Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____ _____

Elizabeth Noznesky Date

A Situation Analysis of Effective Interventions, Barriers and Opportunities for Improving Maternal Nutrition in Bihar, India

By

Elizabeth Noznesky
Master of Public Health

Hubert Department of Global Health

_____

Professor (Dr) Reynaldo Martorell
Committee Chair

A Situation Analysis of Effective Interventions, Barriers and Opportunities for Improving Maternal Nutrition in Bihar, India

By

Elizabeth Noznesky

Master of Anthropology
Temple University
2001

Thesis Committee Chair: Professor Reynaldo Martorell, PhD

An abstract of
a thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in the Hubert Department of Global Health
2011

Abstract

A Situation Analysis of Effective Interventions, Barriers and Opportunities for Improving Maternal Nutrition in Bihar, India

By Elizabeth Noznesky

Introduction: Maternal underweight and anemia are serious problems in Bihar and are important factors in the persistence of high levels of child undernutrition. Although numerous programs and platforms exist for delivering effective interventions for improving maternal nutrition, the coverage and quality of these interventions is low and they are not achieving the desired results.

Objective: This study aimed to assess the status of effective interventions for improving maternal nutrition in Bihar and to identify barriers and opportunities for expanding coverage and quality.

Methods: Forty-eight key informant interviews were conducted with policy makers, program managers and service providers in Bihar at state, district, block and facility levels. Secondary data was collected from survey reports and program documents. All data was analyzed thematically.

Results: Numerous barriers impede the delivery of effective interventions for improving maternal nutrition in Bihar. Implementation level barriers include the shortage of human resources; an inadequate supply of basic equipment and supplies; and low recognition of the magnitude and consequences of maternal undernutrition. Policy level barriers include low prioritization of maternal nutrition and the lack of emphasis on delaying and spacing births. Societal barriers include poverty, gender inequality and caste-based discrimination. Innovations for improving program delivery include household mapping and microplanning; cash incentives for meeting targets; and electronic fund transfer systems. Potential platforms for delivering interventions include Panvjayati Raj Institutions, women's Self-Help Groups, and programs to educate and empower adolescent girls.

Discussion: Significant progress has been made in recent years by the new Government of Bihar to expand the coverage and quality of public health services throughout the state. However, due to years of neglect under previous governments, much remains to be done. Recommendations for strengthening the delivery of interventions to improve maternal and birth outcomes include setting targets in program implementation plans, increasing outreach to adolescent girls and women outside of pregnancy, strengthening field supervision, empowering women and increasing the involvement of community-based organizations. Recommendations will be shared with the Government of Bihar and its partners to assist them in their efforts to improve maternal and child health.

A Situation Analysis of Effective Interventions, Barriers and Opportunities for Improving Maternal Nutrition in Bihar, India

By

Elizabeth Noznesky

Master of Anthropology
Temple University
2001

Thesis Committee Chair: Professor Reynaldo Martorell, PhD

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in the Hubert Department of Global Health
2011

Acknowledgements

This thesis is the product of many wonderful people who graciously shared their knowledge and experience and supported me during the planning, execution and write-up of this study.

At Emory, special thanks go to Dr Reynaldo Martorell, my thesis advisor, and Dr Usha Ramakrishnan for providing me with the opportunity to conduct research in Bihar and guiding me through the research process. Additionally, a very warm thank you goes to two Rollins alumni, Anuraag Chaturvedi and Alyssa Lowe, who provided friendship and support during field work in India.

In India, I am particularly grateful to Dr Sheila Vir, Study Consultant, and Dr Farhat Saiyed, Senior Program Advisor (Nutrition), UNICEF Bihar for helping me to design and implement a plan to conduct research in Bihar. Without their critical support, this project would have turned out very differently.

A very sincere thank you goes to the Government of Bihar, especially to Shri Anup Mukherjee, IAS, Chief Secretary, Shri K. C. Saha, IAS, Development Commissioner, and Shri Sanjay Kumar, IAS, Executive Director of the National Rural Health Mission for supporting this study and facilitating access to government officials and service providers at all levels.

To Shri Shejo Bose, the Director of Janani, thank you for your great generosity in placing a car and driver at my disposal for conducting field visits to Nalanda and West Champaran districts. This enables me to achieve the study objectives in a timely, safe and comfortable manner.

To Shrimata Anjum Fatma, State Coordinator of Micronutrient Programs, UNICEF and Shri Matiur Rahman, Child Development and Nutrition Officer, UNICEF, I am indebted to you for your assistance and wonderful companionship in conducting field research in Nalanda and West Champaran districts. One of the highlights of my trip to Bihar was meeting and working with you.

To all the people who agreed to be interviewed, thank you for sharing your insights and providing me with rich information about what is being done in Bihar to improve maternal health and nutrition.

Last but not least, to my family who put up with me during this hectic period, thank you for all the love and support you have shown me over the years. Special love and thanks to my husband, Ahmed Saadani Hassani, for traveling all the way to Bihar to share in this important experience with me.

Table of Contents

1. Introduction

1.1. Rationale

Undernutrition, particularly maternal undernutrition, is one of the world's most serious but least addressed health problems having major implications for human and economic development for this generation as well as successive ones (Bryce, Coitinho, Darnton-Hill, Pelletier, & Pinstrup-Andersen, 2008). Nearly one-third of children in developing countries is stunted (height for age z scores < 2SD) (Bryce, et al., 2008). Maternal undernutrition (body-mass index of <18·5 kg/m²) is a serious problem in sub-Saharan Africa and south-central and southeastern Asia, where more than 20 percent of women are undernourished. The situation is particularly acute in India, Bangladesh, and Eritrea where two in five women are undernourished (Black et al., 2008).

The cost of undernutrition is huge. Through its interaction with infectious disease, maternal and child undernutrition is the underlying cause of 3.5 million deaths and 35 percent of the disease burden in children under 5 years (Black, et al., 2008). Furthermore, maternal undernutrition increases the risk of poor fetal development through IUGR, which in turn, increases the risk of linear growth failure and stunting. Stunting is strongly associated with poor school outcomes in the medium-term and reduced economic earnings in the longer-run (Victora et al., 2008). At a population level, this translates into poorer economic growth through lost productivity (Bryce, et al., 2008). Furthermore, maternal and child undernutrition is likely to increase the risk of obesity and related chronic diseases in adulthood, especially in populations undergoing the nutrition

transition (C. Fall, 2009).

Progress towards the elimination of child undernutrition has been slow in spite of global commitments, such as MDG1, to reduce child underweight (weight for age z scores < 2 SD). Although the prevalence of underweight among children has decreased in all regions except Western Asia, the rate of decline has been too slow in regions with the highest prevalence of underweight, namely Southern Asia and Sub-Saharan Africa, where prevalence rates are 46 percent and 27 percent, respectively (UN, 2010). This is threatening the achievement of other human and economic development goals, such as the reduction in child mortality and poverty reduction. This is tragic because child undernutrition is a preventable condition. It is estimated that, in the countries with the highest burden, slightly more than a third (36 percent) of stunting could be prevented through existing interventions to improve nutrition and prevent related disease.

Given the importance of maternal nutrition for fetal growth and development, the prioritization of maternal nutrition within health-related policies and programs may result in better maternal, neonatal and child health (MNCH) outcomes, including a more rapid reduction in the prevalence of stunting (Bhutta et al., 2008). Interventions that target adolescent girls and young women, especially during pregnancy, may help break the intergenerational cycle of undernutrition in which low-birth-weight girls fail to grow well and become stunted women who have a diminished capacity to support healthy fetal growth during pregnancy. Such interventions to improve nutrition prior to and during pregnancy could improve the health and well-being of the mother as well as that of her

child, with consequences that can be measured across the life course to adulthood (R. Shrimpton, 2010).

In 2008, the Lancet published a five-part series highlighting the importance of nutrition in maternal and child health. This series aimed to fill a gap in global public health and policy action by reviewing the evidence base surrounding the role of nutrition in maternal and child health, cataloguing the long-term effects of undernutrition on development and health, identifying effective interventions for reducing maternal and child undernutrition through nutritional pathways, and calling for national and international action to improve nutrition for mothers and children (R. Horton, 2008). With respect to improving maternal and birth outcomes, the following interventions were found to be effective: protein-energy supplementation during pregnancy and maternal supplementation with iron, folic acid, and possibly other micronutrients and calcium (Bhutta, et al., 2008). However, the coverage of these interventions remains low in the 20 countries where four-fifths of all undernourished children live. So, while it is known which interventions are most effective for eliminating maternal and child undernutrition, much less is known about how to deliver these interventions so that they reach all the people who require them, when they require them.

