaminated with high levels of fluoride"**

The toxic impact of fluoride occurs when consumption through water or by other means exceeds the Bureau of Indian Standards (BIS) daily limit of 1 mg/l. [3] At these concentrations, exposure to such contaminated water can cause multiple symptoms in the body, together known as fluorosis. Primarily, two forms of fluorosis have been discussed in public health literature: dental and skeletal. However, linked disorders, especially malnutrition-related problems, are receiving more attention.[4]

Fluoride-led disruptions

We first try and understand the known and well-documented problems related to malnutrition caused by fluoride toxicity, specifically those that affect a woman during pregnancy, such as:

- iron-deficiency anemia
- calcium deficiency and bone disorders; and
- other linked disorders.

The work by Dr AK Susheela has well documented the relationship between fluoride toxicity and iron-deficiency anemia, especially for pregnant mothers.[5] It underscores the finding that fluoride toxicity impedes iron absorption and increases anemia in several ways.

Starting with Dr Teotia, followed by Dr Chakma, Dr Reddy and other authors, the disruption in calcium absorption due to fluoride toxicity has now been well established.[6-10] Again, given that pregnant mothers have a high need for calcium, this becomes yet another reason for being conscious of fluoride-induced toxicity.

Other disorders brought to light by continuing research include thyroidal imbalances, the possibility of fluoride breaking the placental barrier, and early brain developmental disorders.

Fluoride toxicity and malnutrition

Early work by Indian authors on the link between fluoride toxicity and malnutrition created high awareness among policymakers, NGOs and researchers. This led to a focus on different segments of the population teams struggle to cope with the pandemic.

Integrated Fluorosis Mitigation (IFM)

In the early 2000s, UNICEF, the National Environmental Engineering Research Institute and the National Institute of Research in Tribal Health initiated the design of IFM programs in Madhya Pradesh (MP) with an integrated approach focused on safe water and better nutrition in fluorosis-affected areas.[11] One of the programs identified calcium deficiency as a major problem and concentrated on addressing this with nutrients from locally available green leafy vegetables. The promotion of Cassia tora as a source of calcium for districts such as Mandla and Jhabua proved successful. This later led to other such experiments on calcium intake and local food across these fluorosis-affected areas. UNICEF has now extended the IFM program to the state of Rajasthan.

The National Programme for Prevention and Control of Fluorosis (NPPCF)

The NPPCF was initiated in 2009–10 to provide a comprehensive support to all fluorosis-affected districts with an approach combining detection, counselling and nutritional supplementation. Within this program, the focus is on identifying early stages of fluorosis in villages and offering support for countering the more severe symptoms.

Anemia Mukt Bharat (AMB)

The AMB program recognizes the linkages between fluorosis and anemia, and includes the provision of safe water, especially in fluoride-affected areas, to counter anemia.

AMB has been able to educate health workers on the fact that anemia is caused not just by nutrition deficiency in food, but also through water contamination. Outreach efforts by AMB in Rajasthan have been highly useful in educating mothers as to the causes and treatment of anemia extended the IFM program to the state of Rajasthan.

NGO experiments

NGOs have been conducting experiments in working on community-led efforts, innovation on solutions and action for long-term behavioral changes in addressing challenges related to malnutrition. The work of the authors from INREM at multiple locations across the country since 2010 has shown the following:[12]

- By working with pregnant and lactating mothers we can prevent malnutrition in fluoride-affected areas.
- Local sources of calcium and related nutrient become important.
- Educating anganwadi workers about the toxic effects of fluoride and offering them options such as nutrition gardens empowers their action and produces better results.

Such positive impacts[16] have been seen in Jhabua (MP), Dungarpur (Rajasthan), Nalgonda (Telangana), Chikballapur (Karnataka) and Balasore (Odisha).

> **"In the longer term, we need better education of all stakeholders, from program managers to field workers"**

Learning from experiences and action strategy

The impact of high fluoride toxicity on malnutrition in pregnancy has now been well documented, and various institutions are taking action to address it. Since the early 2000s, various efforts by these institutions have brought about change in many states.

- The combination of safe (fluoride-free) drinking water and better nutrition is now a recommended strategy for fluoride-affected areas. There is a special ICDS menu in fluorosis-affected areas such as Nalgonda (Telangana).
- National programs such as NPPCF and AMB are now gradually mainstreaming this thinking into action on anemia control and disease detection. Capacity-building of health workers is a necessary step for all fluorosis-affected districts.
- The water ministry now has a flagship program in JJM, which is addressing the problem of safe water supply. This is expected to give promising results for tackling water contamination.
- In the longer term, we need better education of all stakeholders, from program managers to field workers. This thinking needs to be embedded in programmatic action to prevent the severe impacts of fluoride toxicity on pregnant mothers and young children.

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Harnessing the Potential of Nutrition and Agriculture Institutes for Improving Diet Diversity

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Introduction

The problem of malnutrition is multifactorial, but inadequate dietary intake remains an immediate and direct cause. Research from India and similar settings has established the strong association of dietary diversity and undernutrition among children and with socio-economic influencers.[1,2,3,4]

In 2018, the Government of India launched POSHAN Abhiyaan – a joint effort of the Ministry of Health and Family Welfare (MoHFW), the Ministry of Women and Child development (MWCD) and nine other ministries – with the aim of reducing child undernutrition (stunting and wasting) and low birth weight by 2%, and anemia (among young children, women and adolescent girls) by 3% by creating a mass movement (Jan Andolan) for food and nutrition in India.[5]

Under the POSHAN Abhiyaan, 10 themes have been identified for percolating and penetrating Pan-India as a Jan Andolan. These focus on 117 districts that have poor health and nutrition indicators, also referred to as aspirational districts. [6,7] Of the 10 Jan Andolan themes, six focus on healthy diets, food and feeding.

The collaboration across Ministries has increased the availability of human and financial resources for addressing the challenges of a transitioning India. However, there were two stakeholders that were included in the design of the Jan Andolan but were not actively engaged. First, the Ministry of Agriculture and Farmers Welfare, and its huge network of agriculture extension departments, Krishi Vigyan Kendras (KVKs or governmental farmer training schools) and agriculture extension workers with a footprint in practically all 700+ districts of the country.[8] Second, nutrition academic institutes of Food and Nutrition / Food Science / Biotechnology and Food Technology housed in Home Science and Agriculture universities and Indian Institutes of Technology (IITs).

In 2018, the National Centre of Excellence and Advanced Research on Diets (NCEARD) was established at Lady Irwin College, New Delhi, to support the Maternal Health Division, MoHFW, Government of India for technical assistance on maternal nutrition, through policy discourse, supporting the development of women-centric nutrition resources and guidance. However, active engagement of food and nutrition departments to support government nutrition programs at state and regional level has largely remained a missing link.

To this effect, the National Institution for Transforming India (NITI) Aayog (the premier think-tank of the Government of India), in collaboration with NCEARD and United Nations Children's Fund (UNICEF) India, mapped agriculture, home science, food technology, biotechnology and Indian IIT institutions across selected aspirational districts with the capacity and willingness to engage as partner institutions for promoting healthy diets.

> **"Of the 10 Jan Andolan themes, six focus on healthy diets, food and feeding"**

Institutional mapping exercises were carried out from October to December 2018 covering home science / food technology and biotechnology colleges, IIT, and agriculture institutions across the country. The process was initiated in seven states and 25 aspirational districts and later extended to a total of 16 states and 89 aspirational districts across five regions, namely: North region (covering the states of Delhi, Uttar Pradesh and Uttarakhand); South region (Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Telangana); East region (Assam, Bihar and Jharkhand); West region (Gujarat, Maharashtra and Rajasthan); and Central region (Madhya Pradesh and Chhattisgarh).

The following list of criteria was developed for final short-listing of institutes:

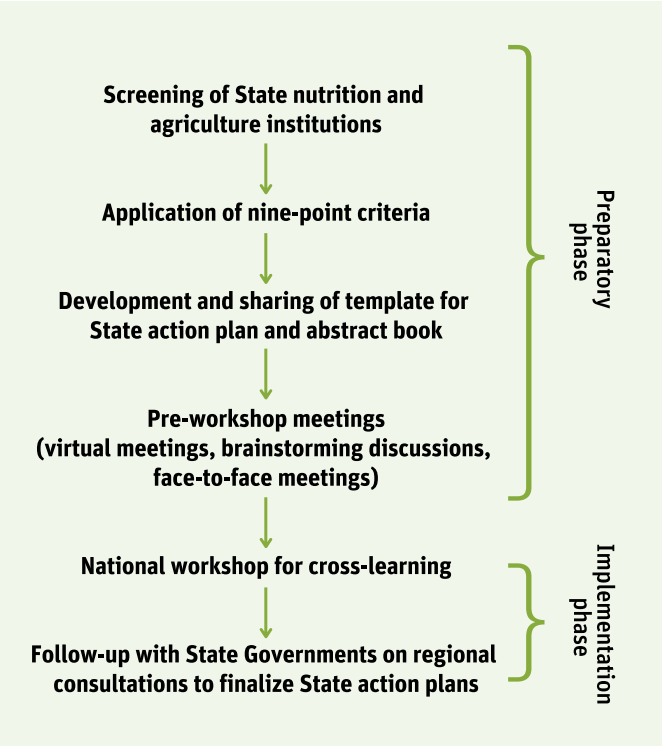
1. A government-funded institute.
2. Offers postgraduate, doctoral and/or post-doctoral courses.
3. Footprint in aspirational districts.
4. Part of state government technical advisory committee.
5. Proven capacity in research / training / food product devel-

opment / dietary Information Education Communication (IEC) / recipe development.

6. Proven capacity to manage UN and/or government funding.
7. Willing to partner with NITI Aayog and/or state government for Jan Andolan.
8. Willingness of development partner to fund the institution for start-up activities.
9. Functional laboratory in place.

Once shortlisted, each institute received a template for the development of a state action plan **(Figure 1)**.

Figure 1: Flowchart for the methodology adopted



One-and-a-half-day national workshop on 20–21 February 2019 in New Delhi involving selected nutrition and agriculture institutions, representatives of UN agencies, state government secretaries from concerned departments, and development partner agencies.

We were able to list 903 universities and 39,050 colleges with approximately 2,250 government institutions across the country.[9] Only 42 institutions across 16 states fulfilled eight of the nine-point criteria **(Table 1)**. The geographic spread of these 42 institutes was representative of all regions of the country **(Figure 2).**

Ongoing models of nutrition-agriculture collaborations on diets and food systems

Every region had a successful collaboration between nutrition and agriculture institutes and the state government. In Uttar Pradesh (North region), for example, the government's Bioenergy Development Board demonstrated successful linkage with agriculture

TABLE 1: Criteria and selection of nutrition and agriculture institutes

S.No.	Criteria	Institutes meeting criteria n(%)
i.	A government-funded institute	731 (100)
ii.	Offers postgraduate, doctoral and/or post-doctoral courses	230 (33)
iii.	Footprint in aspirational districts	42 (5.7)
iv.	Part of State Government technical advisory committee	25 (3.4)
v.	Proven capacity in research / training / food product development / dietary IEC / recipe development	52 (7)
vi.	Proven capacity to manage UN/Govt. funds	42 (6)
vii.	Willing to partner with NITI / State Govt. for Jan Andolan	52 (7)
viii.	Willingness of development partner to fund the institution for start-up	42 (6)
ix.	Functional lab (food/technology) in place	42 (6)

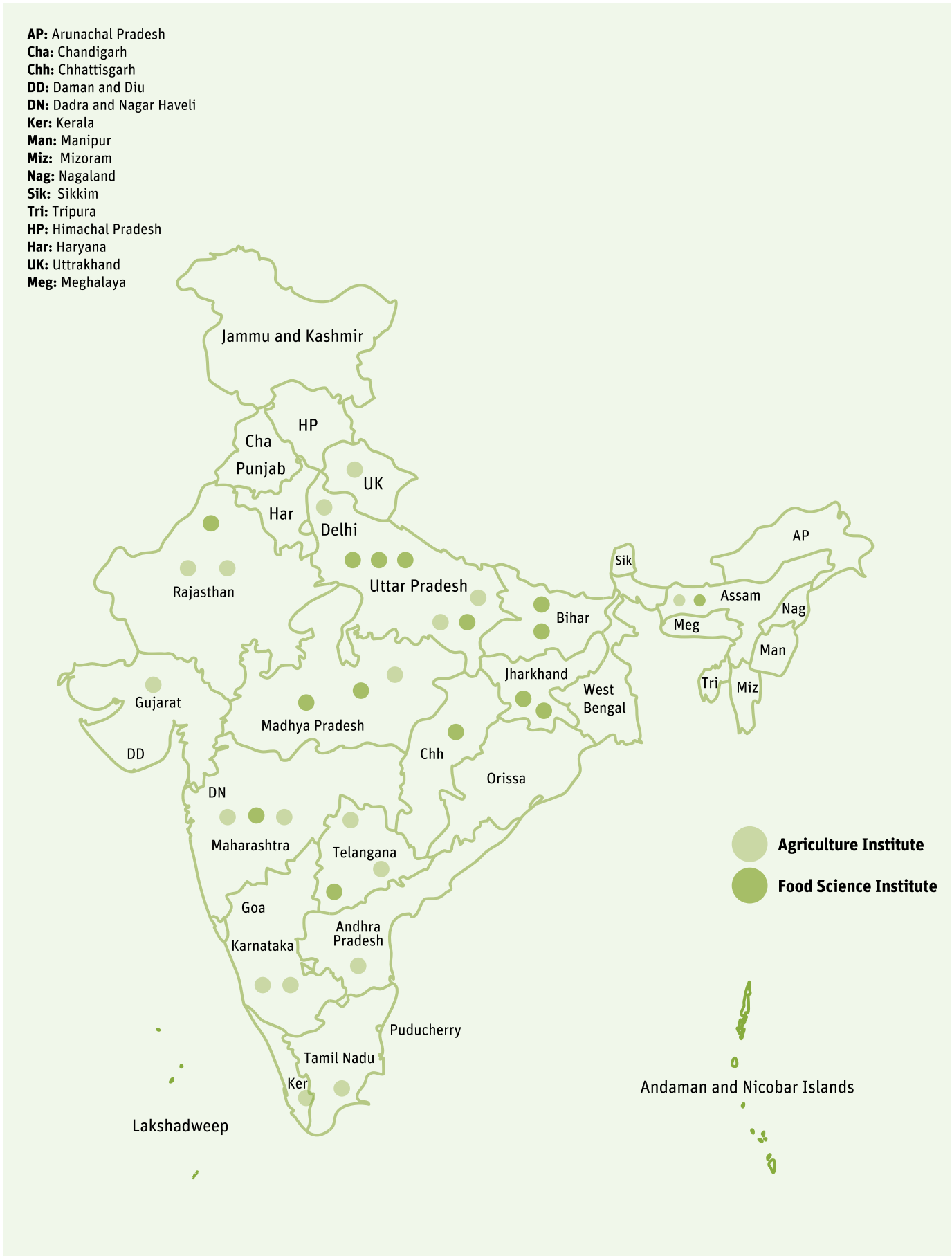
universities and Farmer Producer Organizations (FPOs) to promote the cultivation of resilient and high-nutritive-value grains such as ragi, quinoa and chiya. Another successful example was from Dr Rajendra Prasad Agriculture University, Bihar (Eastern region). With support from UNICEF, an agri-nutrition cell has been established in the university, which piloted and scaled up a school nutri-garden initiative (referred to as Ankuran), now active in 70,000 schools state-wide.

> **"Every region had a successful collaboration between nutrition and agriculture institutes and the state government"**

State action plans to address challenges related to diet and local food systems

An overall state action plan model emerged comprising five stakeholders: 1) state government department(s), 2) academic institutes, 3) KVK, 4) existing training institutions for field workers, and 5) VRPs, women farmers and FPOs under SRLM. It was proposed that state departments should provide technical assistance requests and funds for start-up activities, and also review progress of the institutes at regular intervals. Institutes would take the lead

FIGURE 2: Geographic spread of participating institutes (n = 42)



(Note: Map not to scale, political boundaries not verified. Map gives 35 locations as there were two or more institutes in some locations.)

in developing the state action plan to meet state requirements.

Each of five regions developed a state action plan for 180 days for start-up activities, leading to the formation of nutrition support units in NITI Aayog's aspirational districts. The state action plans reflected the varying context of the regions and the capacity of participating institutes to engage in promoting dietary diversity and strengthening local food systems. The common activities from all regions included: 1) signing MoA with the state department, 2) partnership protocol with detailed roles and accountability, 3) capacity building / mentoring for FPOs/VRPs or other community-based nutrition or agriculture workers, 4) generation of evidence on diets specific to the region, and 5) policy advocacy for increased investments in research and promotion of local foods. The unique features of each region were also reflected in the action plans.

The POSHAN Abhiyaan provides the policy framework for convergent action to improve diets in addition to other services for better nutrition outcomes for children and women. Ideally, academic institutes have the potential to advance POSHAN Abhiyaan objectives. The study substantiates the limited engagement of nutrition and agriculture institutes in POSHAN Abhiyan, with only 3% of more than 700 institutes being part of state governments' advisory committees on any state-funded programs. We also noted that while 230 institutes offered a post-graduate course in nutrition and agriculture, only 42 had a functional laboratory and the necessary resources to manage government or non-government funds. The study reveals the stark variations in the capacities of nutrition and agriculture institutes within and across states and regions. It should be noted that our study was purposive, and that the findings are not generalizable to all nutrition and agriculture institutes in the selected states.

The limited capacity of most government nutrition and agriculture academia reflects an urgent need to review resource allocation to these institutes.

While many institutional capacity gaps emerged from our analysis, we also noted that participating institutes had a range of innovations to showcase. There is an urgent need to shift from lab to land as regional home science, technology and agriculture institutes have developed innovative foods from locally available resources and succeeded in bio-fortified crop production which has potential for scale-up. Needless to say, the KVK trainers, VRPs, farmers and self help groups (SHG) included in the state action plans will need to be trained in promoting dietary diversity and strengthening local food systems.

Finally, the implementation of the proposed plans would require budget allocations which may not be available through government sources alone. Nutrition and agriculture institutes will need to tap into donor and Corporate Social Responsibility funds.[10]

The mapping and screening exercise reinforced the findings regarding the lack of engagement of nutrition and agriculture colleges in government programs. It highlighted the significant gap in institutional capacity, particularly in terms of laboratory facilities and the type of degree courses available. The pre-workshop planning, in combination with deliberations during the workshop, resulted in action plans that were based on the strengths and earlier experiences of the participating 42 institutes that met the minimum criteria of partnering with government on promotion of local foods and dietary diversity. Engaging these institutes will strengthen POSHAN Abhiyaan's footprint in 75% of the aspirational districts.

"The mapping exercise reveals the stark variations in the capacities of nutrition and agriculture institutes within and across states and regions"

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Promoting and Supporting Maternal Diets through Education

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Maternal diets lay the foundations for the health, cognition and productivity of future generations.[1] In India, more than half of all pregnant and non-pregnant women are anemic, and nearly a fifth of the women in the 20–49 years age group are underweight.[2] Furthermore, nearly 25% of women are either overweight or obese.

Gaps in maternal diet

The diet of pregnant Indian woman is suboptimal, with low energy (calories), imbalanced macronutrients, and inadequate micronutrient intakes. In rural India, maternal diet is primarily composed of cereals, as indicated by the National Nutrition Monitoring Bureau (NNMB) surveys in 10 Indian states. These surveys also reveal that more than half of pregnant women do not consume enough protein. Their intake of key micronutrients such as iron, vitamins A and C, and folic acid is less than 50% of the recommended levels.[3]

Between 2006 and 2016, the dietary intake of pregnant women showed no improvement, with a decline in the consumption of pulses and vegetables over time (6 and 16 percentage points, respectively). Moreover, in 2016, less than 10% of pregnant women in India ate meat, fish and eggs, only a fifth consumed fruits, and about half consumed pulses, dairy and vegetables daily.[4] As expected, consumption of nutrient-rich food groups, such as dairy, fruits and green vegetables, was higher among the wealthier households.

Subnational data on the diet of pregnant women, based on a 24-hour recall of 10 food groups, showed that only about a fifth of the pregnant women in Uttar Pradesh (UP),[5] a third of the pregnant women in Bihar and more than half of the pregnant women in Odisha and Chhattisgarh achieved recommended dietary diversity scores (consumed ≥5 food groups in a day).[4]

> **"The diet of pregnant Indian woman is suboptimal"**

Enablers and barriers

Different supply- and demand-side factors influence maternal nutrition. Some of these are: food availability, economic constraints, inadequate exposure to nutrition services and counseling, food restrictions (often imposed by elderly women in the family), gender norms, and gaps in maternal knowledge.

- Pregnant women from richer households were about two times more likely to consume a diverse diet (≥5 food groups)].[5,6]
- Food access interventions such as grain subsidies, food supplements and local food production reduced economic constraints by 10–35%.[7]
- Mothers with higher education or at least six years of education were more likely to have a higher dietary diversity compared to those who were illiterate.[5,6] Higher literacy was associated with consuming special foods such as milk and animal-source foods during pregnancy.[8]
- Receipt of health and nutrition services as well as counseling on diet were associated with a 1.5–3.0 times greater likelihood of higher dietary diversity and consuming more food groups.[5,9,10]
- Increased maternal knowledge was associated with higher diet diversity (OR=2.2) and consumption of a greater number of food groups.[5]
- Women from a lower caste (OR=0.9) and rural households (OR=6.9) were more likely to have a low-diversity diet.[5,9,10]
- Patriarchy and intra-household gender norms resulted in women eating last and also consuming the least amount.[11]

In many households, women had limited access to markets and minimal ability in exercising their choices regarding food items.[12]

Current intervention strategies

Several policies and programs have been implemented to improve maternal nutrition. These include the provision of food supplements for pregnant and lactating women (PLW); cash transfer (under the Pradhan Mantri Matru Vandana Yojana, a maternity benefit program run by the Government of India); antenatal check-ups and distribution of micronutrient supplements; diet counseling by front-line workers; and delivery of subsidized staples through the public Public Distribution System (PDS), along with recent efforts at promoting food fortification and nutrition-sensitive agricultural activities.

Evidence regarding diet improvement

The evaluation of food supplementation and the cash transfer

program suggests that the affordability of diets is improved by reducing economic barriers to obtaining recommended foods.[13] Studies on 'hot cooked meals' noted an increase in the proportion of women consuming a diverse diet post-intervention (57–59%), consumption of specific food groups (eggs and milk: 74–96%), and energy and protein intake among pregnant women.[14,16] Between 2006 and 2016, the overall use of food supplementation increased from 19% to 53%, but equitable coverage remained a challenge, with marginalized groups such as lower castes and tribes, the poorest quintiles, and those with low schooling levels being left behind.[17]

The majority of studies on Social and Behavior Change Communication (SBCC) reported the positive impact on dietary intake of an increase in the quantity and frequency of meals, as well as the quality of diets (with a higher intake of vitamin-A rich fruits, green leafy vegetables, and proteins). However, few studies showed the impact on overall dietary diversity.[18-21] The SBCC approach was effective in improving maternal knowledge, motivating family members (especially husbands and mothers-in-law) to support maternal diets, and addressing food restrictions during pregnancy, especially where foods were available but not utilized optimally.[22] Learnings from Alive & Thrive's maternal nutrition intervention studies in UP[18] and Bangladesh[22] highlighted the need for systems that strengthened efforts at capacity-building, with a special focus on counseling skills, supportive supervision of front-line workers, and the use of data to review and track progress. Evidence is also emerging that nutrition-sensitive agriculture interventions have a positive impact on maternal dietary diversity through women's cooperative poultry farming and exposure to videos and participatory learning activities.[23]

> **"The SBCC approach was effective in improving knowledge of mothers on diets"**

Recommendations

- Operational guidelines need to be strengthened/updated to prioritize counseling on diet and micronutrient supplements, locally adapted food supplements, and the management of special dietary requirements among pregnant women.
- The approach of these interventions should be both universal and targeted. Some interventions must be contextualized to local environments and ought to integrate local food and dietary patterns of the pregnant women.
- Emphasis should be placed on combined packages across health and food systems, as well as on social safety nets and women's empowerment, with SBCC being integral to all interventions.
- Food system approaches, including nutrition-sensitive agriculture, need to be strengthened in order to ensure the availability, affordability and accessibility of diverse, nutrient-rich foods to pregnant women.
- Greater investments are needed in data systems and implementation research to fill the gaps in maternal nutrition.

Conclusion

In conclusion, accelerated multipronged efforts are essential for ongoing tracking of dietary patterns of pregnant women, addressing the identified barriers, including food access and social norms, and strengthening existing service delivery platforms for pregnant women by using both SBCC and systems approaches for quality and equitable coverage.