In order to fill this gap, the Bill and Melinda Gates Foundation funded an 18-month, multi-partner study to improve maternal, neonatal and child health (MNCH) outcomes through better designed policies and programs that enhance nutrition throughout the life cycle, with an emphasis on maternal nutrition (Martorell & Mason, 2009). As part of this

study, an assessment of interventions with the potential to improve MNCH outcomes was required in selected states in three countries with high burdens of maternal and child undernutrition (India, Ethiopia and Northern Nigeria) in order to identify barriers to expanded coverage and make recommendations for implementing these interventions more effectively in resource-poor settings.

1.2. Problem statement

Bihar is a poor and heavily populated state located in northern India. Undernutrition is a problem throughout India, but the situation is particularly serious in Bihar where rates of child stunting, wasting and anemia remaining stubbornly high (IIPS, 2007). The rise in energy and food prices combined with more extreme weather patterns due to climate change is likely to worsen food in security and nutritional status (Roger Shrimpton, Prudhon, & Engesveen, 2009).

Although the prevalence of stunting declined from 54 percent to 45 percent in the 7 years between NFHS-2 (1998-99)[1] and NFHS-3 (2005-06)[2], the prevalence of wasting actually increased from 21 percent to 28 percent over the same period (IIPS, 1995, 2008b). The percentage of ever-married women who are underweight (BMI <18.5) increased between NFHS-2 (1998-99) and NFHS-3 from 39 percent to 45 percent, with younger women being at the greatest risk of being underweight (IIPS, 2008b). Undernutrition is much more common in children of mothers whose body mass index is below 18.5 than for

[1] NFHS-2 calculated stunting and wasting for children under 3 years of age using the US NCHS Growth Reference but figures show here have been recalculated using the 2006 WHO Growth Standards
[2] NFHS-3 calculated stunting and wasting for children under 5 years of age using the 2006 WHO Growth Standards but figures shown here correspond only to children under 3 years of age.

children whose mothers are not underweight (IIPS, 2007). Anemia, which is a good indicator of other MN deficiencies, is a major problem among children and women in Bihar. Not only is the prevalence of anemia extremely high, but it is increasing rather than decreasing. NFHS-3 estimates that 88 percent of children aged 6-35 months are anemic compared to 81 percent for NFHS-2 and two-thirds (68 percent) of ever-married women aged 15-49 years are anemic compared to 60 percent for NFHS-2 (IIPS, 2001, 2008b).

In Bihar, as in the rest of India, persistent maternal and child undernutrition is due neither to a lack of evidence-based programs for improving nutrition nor to a lack of platforms for delivering interventions. Indeed, the Government of Bihar and its development partners support several large-scale health and social safety net programs that aim to improve the nutritional status and food security of children, pregnant and lactating women, adolescent girls and other vulnerable people. The purpose of these programs is to deliver interventions that have demonstrated efficacy for improving maternal and child health outcomes, such as: micronutrient supplementation, protein-energy supplementation, deworming and malaria prophylaxis and treatment. Interventions are delivered through a variety of platforms, such as primary health centers, Anganwadi centers, and schools, which are administered through different government departments, such as Health and Family Welfare, Social Welfare and Human Resource Development.

So, with all these programs, why does the prevalence of maternal and child undernutrition remain so high? Two important factors operating at the macro-level are

widespread poverty and long-term neglect of the primary health care system during the previous government's tenure. A key factor with which this study is directly concerned is the poor coverage and quality of interventions, especially among socially excluded populations. Other critical factors include insufficient recognition of the importance of maternal undernutrition for maternal, neonatal and child health outcomes, the failure to concentrate nutritional interventions on children when they would receive the maximum benefit (i.e. from conception until two years of age), and weak program management, such as a lack of coordination among all the different programs and service providers.

The climate for eliminating maternal and child undernutrition has never been better in Bihar. First, the ruling JD(U)-BJP government has committed itself to improving the quality of life in Bihar and has prioritized investments in human resources and infrastructure that will improve the coverage and quality of primary health services. Second, the Bihar Rural Health Mission, which aims to drastically upscale the availability, accessibility and utilization of reproductive and child health services, is now operational in all 38 districts. Third, DFID and a consortium of NGOs led by CARE India recently launched the Bihar Health Sector Reform Program to increase the utilization of quality health services for the poor and socially excluded with a focus on children and women of reproductive age. Finally, the Bill and Melinda Gates Foundation and the Government of Bihar signed a 5-year agreement in 2010 to reduce the infant mortality rate and maternal mortality rate in the state by providing technical and programmatic assistance to NGOs working in the areas of maternal and child health.

Consequently, there is an excellent opportunity to work with the Government of Bihar and its partners to eliminate maternal and child undernutrition. An assessment of effective interventions to improve maternal nutritional status in Bihar was required to assist the Government of Bihar and its development partners in the design and implementation of policies and programs that that enhance nutrition throughout the life cycle, with an emphasis on maternal nutrition.

1.3. Purpose statement

1.4. Study objectives

This study assesses the status of interventions to improve maternal nutrition and identifies barriers to and opportunities for expanding the coverage and quality of interventions to adolescent girls and women of reproductive age in Bihar. The overarching goal of the study is to provide the Bill and Melinda Gates Foundation and the Government of Bihar with concrete recommendations for improving the effectiveness of existing interventions that aim to reduce maternal undernutrition and break the intergenerational cycle of growth failure.

1.5. Research questions

1) What interventions are available for reducing maternal undernutrition and low birth weight in Bihar and what is their coverage and quality?

2) What are the existing mechanisms / platforms for delivering these interventions to adolescent girls and women of reproductive age in Bihar?

3) What are barriers to delivering and accessing existing interventions for reducing maternal undernutrition and low birth weight in Bihar?

4) What are promising innovations and other potential platforms for improving the coverage and quality of interventions to reduce maternal undernutrition and low birth weight in Bihar?

1.6. Significance Statement

Momentum and funding for maternal, newborn and child survival interventions is increasing, with the Countdown exercise leading the way (Bhutta et al., 2010). However, nutrition remains a neglected area of maternal, newborn, and child health (R. Horton, 2008) due largely to a widespread lack of recognition of the causes and implications of undernutrition and its importance as a determinant of health and development (Bryce, et al., 2008; World Bank, 2006).

Interventions to improve maternal nutrition have received little attention for two main reasons. First, conceptual frameworks developed to better to better understand the causality of child malnutrition, such as the one developed by UNICEF in the 1990's, do not address the role of maternal nutrition in the intergenerational cycle of growth faltering (Nishida C, Shrimpton R, & I., 2009; UNSCN, 2010). Second, interventions that produce gains in child survival, such as vaccination, have been prioritized over interventions that promote child growth and development due, in large part, to the perception that rapid reductions in low birth-weight rates can only be achieved in the long

run (UNSCN, 2010) and to the lack of recognition that half of all growth faltering occurs *in utero* (Li, Stein, Barnhart, Ramakrishnan, & Martorell, 2003).

Despite isolated success in specific countries or for specific interventions, such as universal salt iodization and vitamin A supplementation, most countries with high rates of maternal and child undernutrition are failing to reach all members of the target populations with these effective interventions (Bryce, et al., 2008). In order to make more rapid progress toward achieving the MDG targets for child undernutrition as well as maternal and child mortality, countries with heavy burdens of maternal and child undernutrition will need to break the intergenerational cycle of growth by scaling up effective interventions to improve maternal nutrition and reduce low birth weight (Bryce, et al., 2008; UNSCN, 2010). Unfortunately, not much is known about the best ways to deliver effective interventions to people with the greatest need through large-scale programs (S. Horton, Shekar, McDonald, Mahal, & Brooks, 2009; Shekar, 2008).

This study will address this gap by proving recommendations for strengthening the implementation and scale-up of effective interventions for improving maternal nutrition in Bihar and similar places with high burdens of maternal and child undernutrition.

2. Lit Review

2.1. Maternal undernutrition

Maternal undernutrition, which includes chronic energy and micronutrient deficiencies, is one of most neglected aspects of nutrition in public health globally. The prevalence of underweight (i.e. body-mass index of less than 18·5 kg/m²) among women of reproductive age ranges from 10 percent to 19 percent in most countries (Black, et al., 2008). A serious problem of maternal undernutrition is evident in most countries in sub-Saharan Africa and south-central and southeastern Asia where more than 20percent of women are underweight. With a prevalence of low body-mass index around 40 percent in women, the situation can be considered critical in India, Bangladesh, and Eritrea (Black, et al., 2008). Short stature (i.e. height less than 145cm) which is a sign of past undernutrition is prevalent in many regions especially in south-central Asia, where in some countries more than 10 percent of women aged 15–49 years are shorter than 145 cm (Black, et al., 2008).