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Working with Women's Groups to Improve Nutrition: What Works

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Interventions to improve nutritional status

Concern over the slow improvement in maternal and child nutritional status in India in the last few decades has been exacerbated by recent data showing alarming trends, including persistently high levels of child stunting.[1]

If India is to achieve SDG targets by 2030, the focus must be on identifying and adopting at-scale, targeted and proven interventions. The challenge is a complex one: nutritional status is the result of a host of interconnected basic, underlying and immediate factors.[2] Accordingly, interventions that can target several of these factors simultaneously could prove more effective.[3]

Women's groups stand out as one such approach. These groups are diverse, encompassing autonomous member-based and social solidarity organizations, community mobilization initiatives and microfinance and livelihoods groups such as self-help groups (SHGs). Importantly, groups offer distinct advantages over interventions with individual targets. First, their reach is impressive, working alongside long-standing public programs and front-line health workers to reach women and children, especially those from poor and marginalized backgrounds. SHGs alone currently reach over 50 million households.[4] Second, they engage groups of women on a regular basis, providing the opportunity for mutual support or dissemination of information. Third, they can simultaneously trigger multiple pathways to improved nutrition,[5] such as: increased income and financial security; enhanced food supply through agriculture inputs; changed health behaviors through information provision, and improved service use and quality through social accountability.

Unsurprisingly, donors, international organizations, civil society and the government have thrown their weight behind working with women's groups to improve nutrition outcomes.[6] Research has proliferated in parallel, and close to 100 studies in the last 20 years examined effects, enablers and barriers to working with women's groups to improve health and nutrition in India.[7] Though evidence is still limited to a handful of states,[8] there is much we can learn from these studies.

> **"Interventions with women's groups might not improve nutrition outcomes on their own but could be useful additions to existing interventions"**

What works: A review of the evidence

In the existing evidence base, groups generally fall into two categories: i) SHGs whose primary activity was savings and credit, many of which 'layered' on additional nutrition activities, and ii) groups aimed at community mobilization through engaging women; for example, through a participatory learning and action (PLA) cycle.

These groups employ diverse pedagogical styles and intervention scopes. To illustrate: a program in Saharsa, Bihar, with government-formed SHGs introduced nutrition education sessions with members to raise awareness;[9] an organization in Uttar Pradesh aimed at building group cohesion and strengthening members' skills through cooking demonstrations and some community activities to engage non-members;[10] and a community mobilization approach for building capabilities of women's groups and the broader community through participatory learning and action cycles in Odisha and Jharkhand.[11]

Self-help groups have great potential to improve nutrition

What does the evidence show?

First, impact is largely limited to changes in self-reported dietary diversity or infant and young child feeding practices; these changes rarely translated into measurable improvements in anthropometry for women or for children during the course of study. Second, interventions that did demonstrate an impact on anthropometry included a supply component, such as combining PLA cycles with women's groups along with food provision in creches for children under three years or SHGs that included access to rice credit lines.[12] This suggests that interventions; with women's groups might not improve nutrition outcomes on their own but could prove useful additions to existing interventions delivered to individuals.

Third, there are pros and cons of working with existing women's groups such as SHGs. Pre-existing groups have regular meeting cycles, established group solidarity and collective action norms, which all help reinforce messages and encourage members to adopt practices. However, these groups are generally formed for another purpose, resulting in limited intensity or time among their primary focus group. Retaining members for discussions on nutrition when their primary engagement with the group was around saving and credit, proved hard in interventions,[13] unsurprising given the average age of SHG members was 38–40 years,[14] with only a few who were pregnant or mothers of young children.[15] In contrast, community mobilization interventions formed new groups focused on nutrition and had the potential to attract relevant women as well as other interested stakeholders.

> **"Those designing group-based interventions should pay greater attention to developing an intervention approach that can effectively address nutrition"**

Experimenting with effective pedagogical approaches

It is crucial that those designing group-based interventions pay greater attention to developing an intervention approach that can effectively address nutrition, with individual- and community-appropriate pedagogy and content.

Interventions that rely on group meetings to share information should tailor content for members of the group. Using SHG meetings to provide women past childbearing age with information on infant and young child feeding practices is unlikely to be effective as a primary approach; depending on group members' age and demographic profile; identifying priority issues in a participatory manner may be more effective.

In addition, implementers should invest in needs assessments during content development to ensure messaging and interventions are appropriate.

Finally, implementers should explore the use of participatory methods to engage group members in active learning and agenda-setting. Pairing participatory methods with interactive tools such as recipe demonstrations or healthy eating fairs could work even better to engage women and help them translate the information into practical decisions.

Addressing the supply of relevant services

Improving nutrition requires available services – the health system, market provision of affordable and nutritious foods, the availability of supplementary nutrition services, adequate sanitation and so on; interventions must, therefore, engage well beyond the individual or group. Several women's groups' interventions have attempted to do so, with varying degrees of success. Supplying economic groups with livestock or food credit,[16] or providing children with food in creches,[17] for example, have emerged as effective approaches to improving consumption and, in the latter, case anthropometry.

However, this process of 'convergence' of supply-side actions with women's groups interventions often remains vague, or else the actions are tacked onto existing interventions as an afterthought. For example, the explicit convergence component of an intervention in Bihar with government SHGs was poorly executed as a result of unclear and delayed directives and a lack of role clarity among program staff. The effective integration of supply-side interventions needs to be viewed instead as a 'spice' – crucial to the dish and seamlessly incorporated into its construction.

Conclusion

There has been great enthusiasm for the potential of women's groups to improve nutrition – justifiably so, given their wide scale and potential multiplier effects. But, as public health teaches us time and time again, there is no silver bullet for improving health and nutrition outcomes. Existing evidence on the effectiveness of women's groups to improve nutrition is, at best, mixed, though one message is clear thus far: neither groups alone nor simply 'layering' on information is likely to have a substantial effect on nutrition outcomes.

A clear link between the composition of the group and the content being delivered, investing in building community capabilities and ensuring community buy-in, and an explicit focus on the supply side of the equation are promising approaches that require further investment and evidence. Evidence-based investments with better design have the potential to improve the reach and effectiveness of these group-based interventions.

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Swabhimaan: An Integrated Multi-sectoral Strategy in Resource-poor Settings

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Introduction

India is a global hotspot for maternal malnutrition, with half of its 30 million pregnant women suffering from some form of malnutrition (52.2% are anemic, 18.7% underweight, and 24.0% overweight).[1] An estimated 4.5 million adolescents are either pregnant or mothers. Despite having quality policies and programs to deliver and monitor globally recommended preconception and antenatal nutrition interventions, the average reach remains less than 50%. The challenge lies in the lack of effective operational models to deliver a comprehensive package of essential nutrition interventions for adolescent girls and women to overcome both, systemic challenges and those around user service uptake.[2]

Intervention

Swabhimaan (translating as 'pride, sense of dignity, self-respect'), a five-year initiative, was launched in 2016 by the National Rural Livelihood Mission (DAY-NRLM), Ministry of Rural Development, GoI in partnership with UNICEF, India in three states: Bihar, Chhattisgarh and Odisha. The program delivers a comprehensive package of 18 nutrition-specific and nutrition-sensitive interventions through a combination of system and community-led approaches **(Table 1)**.[3] It integrates services on health, nutrition, agriculture and livelihoods across four government departments, engaging affected communities to customize a maternal nutrition delivery package in response to their needs and manage grants to implement these interventions.[4] The program has an in-built impact evaluation which examines the impact of community-based and systems-strengthening interventions via 231 women's agencies using an invested service approach (4,175 SHGs) for four years (2016–20) on girls' and women's nutrition in 356 villages of the five poorest NRLM-designated blocks in four districts across the three states. The detailed evaluation design and intervention are discussed elsewhere.[5]

The essential interventions include preparation of annual integrated nutrition microplanning led by the community plus participatory learning and action-based monthly group meetings with pregnant women, mothers of children under two, adolescent girls and women farmers. Trained community resource persons identify at-nutritional-risk target groups, conduct nutrition counseling and food demonstration activities, undertake home visits, and provide support in setting up nutrition gardens. Loans are disbursed to at-risk groups, vulnerable households, adolescent girls for education and self-help groups (SHGs) to improve the last-mile delivery of the nutrition interventions.

The primary outcomes for the evaluation of Swabhimaan is improvement in adolescent girls' and women's nutritional status measured by Body mass index (BMI) and Mid Upper Arm Circumference, expected by the implementation of community-led and systems-strengthening interventions. The secondary outcomes include improvement in the coverage of 18 key nutrition-specific and nutrition-sensitive interventions.

Results

Here, we present baseline (2016-17) and endline (2021-22) results for pregnant women (15–49 years) from Bihar and Odisha from the prospective, non-randomized controlled impact evaluation of Swabhimaan with population level estimates.[6,7] At baseline, 468 pregnant women in Bihar and 367 in Odisha were measured, and at endline, 212 in Bihar and 242 in Odisha were measured. **Table 2** shows the impact of intervention strategies on pregnant women's nutrition status, food and nutrition intake, uptake of health and nutrition services, nutrition-sensitive practices and behaviors at endline.

At the Bihar intervention sites, the mean diet diversity score increased from 4.0 to 5.7. By endline, in both states, a significantly higher proportion of women reported higher diet diversity scores (6 or more food groups consumed out of 10). A large proportion of women reported living in households with kitchen gardens.

At endline, pregnant women reported higher consumption of IFA tablets, while consumption of calcium tablets was highly significant in Odisha in comparison to baseline. A marginally higher

TABLE 1: Systems-strengthening and community-led actions

Responsible service provider	Intervention	Frequency
Community-led actions		
Village Organization (VO)		
Social action committee	Selection of Poshan Sakhi ('community resource person') (one per VO)	Once
Poshan sakhi / community resource person	Integrated nutrition microplanning (12 days over two months)	Once, followed by annual review
	Maitri baithak (translated as 'friendly meeting') of women open to non-group members using participatory learning and action (PLA)	Monthly
	One additional monthly home visit / group meeting of nutritionally 'at-risk' women	Monthly
Krishi mitra / village resource person (VRP)	Maitri kishan baithak (translated as 'friendly farmers' meeting') on nutrition-sensitive agriculture PLA	Monthly
	Home-based Poshan (translated as 'nutrition') beds or garden/ backyard poultry	Monthly
SHG	Mobilize family members for VHSND services All members to wash hands before their weekly meeting begins	Monthly
Cluster-level federation (CLF)		
Social action committee	Families with women and children at risk of undernutrition linked to agri-poultry linkage and social protection schemes	Monthly
	Loans for secondary education	Monthly
	Creating farmer training school sites	Monthly
	Training for Poshan sakhi and Krishi mitras	Quarterly
	Newlywed couples' meetings and social drives	Biannual
	Entitlement camps and health check-ups for SHG members	Biannual
	Review of integrated nutrition plan	Annual
Systems-strengthening actions		
	Strengthening of VHSND, including services for at-nutritional-risk and newlyweds	Monthly
	Training of auxiliary nurse midwives on VHSND	Quarterly
	Convergence review at district and block level to address VHSND bottlenecks	Quarterly
	Orientation of service providers Public Health Distribution System, Integrated Child Development Services and Department of Water and Sanitation to ensure communities receive entitled services	Annual

proportion of pregnant women in Bihar reported accessing ANC services in the first trimester by endline. In Odisha, a significant increase was recorded by endline for women accessing ANC in the first trimester. A higher proportion of women reported weight monitoring during pregnancy as compared to baseline. There were significant reductions in the number of women living in households where members practice open defecation in Bihar, but not in Odisha.

Modest improvements were recorded in the use of modern family planning methods for spacing between pregnancies at endline. Significant improvements were recorded in the number of pregnant women attending at least three VHSNDs six months preceding the endline survey in Bihar (32.6%, $p<0.001$). About 90% of pregnant women reported attending VHSND in Odisha by endline (not significant). ICDS entitlements were better utilized and significant improvements were recorded in the utilization of ICDS services by pregnant women.