Maternal short stature and low body-mass index have independent adverse effects on maternal and birth outcomes (Bhutta & Haider, 2009). Maternal short stature is a risk factor for delivery complications due to small pelvis size (WHO, 1995). Low maternal body-mass index is associated with intrauterine growth restriction (Fishman et al., 2004), which, in turn is a risk factor for neonatal and perinatal conditions (Black, et al., 2008). Women who are underweight are more vulnerable to food shocks such as famines and seasonal hunger, especially during pregnancy and lactation, owing to their higher

nutritional requirements. The nutritional status of a woman before and during pregnancy is important for a healthy pregnancy outcome (Kramer, 1987).

A significant proportion of women of reproductive age in developing countries have deficient levels of micronutrients (Allen, 2005) due to poor access to a sufficient supply of nutritious foods, the metabolic and physiologic demands of pregnancy, and infections (Christian, 2010). Micronutrient deficiencies during pregnancy have adverse effects on maternal and birth outcomes. Although iron deficiency is the primary cause of anemia, causing up to 50 percent of anemia cases in women (WHO, 2001), anemia may be caused by deficiencies of other micronutrient, such as vitamins A, B-6, B-12, C, (Fishman, Christian, & West, 2000) as well as malaria, worm infestations, and infectious diseases (McLean, Cogswell, Egli, Wojdyla, & de Benoist, 2009). Where malaria is endemic, anemia is one of many reasons for malaria control (UNSCN, 2010).

Anemia is a widespread health problem that has not slowly improved of time like other nutritional problems (UNSCN, 2010). Some 40 percent of women in developing countries are anemic with hardly any change observed between 1990 and 2000 (J. Mason et al., 2005). Almost 90 percent of anemic women reside in Africa or Asia (Sanghvi, Harvey, & Wainwright, 2010). According to the UNSCN 6th Report, the prevalence of anemia in women is fairly static at around 45 percent in Asia and Africa and 25 percent in South America and the Caribbean. It is highest in South Central Asia, mainly India, where nearly 60 percent of women are anemic and in East, Central and West Africa where the prevalence is over 40 percent and appears to be worsening. Among pregnant women, anemia is most prevalent in South Central Asia where it is 55 percent and in east

and Central Africa where it is greater than 50 percent (UNSCN, 2010). There is some evidence that, in most regions, the prevalence of anemia is declining among pregnant women; however, the rate of change for pregnant women is still slow (UNSCN, 2010).

Maternal anemia has adverse effects on maternal and child health outcomes by increasing the risk of prematurity and intrauterine growth restriction (Rasmussen & Stoltzfus, 2003). Iron-deficiency anemia has profoundly negative consequences on the cognitive (Stoltzfus, Mullany, & Black, 2004) and physical development of children, and on physical performance, especially among adults (McLean, et al., 2009; Ramakrishnan, 2001). Iron-deficiency anemia may also increase the risk of maternal mortality (Black, et al., 2008), although the evidence is not strong (R. Shrimpton, 2010).

2.2. Low birth weight

Low birth weight, defined as birth weight below 2500 grams, is a product of intrauterine growth restriction, preterm birth, or both in combination (Kramer, 1987). In developing countries, where LBW remains a major public health problem, intrauterine growth restriction, defined as birth weight less than the 10^{th} percentile of weight-for-gestational-age, is the primary cause of low birth weight (Villar & Belizan, 1982). Although trends in low birth weight are difficult to measure in developing countries, where many births are unattended and unregistered, the global prevalence of low birth weight is estimated at 16 percent, with signs that these rates are gradually decreasing except in Africa where these rates are static (UNSCN, 2010). South Asia remains the region with the highest incidence

of low birth weight, which is estimated to be around 30 percent (Christian, 2010; UNSCN, 2010).

Low birthweight is associated with impaired immune function and high risks of developing acute diarrhea or pneumonia (ACC/SCN, 2000; Ashworth, 1998; Moore et al., 2004). Consequently, low birth weight infants are at greater risk of illness and death (McIntire, Bloom, Casey, & Leveno, 1999). Infants weighing less than 2500 grams are approximately 20 times more likely to die than heavier babies (UNICEF/WHO, 2004). They are also more likely to be stunted (Fishman, et al., 2004; Martorell, Ramakrishnan, Schroeder, Melgar, & Neufeld, 1998) and to develop chronic diseases, such as diabetes, hypertension and cardiovascular disease, in adulthood (Barker, 2006; Godfrey & Barker, 1995; Rich-Edwards et al., 1997).

Poor maternal undernutrition is the major determinant of intrauterine growth restriction (IUGR) in developing countries. Women who are underweight or stunted prior to conception and women who have insufficient gestational weight gain are more likely to deliver low birth weight babies (Fishman, et al., 2004; Kramer, 1987, 2003; Kramer & Kakuma, 2003). In developing countries, poor maternal nutrition may account for more than 50 percent of low birth weight (Kramer, 1987). Low birth weight tends to move with the prevalence of low body mass index in women (UNSCN, 2010). There is growing evidence that pre- and peri-conceptual micronutrient deficiencies (e.g. iron-deficiency anemia) can influence fetal and infant health (Cetin, Berti, & Calabrese, 2010; R. Shrimpton, Thorne-Lyman, Tripp, & Tomkins, 2009). Teenage pregnancy is another

important risk factor for low birth weight because adolescent mothers who are still growing compete for nutrients with their fetuses (Scholl, Hediger, Schall, Khoo, & Fischer, 1994) (UNSCN, 2010). At the same time, teenage pregnancy impedes the growth of the adolescent. For each year that median age of first pregnancy can be delayed beyond 15 years of age, an additional 1 cm is likely to be added to the height of adult women (Casanueva, Rosello-Soberon, De-Regil, Arguelles Mdel, & Cespedes, 2006; Rah et al., 2008; UNSCN, 2010).

2.3. Effective interventions for maternal and birth outcomes

As part of the Lancet Nutrition Series, Bhutta et al. conducted a systematic review to identify proven interventions to reduce undernutrition in the 36 countries with the highest burdens of maternal and child undernutrition (Bhutta, et al., 2008). The authors found prenatal supplementation with iron-folic acid, multiple micronutrients, and calcium; salt iodization; and tobacco cessation or air pollution reduction to be effective interventions for improving maternal and birth outcomes in the 36 countries with the highest burden of undernutrition. They also found maternal balanced protein and energy supplementation; iodine supplementation; deworming in pregnancy; and intermittent preventive treatment for malaria to be effective interventions for improving maternal and birth outcomes in specific, situational contexts. In contrast, they did not find sufficient or convincing evidence that maternal vitamin A supplementation, family-planning interventions to promote birth spacing, and dietary diversification strategies are effective interventions for improving maternal and birth outcomes in any context.

2.3.1. Iron folic acid supplementation

There is convincing evidence that prenatal iron-folic acid (IFA) supplementation is an affordable and effective strategy for reducing maternal anemia (Bhutta, et al., 2008) and improving birth weight (Christian, 2010), especially when started in early pregnancy. IFA supplementation is the only maternal nutrition intervention that is widely implemented for reducing maternal anemia during pregnancy (Bryce, et al., 2008). Current WHO/INACG/UNICEF guidelines recommend universal supplementation with iron plus folic acid during pregnancy where anemia rates in women of reproductive age are greater than 40 percent (Stoltzfus & Dreyfuss, 1998). Most countries already have a policies and programs to provide IFA tablets during pregnancy, but their coverage remains low due to poor implementation and a lack of attention given to anemia as a problem, especially within efforts to strengthen antenatal care services (Bryce, et al., 2008; Sanghvi, et al., 2010). Unreliable supply (Gillespie & Mason, 1991; UNSCN, 2010) and low compliance have been identified as important barriers to program implementation. What is needed is to systematically adopt lessons about how to strengthen demand and supply systems from successful programs (Sanghvi, et al., 2010). Several changes are required to make existing anemia control programs more effective. First, preventing anemia during adolescence to improve birth weight and prevent stunting should be prioritized (R. Shrimpton, 2010). Second, programs should target all women of reproductive age who are at risk of anemia – not only pregnant women – because it is very difficult to reverse or prevent anemia during pregnancy.

2.3.2. Multiple micronutrient supplementation

There is convincing evidence that supplementation with multiple micronutrients (MMN) during pregnancy is an effective strategy for reducing the risk of low birth weight

(Bhutta, et al., 2008). Although prenatal vitamin and mineral supplementation is ubiquitous in high-income countries, it remains rare in most developing countries (Christian, 2010), where multiple micronutrient deficiency among pregnant women is common (UNICEF/WHO, 2004). As a result, it has been suggested that IFA supplements be replaced with MMN supplements in the package of health and nutrition interventions delivered to mothers during pregnancy (Ahmed et al., 2010; R. Shrimpton, Huffman, Zehner, Darnton-Hill, & Dalmiya, 2009). Several systematic reviews have been conducted to compare trials to compare prenatal MMN and IFA supplementation in developing countries with contradictory results. One study concluded that prenatal MMN supplementation presented no added benefit compared to iron and folic acid supplementation in terms of rates of low birthweight babies or of those who were small for gestational age (Haider & Bhutta, 2006). Another found that prenatal MMN supplementation significantly reduced the risk of low birth weight when compared with iron-folic acid supplementation, but that it did not have a significant effect on the risk of preterm birth or small-for-gestational-age infants (Shah & Ohlsson, 2009). The third, systematic review concluded that MMN supplementation during pregnancy in low-income countries resulted in a small increase in birthweight and a reduction in the prevalence of LBW of about 10 percent relative to IFA supplementation, but that the effect was greater among women with higher BMI (>20 kg/m2) (C. H. Fall, Fisher, Osmond, & Margetts, 2009). These studies suggest that multiple micronutrients may contribute only modestly to improvements in birth weight and have no impact on gestational length or fetal or neonatal survival beyond iron supplementation alone (Christian, 2010).