TABLE 2: Coverage of health and nutrition services for pregnant women (15–49 years) in intervention areas in Swabhimaan in baseline (2016–17) and endline (2021) surveys

Key Indicators	BIHAR					ODISHA				
	Intervention		Control		Effect size of change	Intervention		Control		Effect size of change
	Baseline 2016 (N=468)	Endline 2021 (N=212)	Baseline 2016 (N=468)	Endline 2021 (N=231)		Baseline 2016 (N=367)	Endline 2021 (N=242)	Baseline 2016 (N=447)	Endline 2021 (N=298)	
Estimated sample of pregnant women (n)	374	374	374	374		374	374	374	374	
Pregnant women interviewed (n)	468	212	468	231		367	242	447	298	
Pregnant women's mean MUAC (cm [SD])	23.0 [2.5]	23.2 [2.3]	22.4 [2.7]	23.2 [2.3]		23.9 [2.3]	24.3 (2.2)	23.7 [2.2]	24.6 [2.3]	
Pregnant women with MUAC 23 cm and above (%[SD])	49.6 [0.50]	50.9 [0.50]	42.1 [0.49]	56.9 [0.50]	-13.4**	66.6 [0.47]	76.4 [0.43]	62.2 [0.49]	76.5 [0.42]	-4.4
Pregnant women with high dietary diversity score (6 or more out of 10) (%)	12.1	48.1	14.8	38.9	11.9**	33.5	48.2	28	44.5	-1.8
Pregnant women (in 2nd and 3rd trimester) who consumed at least 25 IFA tablets (%)	42.1	63.2	51	56.6	15.6*	71.8	85.2	74.2	83.8	3.8
Pregnant women (in 2nd and 3rd trimester) who received any calcium tablet (%)	11.8	82.1	13.5	68.6	15.2	49.8	71.5	55	60.3	16.3***
Pregnant women (in 2nd and 3rd trimester) who consumed any tablet for deworming (%)	5.9	30.1	3.1	19.1	8.2	22.5	39.6	23.8	31.7	9.2*
Pregnant women who have had ANC check-up in the first trimester (%)	36.3	52.6	33.5	36.6	13.2	40.1	65.7	32.7	74.2	-15.9***
Pregnant women whose weight was monitored (%)	62	77.8	65.8	58.2	23.6**	77.1	88	70	90.9	-10.0**
Pregnant women living in households with a kitchen garden (%)	18.8	41.2	14.3	31.8	4.9	38.3	56.6	49.1	55.4	12.1
Pregnant women living in households in which members practice open defecation (%)	78.6	39.3	91.2	35.4	16.5***	76.6	61.6	86.6	62.8	8.8*
Pregnant women living in households with access to PDS in the month preceding the survey (%)	58.4	98.6	71.4	97.2	14.5***	69.6	99.5	71.1	99.6	1.5
Pregnant women receiving ICDS entitlement for supplementary food (%)	16.2	33.8	26.1	25.3	18.2**	53.1	84.7	57.5	82.6	6.5
Adopted family planning methods to keep space between pregnancies (%)	3.5	19.1	2.5	8	10.1**	16.5	29.4	16.9	26.1	3.7
Pregnant women who attended at least three VHSND meetings in the six months preceding the survey (%)	3.2	32.6	1.9	17.7	13.6***	31.3	90.9	22.6	40.9	41.2
Pregnant women who attended at least three Poshan Sakhi meetings in the 12 months preceding the survey (%)	3.9	27.5	0	2.4	21.2**	7.9	15.7	4.7	10.7	1.8

COVID impact

Consecutive COVID-induced lockdowns in 2020 and 2021 disrupted nutrition services delivered by women's collectives. These collectives were also tasked with supporting COVID-19 response efforts in rural areas. Biannual tele-monitoring systems were established to monitor and improve nutrition service delivery.[8] During lockdowns, more than 50% of women's collective representatives of five blocks reported a halt in group-based community meetings, food demonstration and counseling sessions in Bihar, Chhattisgarh and Odisha; these resumed post-unlock. However, the provision of emergency funds, focused home visits and the development of nutri-gardens for at-risk women and adolescent girls continued despite lockdown hurdles. Post-unlock, continuity reached more than 90% in all states. Access to PDS, ANC services and THR, as well as home visits to high-risk pregnant women by ASHA, were reported to be almost as high during lockdown as post-lockdown. Micronutrient supplementation and spot feeding programs were largely halted. Women's collectives supported gap-fill and adaptation for continued delivery of nutrition services.

> **"Women groups can be engines to support community engagement on universal health and nutrition coverage"**

Lessons learned and way forward

Evidence on community-based women's groups for interventions emphasize the collective, partnership approach, whereby communities are empowered to implement problem diagnosis and find solutions.[9,10] Factors such as openness of group meetings to non-members, facilitation by a local trained facilitator selected from the group itself, and equal focus on strengthening the supply side of health and nutrition services can impact the effectiveness of the interventions.

A combination of community-based interventions and systems strengthening improves outcomes around access to health and nutrition services as well as diets, behaviors and practices. The Swabhimaan program implemented by DAY-NRLM's women collectives harnesses the power of community institutions and addresses the issue of equity. The approach is action-driven, whereby women decide their own priorities, outcomes and targets through microplanning, with the aim of reaching the most vulnerable groups – identifying, tracking and providing services to those at risk. Causal mechanisms that generate a positive impact include different methods of leveraging interactions among members and non-members of women's collectives at different frequencies – monthly, quarterly, annually, and at various levels of the federated structure such as SHG (tier 1), VO (tier 2) and CLF (tier 3). This is supplemented by regular training and monitoring support.

Simultaneously, the program addresses the supply side – using microplanning and convergence meeting platforms with line departments. The program also focuses on addressing social determinants such as early marriage, school-dropout, decision-making, and other gender barriers. Groups are not simply a 'platform' to deliver health messages; when engaged using dialogue-based, participatory methods, they can be an engine to support community engagement for universal health coverage.[11]

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Social Marketing: Filling the Gap Between Knowing and Doing

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The maternal mortality ratio and the role of anemia

While India has seen a reduction in Maternal Mortality Ratio (MMR) over the last decade,[1] it is important to note that MMR varies greatly between and across states because of the country's geographical vastness and socio-cultural diversity. In 2020, for instance, MMR for the Empowered Action Group (EAG) states (Assam, Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh and Uttarakhand) was 383/100,000 live births[2] as opposed to the national average of 113/100,000 live births.

Anemia is the underlying cause of 20–40% cases of maternal deaths.[3] However, despite numerous anemia control programs over the past 50 years, the latest National Family Health Survey (NFHS) shows that anemia in children and women has in fact worsened in the past five years.[4]

> "There is a need to move from a goal-oriented to a beneficiary-oriented approach"

A change in approach

Many of India's programs are disconnected and inconsistent. A deeper look reveals the need for revising strategies both in design and implementation – moving from a goal-oriented approach to a beneficiary-oriented approach. For this, we need to know and integrate the customer social, moral and cultural fabric in any strategy.

Conventionally, corrective actions are addressed in intervention strategies, and policy makers advocate extensive nutrition and health education to support specific programs with the aim of strengthening state government actions or the role of non-governmental organizations (NGOs). There is, however, little or no mention of perceptions, beliefs or related behaviors.

Behaviors here have three layers:

1. The woman's knowledge and perceptions owing to her socio-cultural background.
2. The gatekeepers and accessibility issues she faces.
3. The policies that determine availability within her environment.

Interventions aiming to improve maternal health need to broaden their focus beyond mere information and instructions. They should inculcate social marketing approaches that address the perceptions and attitudes of the beneficiary, family, and community in a holistic manner.

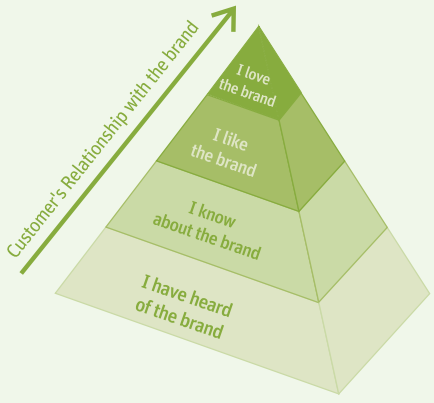
> "Interventions aiming to improve maternal health should inculcate social marketing approaches"

Fighting fire with fire

We live in a world where most products are invisible.[5] How, then, does one make something worth noticing?

By making a promise. In the private sector, a brand is a promise that a specific product will meet the customer's expectations.[6] It conveys an understanding of what the brand will do for a consumer in a functional as well as a symbolic sense[7] **(Figure 1)**.

FIGURE 1: The Customer-Brand Relationship Model



Extensive research and deliberation go into determining the messaging that should be used. If you notice posters or advertisements at a supermarket or in newspaper adverts, you can easily imagine who the advertisement targets. Tone, language, vocabulary, imagery – these all indicate conscious choices made by brands with the object of appearing relevant to their target audience.

When it comes to marketing, representation of the bottom of the pyramid has always been seen as a challenge rather than an opportunity. There is much scope for starting a new conversation with women about maternal nutrition – specifically, with ones who belong to lower socio-economic groups and rural households. Formative research can be used not only to gauge reactions to concepts but also to discover compelling consumer truths that can be leveraged to make the consumer feel seen and heard. This will succeed in galvanizing interest in a new intervention or even a revamped one, by allowing the target audience to buy into the promise, empowering them to make a better choice.

"There is much scope for starting a new conversation with women about maternal nutrition"

Advertising and messaging in the context of maternal care conventionally portray pregnant women with no issues, implying that a woman chooses a particular prenatal product because she cares for the baby and herself. The context is starkly different outside of privileged households – many women do not even get to access antenatal care centers in their villages, they are denied supplements by their next of kin, and many still resort to eating leftovers for daily subsistence. When it comes to speaking to pregnant women in rural areas, or those belonging to lower socio-economic groups in cities and towns, this crucial consideration, appropriate contextualization, and the woman's perspective, are all missing from program messaging. Imagine the potential buy-in when our target audience comes to know about an intervention that makes her feel seen, heard and understood. Social marketing allows us to design interventions that not only reassure but also excite her.

"Social marketing allows us to design interventions that not only reassure but also excite her"

Health services in rural India – whether they involving getting a screening or eating the prescribed diet – are accessed because of fear or pressure towards a desired outcome, especially among pregnant women, and rarely out of willingness or motivation.

However, we humans make choices and adhere to these based on how we feel, and not according to what we know or are told, and this negatively affects compliance, reach and sustainability.

Aspiration with awareness

Private players seem to leverage the consumer perspective expertly, but their primary goal is not to address malnutrition. The need of the hour is to marry the marketing acumen of the private sector, which puts the spotlight on the woman, with the cause of the public-sector intervention or strategy that can genuinely reach and benefit her.

In 2018, when *Sight and Life* (SAL) launched the Eat More, Eat Better campaign[7] in Rajasthan, the project aimed to improve food access and food choices for pregnant and lactating women (PLW) whose calorie intake was 40% below recommendations. However, SAL quickly demonstrated that simply raising awareness through education and information would not suffice; the target audience needed to be motivated to work toward a benefit, or a goal. We had to work on aspiration along with awareness. To do this, we used social marketing techniques and tools and conducted in-depth formative research. Asking the right questions was the top priority and the research questions were framed with the following requirements in mind:

- Identify the benefits and outcomes that are most valued by women during pregnancy and breastfeeding.
- Discover the most appropriate vocabulary to describe these benefits/outcomes.
- Understand important barriers to healthy eating during pregnancy.

Nutritive snacking for pregnant women

The findings helped identify key insights that were used to develop a compelling behavior change strategy. We focused on introducing a new behavior: nutritive snacking for pregnant women. The habit of snacking was accepted and already practiced, making it an easier behavior to influence. Pregnant women were provided with a specially designed snack box they could keep with them, away from the kitchen, along with a treat pouch that could be carried in a sari.

The treat pouches that were designed for the pregnant woman

To make the husband and wife both feel equally invested in the mother's pregnancy, the baby was positioned as a 'Champion' in the campaign that would fill both the mother and father with pride, and parents were encouraged to do what was best for their 'Champion'. The benefit was an emotional one for the mother – a feeling of being special and cared for by her husband and a feeling of empowerment when it came to looking after herself and her babv.