2.3.3. Protein and energy supplementation

Balanced protein and energy supplementation during pregnancy is an effective intervention in specific, situational contexts for improving birth weight and lowering the prevalence of small-for-gestational babies (Bhutta, et al., 2008; R. Shrimpton, 2010). A meta-analysis of 19 food supplementation trials (Bhutta, et al., 2008) found that balanced protein-energy supplementation during pregnancy reduced the risk of a small-for-gestational age baby by 32 percent (relative risk 0·68, 95 percent CI 0·56–0·84). Since this finding was disproportionately influenced by the large Gambian study (Ceesay et al., 1997), this finding is applicable only to specific contexts. Furthermore, a study among Bhutanese refugees in Nepal showed that food supplementation prior to and during pregnancy could bring about rapid decreases in the prevalence of low birth weight (R. Shrimpton, A. Thorne-Lyman, et al., 2009). The Lancet Nutrition Series estimated that if balanced protein energy supplements were provided to all women during pregnancy in locations where less than 10 percent of pregnant women are underweight, then the risk of term intrauterine growth restriction would be reduced by a third (Bhutta, et al., 2008). In practice however food supplementation of pregnant women is not practiced at scale in most of the countries that are severely affected by maternal and child undernutrition (Bryce, et al., 2008; R. Shrimpton, 2010). In areas where low-birth-weight rates are greater than 15 percent, and/or where more than 20 percent of women of reproductive age are excessively thin (BMI <18.5), the recommendation is to provide “balanced” protein-energy food supplements to women during pregnancy and lactation. Rarely, however, do countries have any programs in place to tackle the problem of low birth weight (Bryce, et al., 2008) (UNSCN, 2010b). Of the 20 countries prioritized for intervention due to high

levels of undernutrition, only half have included balanced energy-protein supplementation for pregnant women in their national nutrition plans and none of them are implementing it at scale (Bryce, et al., 2008). There is no programming guidance for maternal food supplementation (S. Horton, et al., 2009). There is some evidence to indicate that, for mothers with suboptimal pre-pregnancy nutritional status, multiple micronutrient supplementation should be accompanied by balanced energy and protein supplementation for the greatest benefit in terms of birth size (Huybregts et al., 2009).

2.3.4. Food Fortification

Food fortification is a highly cost-effective and sustainable strategy for reducing micronutrient deficiencies, such as IDA. Salt iodization is an important strategy for reducing the risk of cretinism and improving child survival (Bhutta, et al., 2008). It has been associated with increased birth weight and weight for age in young children in Asia (J. B. Mason et al., 2002). At a cost of $0.05 per person per year, it has a very high benefit-cost ratio of around 70 (S. Horton, Alderman, & Rivera, 2008). Of all the interventions for maternal and birth outcomes that were recommended in the Lancet Series, salt iodization is the only one to have achieved fairly high level of coverage (R. Shrimpton, 2010) and, yet, many households in South Asia and some sub-Saharan African countries do not have access to it (S. Horton, et al., 2008). Home fortification with products such as Sprinkles appears to be a very cost-effective strategy for reducing anemia in children with a benefit-cost ratio of up to 37. It could be a very promising strategy for reducing anemia in adolescent girls and women (S. Horton, et al., 2008). The fortification of staple foods such as flour with iron is another cost-effective strategy for

reducing anemia and can be done at a cost of only $0.10-0.12 per person per year, with a benefit-cost ratio calculated to be 8.7 (S. Horton, et al., 2008).

2.3.5. Community nutrition interventions

A more comprehensive approach to reducing undernutrition requires community nutrition interventions. There is evidence that such interventions can be very effective for reducing undernutrition in children. In Thailand in the 1980s, for example, the prevalence of underweight was reduced by 3 percent annually, against a baseline of 0.1-1 percent for countries in the region without national programs. Such interventions can also have good benefit-cost ratios if well designed and implemented (S. Horton, et al., 2008).

2.3.6. Deworming

Deworming (i.e. the provision of anthelmintics such as albendazole) when administered twice during pregnancy during pregnancy is an effective non-nutritional intervention for reducing maternal anemia in specific contexts (Bhutta, et al., 2008). It also is effective for improving birthweight and infant survival in hookworm-endemic regions (Christian, Khatry, & West, 2004; Torlesse & Hodges, 2000). The integration of deworming into anemia control programs could improve health outcomes, however, this rarely happens (UNSCN, 2010).

2.3.7. Treatment and prevention of malaria

Intermittent preventive treatment with sulphadoxine-pyrimethamine for malaria during pregnancy reduces maternal anemia and low birth weight in certain settings (Bhutta, et al., 2008). Utilization of insecticide-treated bednets during pregnancy is also an effective

strategy for reducing the risk of low birth weight (Bhutta, et al., 2008). Of the 20 countries with the highest burden of undernutrition, intermittent preventive treatment for malaria and use of insecticide-treated bednets are being implemented at scale in only four countries (Bryce, et al., 2008).

2.3.8. Family planning interventions

Delaying the age at first birth until 18, so that the mother has herself finished growing, would make an important contribution to increasing birth weight and reducing child undernutrition rates in many developing countries (UNSCN, 2010). An observational study of low birth weight among Bhutanese refugees in Nepal surmised that a decreased prevalence of teenage pregnancies within the camp may partly explain a rapid decline in low birth weight (R. Shrimpton, A. Thorne-Lyman, et al., 2009).

Family planning may help to reduce maternal undernutrition and intrauterine growth restriction in populations with high fertility rates (Conde-Agudelo, Rosas-Bermudez, & Kafury-Goeta, 2007). However, objective data from intervention studies are scarce and do not currently support the effectiveness of family planning interventions for improving maternal and birth outcomes (Bhutta, et al., 2008). Policies and programs – such as helping to keep girls in school and implementing laws to prevent under-age marriage – that postpone first pregnancies until the mother is fully grown will have important benefits for the health of both mother and child. This could be a crucial factor in sustainably cutting the intergenerational transmission of malnutrition (UNSCN, 2010). Policy guidance for reducing low birth rates through interventions that address fertility

patterns, teenage pregnancies, and short intervals between births on low birth weight rates needs to be reviewed (R. Shrimpton, 2010).

2.3.9. Development interventions

Interventions that address the underlying determinants of maternal undernutrition, such as food insecurity and poverty, could have larger effects on reducing malnutrition than nutritional interventions. Optimal interventions to improve maternal nutrition need to address household food insecurity (Bhutta & Haider, 2009). Conditional cash transfers and dietary diversification are two promising strategies for improving household access to nutritious foods. Dietary diversification through home gardening, livestock rearing, and dietary modifications is a potentially promising, sustainable and culturally relevant intervention strategy. However, such interventions have only been implemented at a small scale and have not been adequately assessed (Bhutta, et al., 2008). Consequently, little is known about their effect on maternal nutrition and birth outcomes. Broad food system policies that can contribute to longer term alleviation of the undernutrition burden are also rare in the 20 countries with the highest burden of undernutrition. Focusing of agricultural and food system policies on human health and nutrition goals is an under-exploited opportunity with great potential. (Bryce, et al., 2008).

As the Lancet Series demonstrated, there are a number of efficacious interventions whose evidence base is sufficiently robust to warrant their implementation in all or some of the countries with the highest burdens of undernutrition (Bhutta, et al., 2008). Indeed, many countries have included these interventions in their national plans for improving maternal and child health. The problem is that they are not being delivered to the target

populations at appropriate levels of coverage and intensity (Bryce, et al., 2008). Furthermore, rigorous evaluations that examine short- and long-term effects of large-scale interventions on multiple health outcomes are rare (Morris, Cogill, & Uauy, 2008). So, while much is known about *what* needs to be done to eliminate maternal undernutrition and reduce IUGR-LBW, much less is known about *how* to deliver large scale interventions to those who need them the most (R. Horton, 2008; Shekar, 2008). There is a great need for an expanded research agenda of "delivery science" to better understand how to improve the implementation and cost effectiveness of programs at scale (Heikens, Amadi, Manary, Rollins, & Tomkins, 2008). This reflects a bias in the nutritional sciences toward developing new technologies rather than improving the application of existing ones (Leroy, Habicht, Pelto, & Bertozzi, 2007; Morris, et al., 2008). In order to fill this gap, large-scale effectiveness assessments are required to expand the evidence base for strategies and tactics to achieve high, sustained, and equitable coverage with proven interventions to address undernutrition (Bryce, et al., 2008). It is time for a paradigm shift aimed at achieving universal access from the start for proven interventions to address maternal and child undernutrition (Bryce, et al., 2008).