The campaign message features the husband encouraging his pregnant wife to eat more, referring to her as the Mother of a Champion

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Streamlining IFA Supply Chain in Madhya Pradesh

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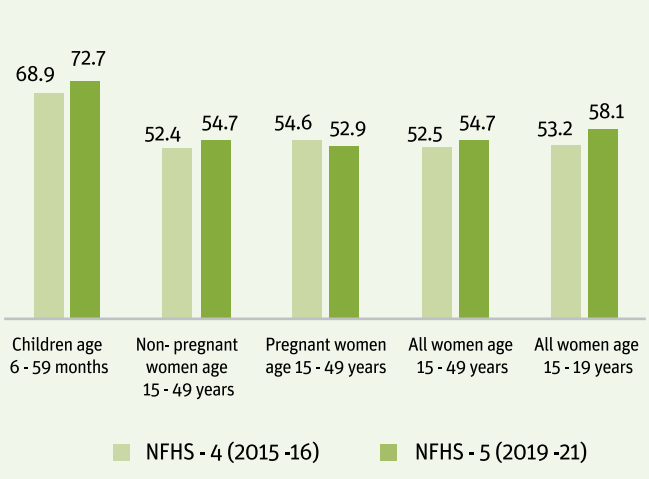
Setting the context

In Madhya Pradesh (MP), 54.7% women (15–49 years) suffer from anemia (Hb < 11.0 g/dl).[1] That is one in every two women. The figure is as high as 72.7% among children (6–59 months). Over the past five years, the prevalence of anemia has increased among most demographic groups due to several reasons, including perhaps the disruptions caused by the COVID-19 pandemic **(Figure 1)**.

FIGURE 1: Prevalence of anemia in MP (in %)



Anemia has a complex etiology and therefore may manifest due to multiple reasons, including iron deficiency, deficiency of folic acid, vitamin A or B_{12}, hemoglobinopathies, and infectious diseases. Iron deficiency has been found to be the most common cause, responsible for close to half the cases of anemia across the globe.[2] Therefore the provision of prophylactic iron-folic acid (IFA) supplements has been one of the key interventions in anemia control programs worldwide, including India's flagship program Anemia Mukt Bharat (AMB).[3]

> **"In India, only 44% of pregnant women consume IFA for 100+ days"**

Implementing such a large-scale program, however, comes with its own challenges. For instance, in India, only 44% of pregnant women consume IFA for 100+ days.[4] While the reasons for this are multiple, IFA stock-out at service delivery points is among the critical ones. It is in this context that the Government of Madhya Pradesh (GoMP), with the support of the Clinton Health Access Initiative (CHAI), embarked upon devising comprehensive measures for streamlining the IFA supply chain in the state.

Procurement problems

In 2016, an independent survey conducted by CHAI found that about 39% of the Anganwadi Centers (AWCs; rural childcare centers) and 35% of schools across MP were facing stock-out of IFA commodities,[5] indicating clear infirmities in the supply chain. After an in-depth examination, multiple aspects, such as improving IFA demand forecasts and streamlining procurement norms, were identified to enable timely and adequate last-mile delivery.

The following key infirmities in procurement and delivery processes were identified:

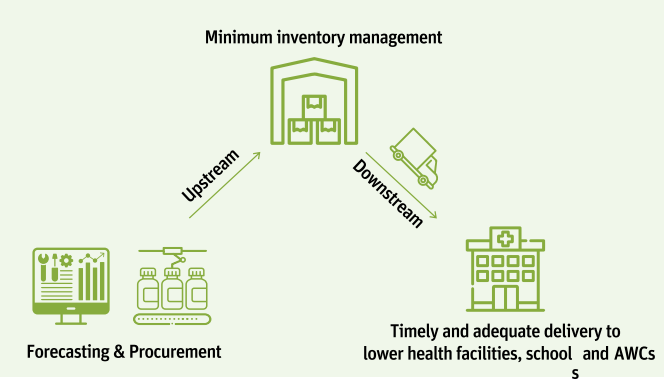
- Districts individually placing orders through decentralized procurement protocols resulted in uncoordinated procurement that made it difficult for the empaneled vendors and state officials to manage and monitor.
- The majority of the districts not maintaining a minimum stock at the time of placing a procurement order often led to stock-out as the delivery lead time from suppliers typically ranged from 45 to 60 days.
- The uncoordinated delivery process (dependent on local transportation via front-line workers) for IFA commodities resulted in poor availability at AWCs and schools.

Supply chains

The GoMP, in consultation with CHAI, adopted a holistic approach to ensure last-mile availability of IFA commodities. The task was fairly complex given that the distribution mechanisms needed to deliver five different formulations of IFA to approximately 1,600 Community Health Centers (CHCs) / Primary Health Centres (PHCs)

across 313 blocks in 52 districts, and around 1.3 lakh schools (single-teacher entities) and 94,000 AWCs across 54,000 villages, at regular intervals for different set of consumers.

FIGURE 2: Upward and downward supply chains



As part of upstream supply chain strategy **(Figure 2)**, standard operating procedures (SOPs) for forecasting, procurement, minimum stock levels and distribution of IFA across the state were established with the following interventions:

- CHAI developed a forecasting tool and estimated consumption trends to enable effective procurement in the district. For greater predictability, norms for bi-annual IFA procurement by the districts were established. This ensured proactive and timely procurement, mitigating the risks of stock-outs. Score keepers and data entry operators across 52 districts were trained in the usage of the tool. Adherence was monitored through a systematic Monitoring & Evaluation plan.
- Inventory norms for different levels of facilities were established by considering both the lead time of procurement/delivery and the minimum stock requirement.
- The downstream supply chain was streamlined after studying various supply chain delivery models, such as courier delivery and third-party logistics. The additional capacity of the existing vaccines supply chain that serves the fairly large and complex Universal Immunization Program was identified as the most feasible and optimal system to serve the needs of the IFA supply chain.

To enable this, CHAI undertook the following steps:

- Assessed the vaccine supply chain and estimated that the quantum of drug load amounted to 85% of space utilization in vaccine vans with five layers of stacking and only five days of run-time for delivery of 2.2 months' stock to all CHC/PHCs. Since it is an existing system, crafting a unified IFA delivery plan was relatively easier with minimal capacity-building.
- The concept of drug delivery boys (DDB), mimicking the Alternate Vaccine Delivery (AVD) concept, was also deployed for the delivery of IFA commodities from health facilities to the schools and AWCs on a quarterly basis. Each DDB had the trip stock capacity of 40 kg (10 kg per village) and could consequently deliver to four villages per trip.

Drug delivery boy delivering IFA commodities

Impact on access to IFA

The forecasting tool has been used by all 52 districts (100%) and over 84% of the districts procured >75% of the adequate IFA commodities set against the population and a consumption-based forecast benchmark.[6] A majority of the districts now maintain prescribed minimum stocks at warehouses to address demand spikes or unforeseen procurement delays.

The downstream delivery strategy was piloted in the districts of Vidisha and Hoshangabad, where the health facilities received 100% of the requisite IFA stock. Following these positive results, the strategy was launched in 24 other districts to ensure the delivery of IFA in more than 26,000 AWCs, 11,000 Gram Aarogya Kendras (GAK; village-level health units) and 47,000 schools via 400+ focal points.[7]

The independent monitoring by CHAI with the support of the state government showcases a significant reduction in IFA stock-outs, i.e, from 35–40% in 2017 to 12–17% in 2020.

As a result of these interventions to strengthen the supply chain, the consumption of IFA by pregnant women for 100 days or more showed a significant increase, from 25.3% to 51.4%.

Sustainability and scale-up

The efforts of the Government of Madhya Pradesh resulted in the formulation of an effective strategy that ensured the operational and financial feasibility of the supply chain systems.

As part of the scale-up plan, the IFA forecasting model is now being replicated for other critical commodities, especially for essential drugs required at Health & Wellness Centers (HWCs) and GAKs, with necessary customization. The forecasting logics and tool are being integrated with the regular Logistics Management Information System (MP-Aushadhi) used for supply-chain management of drugs in the state.

This last-mile delivery model is being expanded to 22 reproductive, maternal, newborn, child and adolescent health (RMNCH+A) commodities for ensured and uninterrupted distribution. The village-level drug delivery model is further being expanded to cater to the supply chain needs of HWCs, making it an integrated supply chain solution.

"The IFA forecasting model is now being replicated for other critical commodities"

The Government of Madhya Pradesh is also making the necessary budgetary provision to support the above-mentioned initiatives. The policies and directives have been modified and the dissemination efforts are being driven by the state. With the success of the pilot and scale-up by the Government of Madhya Pradesh, this model has the potential to be replicated in many other states to ensure streamlined, last-mile delivery of essential medicines and supplements.

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Digital Innovations in Maternal Health and Nutrition

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Introduction

Three in every five pregnant and lactating women in India are anemic and undernourished.[1] Unfortunately, micronutrient deficiencies and inadequate diets seen in women of reproductive age have transgenerational effects, resulting in conditions such as preterm birth and low birth weight. The COVID-19 pandemic has only exacerbated this situation and deepened poverty, hunger and unemployment within many communities. For instance, 72% of eligible households lost access to services such as take-home rations (THR) and hot cooked meals as a consequence of the pandemic.[2]

Fortunately, there are several organizations working to address a part or even the entire pregnancy journey from a nutritional standpoint by leveraging technology. This paper aims to bring to light the role of digital innovations in addressing existing challenges at various stages of a pregnancy while also highlighting certain limitations and pitfalls unique to digital solutions.

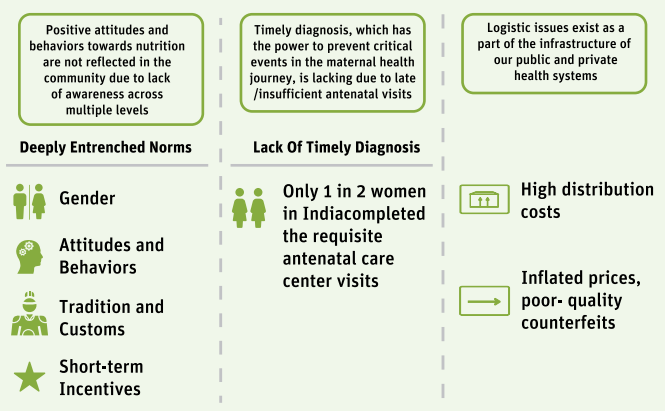
Problem landscape

Maternal nutrition has largely been dealt with through nutritional supplements, antenatal check-ups and THR. Due to the largely 'offline' nature of existing programs and budgetary constraints, most interventions have focused on the antenatal phase. However, the problems and challenges in maternal nutrition begin a lot earlier and stay on a lot longer than is currently taken into consideration. The present landscape is afflicted with systemic challenges that deter adoption of positive health behavior **(Figure 1)**.

1. Deeply entrenched norms

Conventional healthcare devices monitoring maternal health can be expensive, non-portable, difficult to access in remote regions and require the expertise of a health practitioner. Mobile applications and portable healthcare kits can empower health workers to record antenatal data, identify high-risk pregnancies, monitor health status between visits and keep track of pending tasks in a more proactive and organized manner.

FIGURE 1: Understanding the problem landscape across the stages of maternal health, nutrition and pregnancy



2. Delayed diagnosis

As a result of taboos around disclosing the state of being pregnant, many women begin their antenatal check-ups only in the second trimester. Just one in two women in India complete the requisite antenatal care center visits. This creates challenges when trying to initiate relevant timely interventions for pregnant women. Given the real need for income, where every day lost is a loss of daily income, most women do labour-intensive work till the last month of their pregnancy.

3. Last-mile nutrition is a challenge

The lack of availability of nutritious goods and supplements, as well as medical services, at the last mile remains a concern. As a result, in low-income settings, either a nutritious basket of foods is not available, or else sub-standard products are encountered. We mapped possible solutions of the maternal journey across three significant areas of interventions: preconception, antenatal and post-natal stages **(Figure 2)**.

> **"The present landscape is afflicted with systemic challenges"**

Role of digital innovation

In the following section, we profile three innovative business models that are successfully improving maternal health and nutrition access at the last mile.

Last-mile connect: Accessing and engaging with rural com-

FIGURE 2: Understanding ideal outcomes of an intervention or solution across the stages of maternal health and pregnancy

Solutions

	Pre-Conception →	Antenatal →	Post Natal
Awareness	Engaging content on role of Nutrient rich foods in preventing/ treating Anemia Importance of sharing pregnancy with healthcare workers at the earliest (not after 3 months)	Engaging content on role of Nutrient rich foods in preventing/treating Anemia, Micronutrient deficiency, Hypertension, Preeclampsia Diabetes and treating UTIs	Engaging content on role of micronutrient rich foods in preventing/in treating anaemia and hypertension Awareness about post partum depression and its effects on appetite recovery and nursing
Diagnosis, Analysis and Monitoring	Timely flagging of critical Hb levels Timely flagging of critical BMI levels	Availability of Pregnancy kits for early diagnosis Timely flagging of critical Hb levels Timely flagging of gestational weight gain and its monitoring Timely flagging of critical Fasting, Random Plasma Glucose and BP Atleast 4 recorded Antenatal Visits	Timely flagging of critical hb levels Timely flagging of critical fasting random plasma glucose and bp 3 additional visits in case of baby being delivered with low birth weight
Last mile availability	Iron Folic Acid (IFA) supplements Fortified Food Health check-ups at PHC/Aanganwadi with HCW or Doctor	Iron Folic Acid (IFA) supplements Quality take home ration Macronutrients &micronutrient supplements Health check-ups at PHC/Aanganwadi with HCW or Doctor	Nutritious fresh fruits (fruits and vegetables) Iron folic acid ifa supplements Health checkups at phc/anganbadi with hcw or doctor

munities in India is difficult due to wide dispersion, cultural differences and a sense of mistrust towards outsiders. This makes even the best designed programs or innovations difficult to adopt. Organizations are redefining rural India's access to better health and nutrition by 1) implementing a unified digital platform functional at the last mile; 2) creating delivery channels across states at block and village levels; and 3) empowering local agents to utilize the digital and physical channels to sensitize clients about local beliefs and challenges while also placing orders required for their village catchment area.

Inclusive caregiving: The existing public healthcare system, in combination with the volume of patients, massively burdens the health-workers. Due to the large patient volumes, patients tend to be discharged sooner or without sufficient information. Enterprises focused on inclusive caregiving involve family members by connecting them to digital support systems. The technology platforms provide engaging content, answer questions and assess impact on health outcomes, thus empowering next of kin to contribute to the quality of care.

Portable healthcare: Conventional healthcare devices used to monitor maternal health are non-portable, expensive, difficult to access (especially in rural areas), and require the expertise of a health practitioner. Mobile applications and portable healthcare kits can empower health workers to record antenatal data, identify high-risk pregnancies, generate real-time results for doctors, track health following visits, and list pending tasks for the health workers.

On analyzing these innovations, we identified some common drivers and barriers that influenced the impact and adoption of these specific innovations.

> **"The positive impact of digital innovations in the space of maternal health and nutrition is hard to ignore"**

Drivers of growth

1. Growing digital adoption in both urban and rural India means that digital innovations can be deployed and adopted in public health settings with relative ease. Since comfort levels regarding the use of mobile phones have been relatively normalized, this could be a convenient medium for use by the majority of the population.

2. The fem tech industry is dominated by companies focusing on pregnancy and maternal health. Pregnancy and nursing together account for 25% of the industry, making them the largest aggregated sub-sector.

3. The regulatory framework in the form of government policies such as the National Digital Health Blueprint and the Digital

Information Security in Healthcare Act (DISHA) ensures privacy and security of patient information and health records. This provides the legal and regulatory framework necessary to monitor the ethical use of digital innovations and any data collected through the same.

4. Virtual or hybrid communities fostered by innovations were found to be more successful as well as impactful among beneficiaries. This also helped assure family 'buy-in' in the form of their involvement and commitment towards the beneficiary adopting the positive health behavior.

5. Use-generated content (language or cultural references) in the innovation was found to engage beneficiaries. This also encouraged discussion among peer groups, leading to higher reinforcement and acceptance.

6. Engaging local champions – or partnering with 'social leaders' who are comfortable with, and interested in, technology – was seen to evoke human-centric design in the innovation process itself. This also allowed for relevant customization based on inputs shared by the local champion as well as promotion of the innovation among local circles, leading to credibility and higher uptake.

Challenges with digital innovation

1. Access to mobile/network is currently unequal based on gender, geography and economic status. There is a gap of 23% between female and male phone ownership,[3] which means women do not have equal access to mobile telephony.

2. Digital literacy is relatively poor in rural regions and economically weaker sections of society. This is often limited to "Press 1 for" or "Press 2 for" in regional languages and often does not progress to numbers beyond 2.

3. Digital and data privacy have implications that are not fully understood, especially in public health settings. There is a risk of unrealized long-term impact on beneficiaries and society, which must be taken into consideration while deploying digital innovations in a large-scale setting.

Despite the potential challenges intrinsic in technology, the positive impact of digital innovations in the space of maternal health is hard to ignore. With the inclusion of Artificial Intelligence and the Internet of Medical Things, challenges related to customization, cultural sensitivities and scaling up would also be addressed.

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Mobile Maternal Health: What Works and What Does Not

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Providing access to critical information and services

In an overpopulated, geographically and culturally diverse country like India, where almost 60% of women are anemic,[1] it is imperative that pregnant women and new mothers should be aware of best maternal nutrition practices. However, women face a lack of access to critical preventive care information and services during pregnancy and infancy, as inadequately trained and supported health workers often overlook non-technical components of care such as counseling. Mobile health solutions have emerged as a viable route to reach every last woman directly in her home and train health workers. The advantages of scale, agility and cost-effectiveness offered by technology-enabled interventions have come into sharper focus in the last few years as health systems struggle to cope with the pandemic.

Interventions and technology

Nutrition during pregnancy and infancy is one of the crucial aspects covered by ARMMAN's tech-enabled, scalable and cost-effective programs. Free voice-call services such as mMitra and Kilkari deliver information on balanced diet, nutrition and self-care directly to the phones of the women. Mobile Academy, an IVRS-based refresher training program for ASHA workers, includes chapters on nutrition and breastfeeding, which helps them counsel pregnant women, new mothers and their families. Innovations are also being piloted in targeted content, two-way communication through call-center strengthening and WhatsApp with multimedia approaches, and leveraging AI/data analytics for enhanced program effectiveness.

The high mobile penetration in India positions voice calls as an excellent mechanism for reaching women and families with critical preventive care information that enables women and families to take care of themselves and their child and/or take timely decisions to seek care. According to 2021 data from the Telecom Regulatory Authority of India, there are more than 1.17 billion wireless subscribers in the country,[2] and more households have mobile phones than toilets in India.[3] For behavior change communication to be effective, it must be consistent, timed and targeted to reach the right people at the right time, and mobile phones are just the right tools to make this possible. However, women often do not have a phone of their own and are consequently reliant on the phones of their husbands or other family members. Hence, the mMitra program gives them the option to choose their own time slot and follows the system of multiple tries and missed calls to listen to the message. Women are also supported by a call center where a trained executive provides logistical assistance.

"The high mobile penetration in India positions voice calls as an excellent mechanism for reaching women and families"

Traditional solutions for spreading health awareness involve the creation of a parallel health worker network, which is resource-heavy, inconsistent, expensive and not scalable. Also, traditional classroom training for health workers is expensive and does not allow for frequent refresher training. The innovative 'tech plus touch' model leverages the existing front-line health worker network of the government and partner NGOs for multiple touchpoints and combines this with the ubiquity of the mobile phone to achieve scale in a cost-effective manner. This provides non-linear growth at extremely low cost: for example, it costs less than US$ 9.00 to send calls to a woman covering pregnancy and infancy through Kilkari and to train an ASHA worker through Mobile Academy. mHealth-based programs also have the advantage of regular iteration without additional investment, as the beneficiary automatically upgrades their phone.

Health interventions such as Mitra have a significant emphasis on self-care and behavior change. In a computer-assisted telephonic survey covering randomly selected subscribers who were in the last phase of pregnancy, it was found that 26% of respondents increased their intake of vegetables and fruits while 25% started eating smaller meals several times a day after listening to mMitra calls.

Key learnings

While mobile health solutions offer clear advantages, simply adding technology into the equation does not instantly fix the issue.

The 'one size fits all' approach is not effective, especially in the South Asian context, where poverty and gender inequality have a deep influence on women's access to digital technology [4] and the delivery of information via digital interventions falters significantly in the last mile. At the time when pioneering maternal mHealth programs such as mMitra were launched, the intent was to maximize the reach. Evidence from the field now highlights the need for more nuanced programming, whereby women with high-risk conditions and those who are encumbered by issues of equity need more targeted content and handholding, irrespective of their access to technology.

The current ARMMAN interventions and innovations being tested are in alignment with the pyramidal 'fit-for-purpose' approach based on risk categorization and access to smartphones or feature phones. This means that low-risk women receive broad-based content while those with high-risk conditions or the most disadvantaged with the least equity receive more targeted content with greater handholding support through two-way communication and multimedia approaches. The Malnutrition project is one such intervention, in which trained counselors handhold the caregivers of moderately underweight children who are at risk of severe malnutrition and give them a better understanding of appropriate dietary practices.

"The current ARMMAN interventions and innovations are in alignment with the pyramidal fit-for-purpose approach"

To address the issue of last-mile connectivity, ARMMAN has partnered with a coalition of organizations, including UNICEF, to develop lateral approaches (through national and state Rural Livelihood Missions and self-help groups) to reach women, adolescent girls and malnourished children living in the remotest and most underdeveloped areas. The government's Swabhimaan 2.0 project enables each partner to leverage its strength to create an impactful, intersectional intervention that integrates livelihood with hygiene, sanitation and health, and to reach the most vulnerable and marginalized communities facing the highest inequities in healthcare access.

Another learning from the field is that not all digital media are effective across target groups and that programs must be designed based on evidence. For example, SMS is an alternate digital communication method, but it lacks the emotional connection of a voice call and has limited reach, as 34.5% of Indian women are illiterate.[5] Before implementing mMitra, interviews were conducted with 100 women from Dharavi in Mumbai and the results revealed that 56% of them could not understand how to receive an SMS, 62% could not read an SMS, and 72% could not send an SMS. Every technological solution is incomplete without a tangible aspect. Simply sending out calls to women without establishing the context would result in poor levels of engagement. The various touchpoints in ARMMAN's tech-enabled programs encourage familiarity and establish trust among subscribers. In rural areas, women enrolled in the Kilkari program are tagged with front-line health workers (ASHA) on the ground, while in urban areas in Maharashtra, women are enrolled into the mMitra program via staff stationed in partner hospitals and women leaders (called sakhis) from partner NGOs.

Conclusion

Market conditions are very encouraging for mobile maternal and child health interventions such as Kilkari, Mobile Academy and mMitra. Further, the government's focus on technology via its flagship program Digital India, along with the affordability of mobile phones, call and data tariffs, makes the entire ecosystem highly supportive. As mobile penetration, mobile literacy and internet access via mobile phones increase, the financial viability and effectiveness of mHealth programs will significantly improve. However, while technology is a great enabler, it can also potentially reinforce the same inequities that it seeks to address. It is imperative to look more closely at integrating empowerment and equity into digital programs in a tangible manner while designing and testing tools that can be used to measure progress.

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HELLO DIDI 2.0: Mobile Phones for Improving Nutrition Behaviour

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Introduction

In six districts of Uttar Pradesh (Bahraich, Sonbhadra, Mirzapur, Chandauli, Banda and Ambedkarnagar), Hello Didi, a phonebased counseling and information service, was conceived in April 2020 with women Self-Help Groups (SHGs) as a response to the discontinuation of project activities induced due to COVID-19 pandemic linked lockdown. The role of female change agents was transformed into that of tele-counselors so as to be able to reach SHG women with accurate, appropriate and timely COVID-19 messages. The initiative successfully demonstrated the viability of improving health and nutrition awareness by this means. A total of 220,118 phone calls were made to SHG members on COVID themes.

A tele-counseling program worked in Uttar Pradesh

Building on this experience, in the year 2021, UNICEF India, with support from the Public Health Foundation of India (PHFI), established a phone-based counseling system, Hello Didi 2.0, to accelerate the rehabilitation of Severe Acute Malnourished (SAM) children at home and increase demand for, and utilization of, maternal health services. Under the project, a team of trained counselors periodically engaged with pregnant women and caregivers of SAM children over the phone, to improve their health and nutrition knowledge and support them in translating that knowledge into action.