3. Methods

3.1. Introduction

The objectives of this study were to assess the status of interventions to improve maternal nutrition and identify barriers to and opportunities for expanding the coverage of quality

interventions to all adolescent girls and women of reproductive age in Bihar. We selected the study methods based on their ability to quickly and accurately provide answers to specific research questions and to lay the foundation for community-based qualitative research to be conducted at a later date.

3.2. Setting and study population

Bihar is a state in eastern India sharing a border with Nepal that is bisected west to east by the Ganges River. With a population of 83 million (Census 2001), Bihar is the second most populous state in India. Administratively, the state has 9 divisions and 38 districts, which are divided into 101 subdivisions, 533 development blocks, and 45,356 villages. Blocks are the most basic unit of administration. The state capital is Patna, which is located along the Ganges River in central Bihar. Nalanda District and West Champaran District are located in the northwest and southwest quadrants of the state, respectively.

3.2.1. Selection of sites for field visits

Fieldwork was conducted in the state capital, Patna, and in select blocks of West Champaran and Nalanda Districts. The NRHM Director selected these districts based upon request. The sole criterion for selection was that the districts differ substantially from each other in terms of disease burden and key performance indicators used by the NRHM, such as routine immunization and institutional deliveries. Nalanda, which is the highest performing district in the state according to the state HMIS and also home to the Chief Minister, was selected as the “high” performing district. West Champaran, which has seen a rapid improvement in key process indicators from a very low baseline, was selected as a “moderate” performing district. The NRHM Executive Director excluded

low performing districts from his selection, because he felt that there would be little to observe in these areas. Within each district, a minimum of two blocks, one urban and one rural, were selected in consultation with district health authorities and UNICEF staff (figure 1). Accessibility by road from the district seat, availability of accommodation at block level and, in the case of Gaunaha block in West Champaran, presence of a unique tribal population living along the Nepal border were the primary criteria for block selection. Within each block, local staff from the ICDS and UNICEF selected AWCs, HSCs, PHCs, and schools for site visits based primarily upon their accessibility from the block headquarters and the presence of good staff. The NRHM Director informed the District Health Societies of our planned visits in advance of our arrival in Nalanda and West Champaran in order to facilitate field work; however, at block level, all visits took place without advance notice.

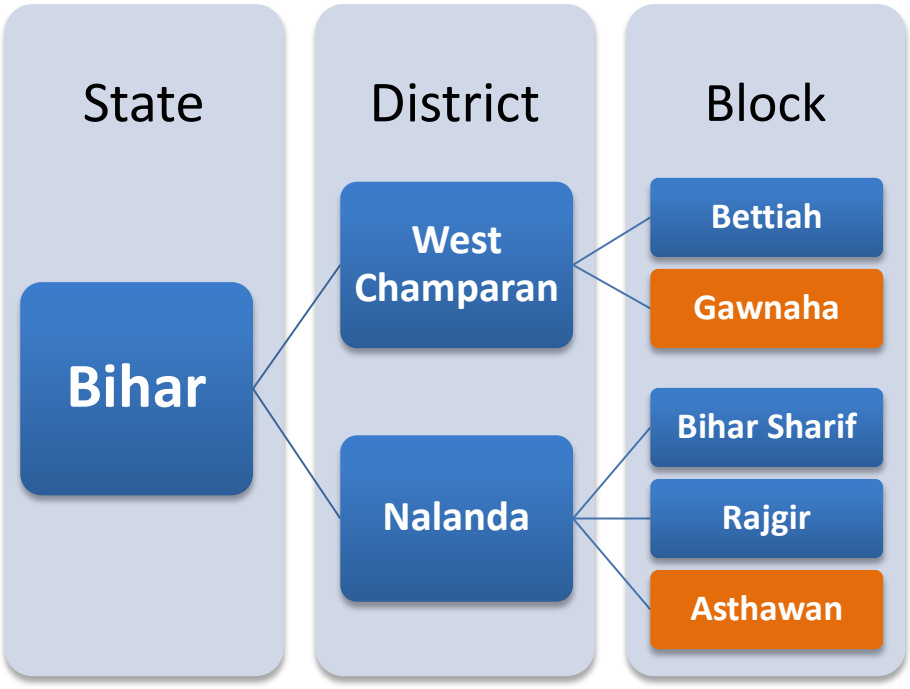

Figure 1: Selected districts and blocks of Bihar for field visits. Rural blocks are indicated in orange.

3.2.2. Selection of key informants

For this study, I performed semi-structured interviews with a total of 48 key informants at different administrative levels. At the national level, I interviewed the Deputy Director of the Bill and Melinda Gates Foundation and senior staff from Micronutrient Initiative and Pathfinder. At the state level, I interviewed government officials from key line departments (e.g. Health and Family Welfare, Social Welfare, and Food and Consumer Protection) and programs (i.e. National Rural Health Mission, Integrated Child Development Services, Women's Development Corporation), technical and program staff from UNICEF and UNFPA, directors of international and national NGOs working in nutrition and family planning (Micronutrient Initiative, CARE, Janani, Population Services International and Bihar Voluntary Health Association) and academics from research institutes (i.e. ANSISS and ADRI) in order to understand how the Government of Bihar and its partners are working to reduce maternal undernutrition and improve birth outcomes. At district and block levels, I interviewed government officials in charge of health and the ICDS. At the facility level, I interviewed managers and medical and paramedical staff based in health facilities, Anganwadi Workers providing nutrition and health services through Anganwadi Centers, and one of the nodal teachers for the School Anemia Control Program (Appendix 8.1).

Key informants were purposively selected for interviews based on their job titles and responsibilities. A list was compiled of all state-level government departments and organizations managing, implementing or researching interventions that have the potential to impact the nutrition of adolescent girls and women in Bihar. Those

responsible for such activities within these organizations were subsequently identified and contacted for interviews. During each interview, key informants were requested to provide the names of other people to contact for interviews. Interviews were conducted with most of the people who were contacted for an interview. This was possible due to the length of time spent in Patna. A similar exercise was conducted for government departments and organizations operating at the district, block and facility level to manage and deliver health, nutrition and family planning services. A larger percentage of district and block government officials were not available for interviewing because they were on leave or duty travel for the duration of the field visit.

3.3. Research design

Research was carried out between May 2010 and August 2010 in New Delhi, the state capital of Bihar, and selected blocks within Nalanda and West Champaran districts by a one-person study team. Two UNICEF field staff and Janani provided logistical support for the district visits. Data was primarily collected the data through semi-structured key informant interviews and site visits to health facilities and Anganwadi Centers. This study does not constitute human subject research according to the definition used by the IRB and therefore did not require IRB approval.

3.3.1. Research instruments

In Atlanta, members of the study team jointly designed a “Minimum Information to Collect” matrix to guide secondary data collection on policies and programs affecting maternal nutrition in selected states of three countries: India, Nigeria and Ethiopia. This instrument was designed to standardize the collection of different categories of

information concerning key interventions being implemented at national and sub-national levels to improve nutrition during critical periods in the life cycle (i.e. pregnancy, before and after pregnancy, early childhood and adolescence). Based on this matrix, the study team for India developed a set of common questions around seven topical areas that provided the foundation for developing key informant interview guides for each of the three focal states: Bihar, Tamil Nadu and Uttar Pradesh.

For Bihar, I developed a key informant interview guide that could be modified as required for specific organizations and government departments at different levels of administration (i.e. state, district, block and facility). This guide was structured around fourteen key questions addressing different aspects of interventions to improve maternal nutrition, including: the health & nutrition context; programmatic priorities; intervention type and delivery mechanisms; human and financial resources; achievements; challenges; innovations; performance monitoring and impact evaluation; technical guidelines; collaboration; and future opportunities. Prior to arrival in Bihar, three interviews were conducted with organizations based in New Delhi that have programs in Bihar in order to test the guide and make revisions. The key informant interview guide continued to be revised and refined throughout the course of fieldwork to incorporate new learning acquired through interviews (Appendix 8.2).