Using technology to reach more women with nutrition messaging

Project area

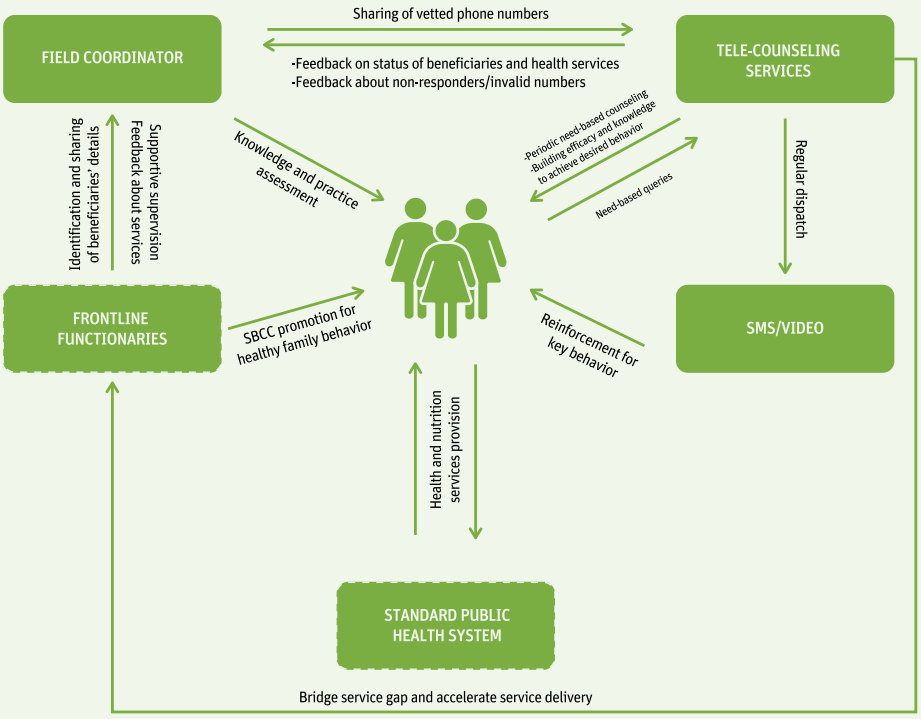
The Hello Didi 2.0 tele-counseling system was set up in six blocks of three aspirational districts of Uttar Pradesh: Balrampur, Shravasti and Sonbhadra. The project covered 1,121 beneficiaries (278 SAM children and 843 pregnant women) from 326 villages.

Project framework

Figure 1 depicts the Hello Didi 2.0 project implementation pathway. With beneficiaries at the core, tele-counselors engaged with frontline functionaries (FLF) and field supervisors to collate, verify and update phone numbers, and provided feedback to functionaries about service gaps. Linkages were built with FLFs and the local health system to accelerate service delivery. Tele-counselors scheduled monthly calls to beneficiaries and engaged with them to increase their knowledge and self-efficacy for maternal and child-care practices. The counseling framework employed techniques to 'engage – motivate – enable' people to adopt appropriate behavior. The counselors used a comprehensive strategy with a three-pronged approach for modifying health and nutrition behavior: information, problem-solving, and media.

In terms of information technique, the counselors provided information about health and nutrition problems and their causes. Regarding problem-solving, counselors identified behavior enablers as well as internal and external barriers, and helped beneficiaries solve problems in enacting the behavior in home settings. Media platforms such as SMSs and videos were used between calls to repeat the messages for the purposes of enhanced recall, with more personal and contextual meanings.

FIGURE 1: The Hello Didi 2.0 project implementation pathway



Counselors also provided personalized support to beneficiaries who called them on their own accord. Calls were flexibly scheduled according to the individual beneficiary's availability.

The project activities were as follows:

- Enrolment of pregnant women through Anganwadi Workers (AWWs) and Accredited Social Health Activists (ASHAs).
- Onboarding of FLWs to create synergies between tele-counseling and the health and nutrition promotion work of FLWs.
- Continuous capacity-building and feedback of tele-counselors.
- Initiating and maintaining calls with beneficiaries.
- Tracking project trajectory and generating evidence through monitoring systems and assessments.

Counseling technical package

Every tele-counseling session comprised four elements:

(a) Identification of problem behavior or behavior bottlenecks.

(b) Understanding reasons for sub-optimal behavior.

(c) Providing information, building skills and efficacy for practicing behavior.

(d) Providing triggers for practicing the behavior.

Four counseling sessions on evidence-based recommendations were designed for pregnant women. **Table 1** provides the overview of counseling topics with beneficiaries.

Results

The project was implemented from September to December 2021 and engaged with 843 pregnant women who were either in the first or second trimester of pregnancy. A total of 3,075 tele-counseling sessions were completed with pregnant women, **(Table 2).**

TABLE 1: Counseling package for pregnant women

Counseling session	Maternal health
Session 1	Antenatal check and its importance
Session 2	Increasing dietary diversity and frequency of food intake
Session 3	Improving uptake of iron and calcium tablets
Session 4	Post-delivery care of mother and newborn

The counseling dose decreased slightly by the fourth session—81% of the 843 pregnant women attended all four counseling sessions compared to 100% participation in the first session. About 85% women also received scheduled SMSs from tele-counselors. Due to limited access to smartphones, only about 45% beneficiaries were sent maternal health and nutrition videos. Our results showed significant association between duration of counseling and weight gain. The average duration of counseling was significantly higher for pregnant women who gained 10 kg or more.

TABLE 2: Coverage and intensity of tele-counseling calls

	Pregnant women (N=843)
Attended counseling session 1 (%)	100
Attended counseling session 2 (%)	99
Attended counseling session 3 (%)	87
Attended counseling session 4 (%)	80
Average duration of counseling	24 minutes
Attended all four counseling sessions (%)	81
Attended at least one counseling session (%)	100

Evaluation of impact

A two-armed evaluation method (intervention and comparison)

was designed to gauge the impact of tele-counseling on maternal health and nutrition practices. A total of 790 pregnant women were interviewed on both aspects at two time points: second trimester and third trimester. The difference-in-difference (DID) result shows significant improvement in knowledge for ANC check-ups, weight gain during pregnancy, consumption of 100+ IFA tablets, and sourcing of protein-rich food. Likewise, significant improvement was observed in maternal health and nutrition practices for ANC visits, ANC tests, and consumption of five or more food groups. ANC test results, in the end line, show ($p<0.05$) for blood pressure (BP) test and 7% ($p<0.05$) for urine test in the tele-counseling intervention area with respect to change in the comparison area. Likewise, consumption of five or more food groups increased in both the groups, the net improvement being 9.4% ($p<0.001$).

Discussion

Over a period of four months (four counseling calls), the project was able to improve ANC and maternal nutrition knowledge and practices. Our result shows that pregnant women who received tele-counseling were more likely to have received four ANC check-ups, had undertaken a BP and urine test, and had

TABLE 3: Maternal health and nutrition knowledge and practice at baseline (BL) and endline (EL), and net change in percentage

	Pregnant women: tele-counseled		Pregnant women: not tele-counseled		Net change	P - value
	BL	EL	BL	EL		
Knowledge about maternal health & nutrition						
Knowledge about 4 or more ANC check-ups	13	41.3	13.3	20.1	21.5	0.000***
Knowledge about all six ANC tests (BP, urine, weight, abdominal, blood, ultrasound)	5.5	8.5	5.5	6.1	2.3	0.03*
Knowledge about weight gain by 10 kg or more during pregnancy	7.7	21.3	6.8	10.9	9.6	0.009***
Knowledge about consumption of 100 or more IFA tablets during pregnancy	15	45.3	17.7	21.1	26.3	0.000***
Knowledge about daily consumption of two calcium tablets during pregnancy	0.7	4.7	3.4	4.4	3	0.4
Knowledge about time interval between consumption of iron and calcium tablets	62	76	62.2	71.4	4.8	0.5
Knowledge about at least three locally available protein-rich foods	12.7	18.7	14.6	5.8	14.8	0.000***
Knowledge about at least three locally available iron-rich foods	0.7	5.7	1	2.7	3.3	0.07
Maternal health & nutrition practices						
Pregnant women reported 4 or more ANC check-ups	2.1	41.7	4.2	26.9	16.9	0.000***
ANC tests done by pregnant women						
BP	57.7	87.0	53.1	69.6	12.8	0.01**
Urine test	45.0	68.0	40.8	56.8	7	0.01**
Weight check	58	83.7	52.4	72	6.1	0.25
Abdominal	10.7	27.3	7.5	27	2.7	0.32
Blood test	41.3	85.7	47	87	4.7	0.98
Ultrasound	30.3	80.3	37.8	85.3	2.4	0.63
All six tests	7.6	9.6	7.1	9.2	0.2	0.74
Pregnant women who consumed additional meal during pregnancy in last 24h preceding the survey	20	34	11.6	23	2.1	0.66
Pregnant women who consumed five or more food groups in last 24h preceding the survey	10.3	55.6	17.2	43	19.4	0.001***

*Significant difference between baseline and end-line results; ***p<0.001, **p<0.01, *p<0.05*

Collective learning and charting nutrition goals

consumed diverse foods (five or more food groups) compared to pregnant women who did not receive the calls.

For diet, counselors used an in-house diet assessment tool (Poshan Tashtari), which helped them analyze, in real time, the maternal dietary gaps in food frequency, amount and diversity. This enabled the counselors to provide contextual, relevant and practical diet solutions to women.

Coverage of maternal health services also showed improvement. To improve coverage, besides providing information, counselors also helped women to develop individual triggers that reminded them to take their pills or go for their check-ups. Women used phone alarms and notes on mirrors, and kept IFA tablets under their pillow or near food utensils, etc. to trigger the behavior. Counselors also built linkages with FLWs and shared feedback of ANC service coverage with them. This also helped in increasing the mobilization of women for ANC services in villages.

Many learnings were generated during the project operation:

- Onboarding of FLWs at the start of the project helped to build trust and improve program uptake. FLWs became advocates and promoted the call within women's groups.
- Time and effort should be spent on rapport-building with women on the first call.
- Planning too many calls in a month may lead to fatigue and loss of interest. In a similar project with SAM children, the participation of mothers was of higher quality and more intense with a maximum of four calls.
- Customized dietary and feeding suggestions have a higher acceptability than general information and suggestions.

Key recommendations

India has a mega digital presence, with 1.17 billion wireless phone subscribers, 560 million internet subscribers, 354 million smartphone devices, and 294 million users engaged in social media. [1] The Hello Didi 2.0 experience offers a proof of concept that nutrition services and practices can be effectively promoted through digital platforms. Keeping in view the importance of scale, diversity and equity issues in India, it is recommended to:

a) institutionalize digital capacity within government flaships and training resource centers;

b) enhance digital capability in the social sector (i.e., Centre of Excellence approach);

c) adopt a mix of conventional (FLF and community platforms) and digital platforms for accelerated change in behaviors; and

d) engage more with women SHGs and similar organized federations owing to women's greater individual agency and access to digital devices in these contexts.

Moreover, nudging men about inter-related family health and nutrition decisions is more practicable than ever before thanks to digital platforms.

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Nutritional Intervention Programmes: Gaps We Need to Fill

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Introduction

While India has made substantial progress in reducing maternal mortality, maternal malnutrition has persisted. This is despite several government programs to improve maternal diets, and the COVID-19 pandemic has only made matters worse. Apart from nutrition intervention programs – from dietary provisions such as take-home rations and hot cooked meals for pregnant and lactating women (PLW) to behavior change communication through education and counseling – India has also developed national food composition tables and nutrition databases, as well as conducted studies and surveys.

However, there has been limited research on the impact and evaluation of these programs, and their impact on delivery outcomes or maternal health is yet to be clearly established.

Research gaps in anemia status

Even today, more than half (52.2%) of pregnant women in India are anemic.[1] Despite the increase in ANC coverage, the prevalence of anemia has not gone down, thus warranting in-depth research. The most common causes of anemia include nutritional deficiencies, particularly that of iron, though deficiencies in folate, vitamins B_{12} and A are also crucial. Hemoglobinopathies and infectious diseases, such as malaria, tuberculosis, HIV and parasitic infections, also need consideration.

The measure of anemia is based on hemoglobin concentration at the population level mostly because this is cost-effective and easy to determine in field settings. Still, the hemoglobin level does not exactly denote iron status because it lacks specificity – hence concentrations of serum ferritin and transferrin receptor have been recommended. Ferritin has its drawbacks, too, as it is elevated in the acute-phase response and is inappropriate in locations prone to infectious diseases. Both serum ferritin with transferrin receptors, when measured together, have been able to differentiate between inflammation and iron deficiency. However, this still requires further validation through population-based studies.[2]

To monitor and assess the impact of interventions on iron status, the World Health Organization (WHO) recommends using serum ferritin in combination with hemoglobin.[3] However, the challenges associated with using different markers, reference cut-offs and lack of point-of-care or field-based assessment present a challenge to population assessment of anemia and iron status. This makes it difficult to gauge the impact of interventions. A research gap still exists in establishing changes affecting ferritin concentrations during pregnancy and establishing cut-off points by trimester.