3.3.2. Research procedures

Research was conducted over a 70-day period between May and August 2010 in the Indian states of New Delhi and Bihar. Secondary data collection and planning for field research in Bihar took place in New Delhi from May 28 until June 30 with the assistance

of Dr. Sheila Vir, a Consultant and expert in nutrition, and Anuraag Chaturvedi, a member of the India study team and a faculty member of the Population Health Foundation of India. Field research was conducted in Bihar between July 1 and August 9 of which 30 days were spent in Patna and 10 days were spent in Nalanda and West Champaran Districts. UNICEF's Senior Nutrition Advisor, Dr. Farhat Saiyed, facilitated a meeting with the Chief Secretary of the Government of Bihar to obtain official support for conducting research in Bihar. At the Chief Secretary's request, the Development Commissioner for the Government of Bihar convened a meeting on 26 July for the study's Principal Investigator, Primary Investigator for India and myself to meet with representatives of key government departments and programs (NRHM, Social Welfare, Public Health Engineering, and Rural Development) in order to discuss the project and initiatives by the Government of Bihar to reduce maternal undernutrition and improve birth outcomes.

Secondary data were collected throughout the study period on the magnitude and distribution of malnutrition and its determinants and the coverage, intensity, and quality of interventions and services to improve the nutritional status of adolescent girls and women, and potential alternative platforms for delivering interventions and services to improve the nutritional status of adolescent girls and women. Secondary data sources included representative, population-based survey reports (e.g. National Family Health Surveys and District Level Health Surveys), program planning documents (e.g. NRHM Program Implementation Plan 2010-2011), first- and third- party program evaluations, technical guidelines, annual reports, journal articles, news stories, and organizational

websites. Secondary data was collected from a variety of sources including key informants, the library of the A.N.Sinha Institute of Social Sciences in Patna, and internet searches. The Google search engine was used to identify and retrieve secondary data sources and locate the official websites of government departments, UN agencies, NGOs and other public health and development agencies working in Bihar. PubMed was used to identify and locate published studies that looked at the outcomes of interest in Bihar or India.

Key informant interviews were conducted in Patna and Nalanda and West Champaran Districts to confirm and supplement findings from secondary data collection and to shed light on local perceptions of maternal nutrition and the challenges and opportunities related to program delivery. All interviews at the state and district levels were conducted in English. Several interviews as block and facility level were conducted in Hindi, with a UNICEF staff member translating questions from English into Hindi and answers from Hindi into English. Interviews with key informants from UN agencies, NGOs and research institutes were tape recorded and transcribed verbatim. Interviews with key informants from government departments and facilities were recorded through note-taking only. All interviews were conducted at the workplace during regular office hours.

3.3.3. Data Analysis

All information derived from secondary sources and key informant interviews was organized by deductive themes including: epidemiology of maternal nutrition; intervention (type, coverage, quality); delivery mechanism / platform; program management and monitoring and evaluation; barriers to service delivery; innovative

strategies for improving coverage and quality; and other potential platforms for program delivery.

4. Results

4.1. Overview of Bihar

Bihar is the third most populous State in India with 83 million people (GoB, 2001). The population grew faster in Bihar between 1991 and 2001 than in any other state in the country, resulting in a population density that is more than twice the national average (GoB, 2001). 90 percent of the population lives in rural areas and three-quarters make a livelihood from agriculture (NSSO, 2006). The state is highly flood prone, every year experiencing some of the worst flooding in the country. At the same time, a majority of districts are drought affected. Bihar is one of the poorest states in the country. More than half the rural population (56 per cent) lives below the poverty line (GoI, 2009), with 86 per cent of households lacking a toilet facility and 78 per cent lacking electricity (IIPS, 2008a). Scheduled Castes (SC) comprise 16 percent of the population. Bihar ranks lower than any other major state in terms of human development. At 34 per cent, the female literacy rate lags 26 points behind the male literacy rate and is the lowest in the country (GoB, 2001). Female life expectancy is only 59.5 years, nearly seven years less than the national average. The under 5 child mortality ratio is 85 deaths per 1,000 live births and the maternal mortality ratio is 312 per 100,000 live births (IIPS, 2008b). Nearly one in two (45 percent) children aged 0-3 years is stunted and nearly three in ten (28 percent) are wasted (IIPS, 2008b). However, things are changing in Bihar. In 2005, a new political

alliance came to power on a reform platform, unleashing unprecedented economic growth of 11.3 percent between 2005 and 2009 (GoB, 2010). Under the leadership of Chief Minister Nitish Kumar, the government has restored law and order and made large scale investments in public infrastructure and human resources for the health, education and transport sectors. As a result, many population health indicators, especially full immunization coverage and institutional deliveries, have been improving rapidly in the years since the NFHS-3 and DLHS-3 were conducted in 2005-06 and 2007-08, respectively.

4.2. Maternal undernutrition

Maternal underweight (BMI <18.5 kg/m^2) is a serious problem in Bihar and does not show any signs of decreasing. Between NFHS-2 and NFHS-3, the prevalence of underweight among women of reproductive age (15-49 years) increased slightly from 39 percent in 1998-99 to 43 percent in 2005-06. At 52 percent, it was even higher among adolescent girls aged 15-19 years in 2005-06 (IIPS, 2008b). Maternal short stature (<145 cm), a marker of past undernutrition, decreased from 20 percent in 1998-99 to 16 percent in 2005-06, although it is remains higher than the national average of 11 percent (IIPS, 2008b). Maternal anemia is another widespread and growing problem in Bihar. The prevalence of anemia among women of reproductive age (15-49 years was more than 60 percent in 1998-99 compared to 67 percent in 2005-06 (IIPS, 2008b). Among pregnant women, the increase was even greater from 46 percent in 1998-99 to 60 percent in 2005-06 (IIPS, 2008b). According to a baseline study conducted by UNICEF in 2007 as a prelude to the School Anemia Control Program, the prevalence of anemia among

adolescent girls aged 15-19 years is 93 percent (Saiyed, Ayoya, & Aguayo, 2009). Multiple micronutrient deficiencies (e.g. vitamins A, B-complex and C) are common among women (Vir, Singh, Nigam, & Jain, 2008). Low birth weight, a consequence of maternal undernutrition, affects 28 percent of all newborns (IIPS, 2008b).

The determinants of maternal undernutrition and low birth weight in Bihar are multiple and interrelated. They can be classified as immediate, underlying and basic in accordance with the UNICEF Conceptual Framework on the Causes of Malnutrition. Immediate determinants include inadequate dietary intake, infectious disease, teenage pregnancy and high fertility coupled with short birth intervals. Rural diets are heavy in carbohydrates, which provide 74 percent of daily caloric intake, and low in animal foods, pulses and green leafy vegetables (Vir, et al., 2008). Helminthic infection is highly prevalent among school-age children due to poor hygiene conditions and may be as high as 80 percent in some areas. Early marriage and teenage pregnancy are common in Bihar. By the time girls are 19 years of age, 58 percent are mothers or pregnant with their first child (IIPS, 2008b). By the time they are between the ages of 20 and 24, 60 percent have two or more children (IIPS, 2008a). Bihar has the highest total fertility rate in the country with women having four children on average with (IIPS, 2008b).

The underlying determinants of maternal undernutrition and low birth weight include household food insecurity, inadequate care for women, and insufficient access to health services, safe water and sanitation. Household food insecurity is a serious problem in Bihar due to high rates of poverty, highly unequal land tenure patterns, low agricultural

productivity resulting from poor access to inputs, and widespread annual flooding that destroys both crops and livestock. Among the 17 major states, Bihar ranks 15 on the India Hunger Index 2008 (Menon, Deolalikar, & Bhaskar, 2009) and more than half of its 38 districts are food insecure, including nine that are severely food insecure (WFP, 2009). Females are particularly vulnerable to food insecurity due to inequitable household food distribution that favors males. Even during pregnancy and lactation, few women have access to the care they require, such as extra foods, rest from heavy workloads and antenatal care.

TABLE: PERCENTAGE OF CURRENTLY MARRIED WOMEN (AGED 15-49) WHO RECEIVED ANTENATAL CARE, BIHAR, DLHS-3 (2007-08)

	Any ANC	**3+ ANC**	**1st trim ANC**	**100 IFA**	**1+ TT inject**	**Full ANC***
Bihar	59	26	24	9	58	5
India	75	50	45	47	73	19

* Full ANC = 3+ ANC, 1+ TT injection, and 100 IFA tablets

Only 26 percent of women receive 3 or more ANC checkups and only 24 percent have their first ANC checkup during the first trimester. Uttar Pradesh is the only state with lower coverage (IIPS, 2010). During ANC checkups, fewer than two thirds had their blood (64 percent) or urine (57 percent) tested, about half (48 percent) were weighed and only one third (34 percent) were told where to go if they experienced pregnancy complications (IIPS, 2008b).

TABLE: PERCENTAGE OF CURRENTLY MARRIED WOMEN (AGED 15-49) WHO HAD PREGNANCY, DELIVERY, POST-DELIVERY COMPLICATIONS AND THEIR TREATMENT SEEKING BEHAVIOR, BIHAR, DLHS-3 (2007-08)

	Complication during pregnancy	**Treatment during pregnancy**	**Complication during delivery**	**Complication after delivery**	**Treatment after delivery**
Bihar	76	42	81	57	57
India	59	55	61	37	58

Although three out of four (76 percent) women experienced complications during their last pregnancy, only 42 percent sought treatment (IIPS, 2010). Postnatal care is also low with only 26 percent of women receiving a postnatal checkup from health personnel within two weeks of delivery compared with 50 percent for the country. Few rural households have access to safe water and sanitation with only 1.6 percent having access to piped drinking water or a covered hand pump/bore well and less than one-fifth of the population (17 percent) having access to a toilet facility (IIPS, 2008a).

Basic determinants of maternal undernutrition and low birth weight in Bihar include illiteracy, gender inequality, caste inequality and poverty. In addition to having one of the lowest absolute literacy rates in the country, Bihar has the largest gender gap in literacy. Only 37 percent of women aged 15-49 years are literate compared to 70 percent for men (IIPS, 2008b). Total school enrollments are also low with the gender gap increasing sharply with age so that boys aged 15-17 years are twice as likely as girls the same age to be enrolled in school (48 percent of boys compared to 24 percent of girls) (IIPS, 2008b). Gender inequality also impedes women's mobility, access to income, and decision-making power. Fewer than two in five women are allowed by their husbands to go alone to a health facility (36 percent) or to the market (39 percent) (IIPS, 2008a). Only 33

percent of currently married women report being able to participate in decisions about any of the following: their own health care, making large household purchases, making purchases for daily household needs, and visiting their own family or relatives. Poverty is widespread in Bihar, especially in rural areas, with 56 percent of the population living below the poverty line with (IHD, 2010). Caste inequality is pronounced in Bihar with major disparities in health education and wealth between Scheduled Castes (SC) and Scheduled Tribes (ST) on the low end of the spectrum and General Classes (i.e. upper castes) on the high end. Other Backward Castes (OBC) fall somewhere in between the two. For example, two-thirds (64 percent) of Scheduled Castes (SC) and 56 percent of Scheduled Tribes (ST) living in poverty compared to 39 percent for Other Backward Classes (OBC) and 26 percent for General Classes (WFP, 2009).

4.3. Existing interventions for improving maternal nutrition

The Government of Bihar is delivering a number of evidence-based interventions to reduce maternal undernutrition and low birth weight in Bihar, including Iron Folic Acid supplementation, deworming, protein-energy supplementation, nutrition education, family planning and social safety nets. These interventions are delivered to adolescent girls and women of reproductive age through five different platforms: the primary health system, the ICDS program, secondary schools, the private sector, and Fair Price Shops.

4.3.1. Iron Folic Acid supplementation

Iron Folic Acid (IFA) supplementation is the main strategy used by the Government of Bihar to prevent maternal anemia. The Department of Health and Family Welfare distributes 100 IFA tablets (100mg ferrous sulphate and 0.5mg of folic acid) to pregnant

women as part of routine antenatal care to prevent and treat mild to moderate anemia (GoB, 2009). In addition to dispensing IFA tablets during antenatal care visits to health facilities, the Department of Health and Family Welfare collaborates with the Department of Social Welfare to distribute 100 IFA tablets to out-of-school adolescent girls and pregnant and lactating women through events organized around Anganwadi Centers (AWC). Key events are weekly Routine Immunization (RI) days, weekly Mahila Mandal meetings and monthly Village Health and Nutrition Days. Community health workers, namely AWWs, ASHAs and ANMs, are responsible for providing adolescent girls and women with information intended to increase IFA compliance, reduce side effects, and encourage the consumption of iron rich food. Coverage of IFA supplementation is very low in Bihar. The NFHS-3 (2005-06) estimates that only 30 percent of women in Bihar received any IFA tablets during their last pregnancy and only 10 percent consumed IFA tablets for the recommended 90 days or more (IIPS, 2008b). A similar finding from the DLHS-3 (2007-2008) suggests little improvement in IFA coverage over the two years between surveys (IIPS, 2008a). The School Anemia Control Program provides directly observed IFA supplementation on a weekly basis to all adolescent girls attending secondary schools. This program has been rolled out by the Department of Human Resource Development with support from UNICEF in all 38 districts. An evaluation conducted by UNICEF in 16 districts in 2008 found that the School Anemia Control Program achieved a compliance of 85 percent over a one-year period and decreased the prevalence of anemia only slightly from 93 percent to 84 percent (Saiyed, et al., 2009).

4.3.2. Deworming

Deworming is another strategy used by the Government of Bihar to reduce anemia among adolescent girls and pregnant women. The Department of Health and Family Welfare is collaborating with the Department of Social Welfare to distribute deworming tablets (400 mg of albendazole) to pregnant women during their first antenatal checkup. However, deworming efforts do not seem to be happening on a regular basis and coverage is very low. The NFHS-3 (2005-06) estimated that only 4 percent of married women took a deworming pill during their last pregnancy (IIPS, 2008b). The School Anemia Control Program distributes deworming tablets (400 mg of albendazole) every six months to adolescent girls attending secondary schools. The actual coverage of this program is not known. However, it is likely to be similar to the coverage of IFA supplementation, because the two interventions are integrated and supported by UNICEF. The Departments of Health and Family Welfare and Elementary Education launched a mass program with Deworm the World in February 2011 to eliminate intestinal worms in younger schoolchildren. Under this program, a single dose of deworming tablets will be given to children in areas where the prevalence of intestinal parasites is greater than 20 percent. The program plans to cover 67,000 schools in all 38 districts.

4.3.3. Protein energy supplementation

Protein energy supplementation is the main intervention delivered by the ICDS Program to reduce maternal undernutrition and low birth weight. The ICDS program, which operates under the purview of the Department of Social Welfare, provides take home food rations to pregnant and lactating women through its Supplementary Nutrition

Program. Food rations comprise 3 kg rice and 1.5 kg pulses per month and are distributed on a monthly basis during events organized through AWCs, such as Routine Immunization (RI) days, Mahila Mandal meetings and Village Health and Nutrition Days. A quota set by the Government of Bihar, stipulates that, in any given month, no more than 16 women (8 pregnant and 8 lactating) per AWC may receive take home rations. According to NFHS-3 (2005-2006), virtually no (0.6 percent) women with children under age six years in areas covered by an Anganwaadi Center (AWC) received supplementary nutrition from their local AWC during their last pregnancy or nursing period (IIPS, 2008b). Based on information collected through field visits, it is very likely that current coverage is considerably higher. It will be interesting to see findings from NFHS-4.

4.3.4. Nutrition education

Nutrition education is another intervention delivered by the primary health system and the ICDS Program to reduce maternal undernutrition. Community health workers (AWWs, ASHAs and ANMs) provide information to adolescent girls and women on several issues related to diet and the prevention of anemia. This includes information about the importance of taking IFA supplements to prevent anemia, eating a balanced diet that contains foods rich in iron and other essential nutrients, eating enough food during pregnancy to gain at least 1kg per trimester, taking rest during pregnancy and lactation, and using only iodized salt in food. Community health workers provide this information through a variety of channels and forums, including ANC/PNC checkups, events organized at the AWC, and home visits. According to the NFHS-3, a miniscule fraction (0.3 percent) of women with children under age six years in areas covered by an

Anganwaadi Center (AWC) received health and nutrition education from their local AWC. Again, based on information collected through field visits, this figure is likely to significantly underestimate current coverage. For school going girls, the School Anemia Control Program is an important source of information on a nutritious diet and anemia prevention. Furthermore, it provides girls with critical information about hygiene and menstruation as well as life skills education which addresses gender-related issues, such as household food practices that favor males.

4.3.5. Family planning

Family planning services are delivered through the Reproductive and Child Health Program, which operates under the purview of the Department of Health and Family Welfare and is a key component of the National Rural Health Mission. The heath system provides clinical family planning services through certified clinics and free contraceptive consumables, such as oral contraception and condoms, through primary health facilities and community health workers. ASHAs and AWWs are responsible for generating demand for family planning services within the community. However, the utilization of family planning services remains low. According to the DLHS-3, among currently married women aged 15-44 years, only 34 percent use any contraceptive method and only 28 percent use a modern method (IIPS, 2008a). In Bihar, as in the rest of the country, the main goal of family planning is population stabilization. Improved maternal and child health is secondary. Consequently, the Reproductive and Child Health Program actively favors permanent methods, especially tubal ligations, over temporary methods, such as IUDs and oral contraception. As a result, there has been very little programming around the use of temporary contraception to delay the first birth and increase the intervals

between births. This is reflected in DLHS-3, which estimates that 25 percent of all currently married women aged 15-44 years used tubal ligation to prevent future pregnancies whereas only 2.9 percent used a condom, oral pill or IUD for the same purpose (IIPS, 2008a). In addition to spacing and limiting, the Government of Bihar and its partners are trying to prevent teenage pregnancy by increasing the age at which girls marry to 18. In collaboration with the Department of Social Welfare and the Department of Human Resource Development, the State Health Society of Bihar is coordinating a campaign that uses the media and the school curriculum to discourage early marriage.