> **"Even today, more than half (52.2%) of pregnant women in India are anemic"**

Surveys and data on micronutrient status

The information on the macro- and micronutrient status of women is equally scarce. Vitamin B_{12} deficiency, which affects a child's cognitive development, is associated with lacto-vegetarianism and low birth weight. The Comprehensive National Nutrition Survey (CNNS) reported that 14% of India's pre-school children, 17% of school-age children and 31% of adolescents are deficient in vitamin B_{12}.[4] However, there is no relatable information regarding B_{12} deficiency in women. Similarly, data on folate, calcium, vitamin D, zinc and other micronutrients is unavailable.

India's guidelines for iron and folic acid (IFA) supplementation align with WHO recommendations of 180 tablets during pregnancy, 60 mg elemental iron and 400 mcg folic acid daily; however, the recommended dose for calcium supplementation is lower at 1 g (2 tablets daily of 500 mg each).[5]

As per the results from the National Family Health Survey (NFHS)-5, 18.7% of the women of reproductive age have a low body-mass index, and one in four are obese or overweight.[1] Pregnancy weight gain is directly related to the newborn's birth weight. The national guidelines recommend 1.5–2 kg per month or 9–12 kg total in the last two trimesters. However, the pregnancy weight gain recommendations do not consider pre-pregnancy weight while recommending weight gain.

This results in inadequate monitoring of pregnant women for

gestational weight gain. There is also no district-wise/state-wise data nor is there any recorded data on the stature of women, a better marker for chronic under and/or overnutrition, also a risk factor for low birth weight in newborns.

Nguyen et al. report[6] that the NFHS data lacks inclusion of sufficient food groups to account for maternal dietary diversity, macro- or micronutrient intakes, or food security status. The decade-old National Nutrition Monitoring Bureau (NNMB) data has a very small sample size. The NNMB data from urban areas in 2015–2016 excludes pregnant women.

India ranks 107 out of 121 countries in the Global Hunger Index 2022.[7] In their review, Farrukh et al. reported[8] that at the country level, prices and inflation, or Consumer Price Index, are taken into account in order to assess food availability and access. However, these are poor indicators, and research needs to focus on household-individual level food availability and access, not to ignore the role played by factors such as gender, caste and religion. This is especially important with respect to women, where factors such as seasonality and travel limitations impact access to food. Also, women are generally the last to consume food in the household and are left with less than the required quantity.

No matter what is done during pregnancy, the greatest benefits are reaped when we improve nutrition in the early stages of life. This will help ensure the best possible environment for mothers before conception and break the intergenerational cycle of malnutrition.

Way forward

Investments are necessary to build systems for efficient data collection, consolidation and analysis and to inform policymaking and implementation. To guide programing, routine national surveys, such as demographic and health surveys and multiple indicator cluster surveys, should be age-disaggregated to represent all stages through the life course.

A continuum, comprehensive approach is required by focusing on efforts to tackle malnutrition in specific windows through the life course. For example, any focus on childhood and adolescent malnutrition necessitates developing and monitoring adolescent-specific nutrition targets at state and national levels. These should go beyond anemia in women of reproductive age. In order to improve childhood and adolescent nutrition, health and well-being, more research and evidence-based policies are required. These include understanding and developing effective interventions, particularly for dietary patterns to reduce overweight/obesity as well as to address the nutritional needs of subgroups such as the elderly, adolescents, those out of school, and adolescents in contexts of humanitarian crisis.

The most useful indicators to identify and classify malnutrition at the population level should be simplified and used to guide different levels of implementation. More importantly, greater attention and funding from donor agencies are required to address the research and programmatic gaps, the closing of which will ultimately improve nutritional outcomes.

Regular testing will help to make effective interventions

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Afterword

The Promise and Potential of India

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Having demonstrated the ability to implement largescale public health programs successfully, India is well poised to lead the maternal health and nutrition space. By doing this, it can become an exemplar state for the world to follow. The abiding feeling after reading the experiences recorded in this report is how much work has been done and how many new frontiers are being explored. This is why we carefully named this report The Promise and Progress of Maternal Nutrition in India – there's a lot done, a lot in progress and a lot that can be done – and the marvelous collection of authors that we feature outline both the promise and progress very well.

When we talk of health equity in LMICs, we talk of maternal nutrition, as the mother is the focal point of life itself. A lot of effort is being made on the first 1000 days of life in an effort to improve newborn health, and this is the right direction to take. An additional push could be made to bring a special focus on the first 280 of those 1000 days of life, the stage of the pregnancy itself, and even a little before that, the preconception stage. By focusing on these two stages, India can make marked progress in improving the maternal nutrition status.

The vast number of experts who have lent their time and research generously for this Special Report show the number of ways in which interventions are ongoing, and the number of ways in which efforts can be improved. From preconception care to postnatal wellbeing, a range of programs have been piloted that leverage advancements in technology and connectivity to improve program delivery and coverage. From practical and obvious aspects such as diets, weight monitoring, behaviour change, last mile coverage, to lesser talked about areas such as mental wellbeing, overnutrition, maternal disease, and hidden hunger in urban populations, we have covered a wide range of topics to build a holistic picture of where we stand when it comes to maternal nutrition in India today.

There is a lot to be learned from the Experiences from the Field section and a lot of promise in the Evidence section. At *Sight and Life*, we are excited about the possibilities and the hope these papers bring to light. A big thank you to all our authors for this crucial knowledge sharing.

India can lead the maternal nutrition success story

Special thanks must also be extended to Vani Sethi, UNICEF ROSA, for helping us curate this excellent line-up of reportage from the ground, collaborating closely with the editorial team, and supporting us all along the way.

We are proud to launch this report jointly with FIGO and FOGSI. Our first Special Report on India, this publication captures the gains made in maternal nutrition in the country and identifies the gaps that still remain. We celebrate the progress and hope to work with the community to close the gaps.

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Women's Nutrition Factsheet - India

Women's nutrition (15–49 years) (%)		
	NFHS - 4	NFHS - 5
	2015 - 2016	2019 - 2021
Thinness (Women with BMI <18.5 kg/m2)	23	19
Low Stature (Women with height below 145 cm)	11	12
Overweight or Obese (Women with BMI >25 kg/m2)	21	24
Anemia (WRA) Anemia among women of reproductive age (WRA, 15 - 19 years)	53	57
Obesity (Women with BMI <30 kg/m2)	5	6
Anemia (Pregnant) (Anemia among pregnant women (15 - 49 years)	50	52
Anemia (Adolescent) (Anemia among adolescent girls (15 - 19 years)	54	59
Pregnant women (15–49 years) consuming specific foods at least once a week (%)		
	NFHS - 4	NFHS - 5
	2015 - 2016	2019 - 2021
WRA Minimum Dietary Diversity %	50	51
WRA consuming iron-rich food (%)	46	69
Child care (15–49 years) (%)		
	NFHS - 4	NFHS - 5
	2015 - 2016	2019 - 2021
Mothers who initiated breastfeeding (Children < 3 years breastfed within 1 hour of birth)	42	42
Mothers exclusive breastfeeding (0-5months)	55	64
Low birth weight children (less than 2.5 kg)	18	18
Adequate diet among breastfeeding children (6 - 23 months)	9	11
Coverage of maternal nutrition interventions (%)		
	NFHS - 4	NFHS - 5
	2015 - 2016	2019 - 2021
Mothers who had an antenatal check-up in the first trimester	59	70
Women aged 15-49 years who received at least 4 antenatal care (ANC) visits	51	58
Women aged 15-49 years who received ANC from a skilled provider	79	85
Mothers who received postnatal care from a doctor/nurse/LHV/ANM/midwife/ other health personnel within 2 days of delivery	62	78
Mother who received supplementary food from an Anganwadi center (AWC) during pregnancy	52	66
Mother who received health and nutrition education from an AWC during pregnancy	39	60
Women aged 15-49 years who consumed iron folic acid (IFA) for 180 days or more during pregnancy	14	26
Institutional births	79	89
Population living in households that use an improved sanitation facility	49	70
Households using clean fuel for cooking	44	58
	SRS	
	2017-2019	2018-2020
Maternal Mortality Ratio	103	97
	SRS	
	2019	2020
Neonatal Mortality Rate	22	20

S.no	Indicator	HMIS (up to March 2017)*	HMIS (up to March 2022)*
A	**Receipt of Services**	**(%)**	**(%)**
1.	Pregnant women provided full course 180 IFA tablets	**76.7**	**84.7**
2.	Pregnant women provided full course 360 calcium tablets	**41.6**	**77.5**
3.	Pregnant women given one Albendazole tablet after 1st trimester	**29.1**	**50.4**
4.	Pregnant women tested for Haemoglobin (Hb) 4 or more than 4 times for respective ANCs	**73.3**	**74.6**
5.	Pregnant women having Hb level<7 g/dl (severe anaemia) tested	**3.6**	**2.9**
6.	Pregnant women having severe anaemia (Hb<7 g/dl) treated	**1.6**	**1.9**
7.	Pregnant women having gained weight <1 kg per month	**NA**	**NA**
8.	Pregnant women provided - free diet under Mother & Child Protection Scheme/Janani Shishu Suraksha Karyakram (JSSK)	**45.9**	**63.6**
*** Denominator: Estimated pregnant women, as per Anemia Mukt Bharat dashbarod**			

Maternal Nutrition Financing

Budget allocated for nutrition interventions during pregnancy from Health Sector Plan (NHM PIP) 2019-20, 2020-21 and FY 2021-22, India, INR in million

Budget Items	2019-20	2020-21	Change %	2021-22	Change %
Procurement of IFA (for pregnant women & lactating women), Calcium, Albendazole, Iron Sucrose, FCM, Folic Acid tablets and digital hemoglobinometers	3249	3426	5.4	4038	17.9
Incentive to community volunteers (ASHAs) for mobilizing pregnant & lactating women for IFA consumption and tracking of High Risk Pregnant Women	111	134	21.1	46	-66
Strengthening of Services such as line listing of severe anemic women and those with blood disorders, distribution of long lasting insecticide nets in malaria endemic regions	4140	4151	0.3	4104	-1.2
IEC/SBCC	105	97	-7.7	6	-94.3
Printing	138	489	71.8	494	1
Innovation (State Specific)	0	5	100	8	64.3
Total	7,743	8302	7.2	8694	4.7

Data sources: PIP (planned budgets) and RoP (Approved budgets) at National Health Mission's website of Ministry of Family Health and Welfare, *https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=1377&lid=744*

Status of policies and guidelines on maternal nutrition interventions during pregnancy, 2022

WHO recommendations	Existence of policy/guideline addressing recommendation	Existence of policy/guideline addressing recommendation	Alignment of policy/guideline with components of recommendation
1. Nutrition Assessment	Yes	Yes	Weight, height & blood pressure; Blood & urine test
2. Counselling on healthy eating and physical activity to prevent excessive weight gain	Yes	Yes	Healthy eating; Physical activity
3. Counselling in undernourished populations on increase energy and protein intake	Yes	Yes	Energy intake; Protein intake
4. Balanced energy and protein dietary supplementation in undernourished populations	Yes	Yes	Energy; Protein
5. Daily iron (60 mg)and folic acid (500 µg) supplementation	Yes	Yes	Iron dose; Folic acid dose; Daily frequency; Early initiation
6. Intermittent iron (120 mg) and folic acid (2800 µg) supplementation to improve acceptability and where anemia among pregnant women is <20%	Not applicable	Not applicable	Iron dose; Folic acid dose; Weekly frequency
7. Folic acid supplementation (400 mcg only in 1 st trimester)	Yes	Yes	Folic acid dose; Only in 1st trimester
8. Deworming (one tablet of 400 mg Albendazole recommended in 2nd trimester)	Yes	Yes	Albendazole dose; Once in 2nd trimester
9. Calcium supplementation (1.5–2 g) in populations with low calcium intake to reduce risk of pre-eclampsia	Yes	Yes	Calcium dose; From 20 weeks; Daily frequency
10. Vitamin A supplementation in areas where deficiency is a severe public health problem	Not applicable	Not applicable	Vitamin A dose; Frequency; Duration
11. Restricting caffeine intake for women with high daily intake (>300 mg per day)	No	No	
12. Prevention and management of malaria (provision of insecticide treated bed-nets for prevention of malaria in endemic areas)	Yes	Yes	Long Lasting Insecticide-treated Nets (LLINs); Incentives to community workers

Yes · No · Not applicable

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