4.3.6. Social Safety Nets

The Targeted Public Distribution System is a social safety net program under the purview of the Department of Consumer and Civil Supplies that provides subsidized food commodities (i.e. rice, pulses and sugar) and kerosene to households through a network of independently run Fair Price Shops located throughout the state. The TPDS provides food grains to households at two sets of prices, depending on whether they are above or below the poverty line. APL households pay close to market price for food items whereas BPL households pay highly subsidized prices for 25kg of rice and 10kg of wheat per month. According to official TPDS statistics, 12,200,000 households possessed a BPL ration card In August 2010. With an estimated population of 83 million and an average family size of 5.6 (IIPS, 2008a), this would mean that 82 percent of all households have access to subsidized food grains through the PDS. However, it is highly unlikely that even a majority of households with BPL cards are able to collect their full entitlement from Fair Price Shops for reasons that will be discussed later.

4.4. Platforms and mechanisms for delivering interventions

Several platforms exist for delivering interventions to reduce maternal undernutrition and low birth weight in Bihar. These include the Primary Health Care System (Department of Health and Family Welfare), the National Rural Health Mission (State Health Society of Bihar), the ICDS (Department of Social Welfare), secondary schools (Department of Human Resources Development), and the Targeted Public Distribution System (Department of Consumer and Civil Supplies).

4.4.1. Primary Health Care System

TABLE: SHORTFALL IN HEALTH FACILITIES			
Health Institutions	**Required**	**Present**	**% of shortfall**
Health Sub-Centre	16,576	8,858	47
Primary Health Centre (Add'l)	2,787	1,243	55
Primary Health Centre (Block)	544	533	2
Community Health Centre	622	70	89
Sub-Divisional Hospital	101	22	78
District Hospital	38	25	34
Medical Colleges	18	9	50
Source: State NRHM PIP 2010-2011			

The Department of Health and Family Welfare provides preventive and curative primary health services through a decentralized network of health care facilities throughout the state. Health Sub-Centers (HSCs), which are located at panchayat level, are the first point of access to the public health system for most people. The Indian Public Health Standards (IPHS) recommend 1 HSC for every 5,000 population. In order to cover the entire population, Bihar requires 16,576 HSCs. However, only 58 percent (n=8,858) of the required HSCs are functional (GoB, 2009). Half of these facilities operate from a rented building or Panchayat office (GoB, 2009) and one in five function on an ad hoc basis out

of a primary school building or a room in a construction site (Gill, 2009). 50 percent of HSCs lack running water and sanitary facilities (GoB, 2009) and 72 percent do not have a regular electricity supply (Rural Health Statistics, 2008). Primary Health Centers (PHCs), which are located at the block level, form the cornerstone of rural health services providing preventive and curative health care services on an in- and out-patient basis. Nearly all (98 percent) 544 development blocks have a PHC (GoB, 2009). However, this is not sufficient to meet the IPHS recommendation of one PHC for every 100,000 population and an additional 2,787 PHCs (APHC) are required at sub-block level. Only 45 percent (n=1,243) of the Additional PHCs (APHCs) have been operationalized (GoB, 2009). In theory, APHCs should be equivalent to PHCs in terms of the services they provide; however, in reality, many APHCs serve as outposts with staff commuting from the PHC to the APHC only when required. Community Health Centers (CHCs) and sub-divisional hospitals are first referral units (FRU) for the primary health system. A number of block PHCs are in the process of being upgraded to Community Health Centers (CHC) and sub-divisional hospitals.

TABLE: SHORTFALL IN HEALTH FACILITIES AS OF NOVEMBER 2009				
Personnel	**Location**	**Required**	**In position**	**% shortfall**
Accredited Social Health Activist (ASHA)	Village	87,136	69,640	20
Male Health Worker	HSC	8,858	1,074	88
Auxiliary Nurse Midwife (regular)*	HSC & PHC	11,928	9,900	17
Auxiliary Nurse Midwife (contractual)*		11,000	6,000	45
Lady Health Visitor (LHV)	APHC & PHC	1,641	479	71
Male Health Assistant		1,641	634	61
Doctors		1,641	1,565	5
Surgeons**	CHC	70	28	60
Obstetricians & Gynecologists**		70	21	70
Physicians**		70	38	46
Pediatricians**		70	17	76
Sources: State NRHM PIP 2010-2011; Economic Survey of Bihar 2009-2010*; and Rural Health Statistics, 2008**				

The primary health workforce at community level comprises Accredited Social Health Activists (ASHAs), Auxiliary Nurse Midwifes (ANM) and Male Health Workers (MHW). ASHAs are female volunteers who raise awareness on health issues in their respective communities and facilitate the uptake of primary health services. According to IPHS guidelines, each village should have two ASHAs. ANMs form the backbone of the primary health care system, providing basic preventive and curative health services from health facilities and within communities, usually in collaboration with Anganwadi Workers (AWW). ANMs are based in HSCs and PHCs. In order to increase outreach, the government recently increased the staffing requirement of one to two ANMs per HSC. Male Health Workers (MHW) are the male counterpart to ANMs, but they focus more on infectious disease control and family planning. Supervision is provided to the primary health workforce by Lady Heath Visitors (LHV) and Male Health Assistants (MHA) from their base in the A/PHC. They are responsible for making field visits to monitor and support the work of ASHAs, ANMs and MHWs. The Medical Officer in-Charge runs the

PHC and has overall responsibility for the functioning of all APHCs and HSCs in the block.

The Department of Health and Family Welfare is facing an acute shortage of human resources. At the community level, there is a 20 percent shortfall of ASHAs, a 17 percent shortfall of regular ANMs and a 45 percent for contractual ANMs who are being recruited to increase the number of ANMs per HSC from one to two. At 88 percent, the shortfall is most acute for MHWs. As the only male health worker at community level, this means that many men are not being reached with information or counseling on gender sensitive topics like family planning. The lack of human resource is even more severe at the field supervisor level. Although the IPHS recommends one Lady Heath Visitor and one Male Health Assistant for every APHC/PHC, the reality is very different. 71 percent of Lady Health Visitor posts and 61 percent of Male Health Assistant posts remain vacant. Among primary health workers, doctors have the highest staffing level with 95 percent of all posts filled. However, they are not equitably distributed among health facilities. Three quarters (76 percent) of APHC/PHCs lack a doctor on staff while 21 percent are overstaffed with 4 or more (Rural Health Statistics, 2008). Furthermore, 72 percent of APHC/PHCs lack Lady Doctors, presenting a barrier to women seeking reproductive health services (IIPS, 2008a). Specialists are also in short supply, especially at block and district levels. CHCs are staffed with only 40 percent of required surgeons, 30 percent of Obstetrician/Gynecologists, 54 percent of physicians and 24 percent of pediatricians (Rural Health Statistics, 2008).

4.4.2. National Rural Health Mission

The National Rural Health Mission (NRHM) was launched by the Government of Bihar in August 2005 to extend coverage of high quality healthcare services to all rural residents, especially the most vulnerable, by reconfiguring and strengthening the public health system. Most noteworthy is its focus on eliminating the gaps in infrastructure and human resources, decentralizing program planning and management, increasing community engagement, and improve convergence among programs that address the underlying determinants of health, such as access to nutrition, family planning and sanitation services. The current NRHM Program Implementation Plan (2010-2011) aims to "dramatically scale up the availability, accessibility and utilization of Reproductive Child Health services with a special emphasis on disadvantaged groups" (GoB, 2009). Specific objectives include reducing IMR and MMR through increased immunization and institutional deliveries, and a reduction in total fertility. The State Health Society of Bihar (SHSB) has overall responsibility for the NRHM. An Executive Director manages the day-to-day operation under the guidance of the SHSB Board, which is chaired by the Development Commissioner and includes the Secretaries of the Department of Health and Family Welfare, the Department of Social Welfare and the Public Health Engineering Department.

The NRHM has five components: the Reproductive Child Health Program, Innovations under NRHM, Routine Immunization, National Disease Control Programs, and Inter Sectoral Convergence. The Reproductive Child Health Program comprises maternal health, child health, family planning, adolescent health and vulnerable communities.

Innovations under NRHM refer to new structures, systems and schemes that have been introduced by the NRHM. An important innovation is the creation of Accredited Social Health Activists (ASHA) to raise awareness of health in their villages and increasing the uptake of primary health services. ASHAs are female volunteers with an 8th grade education who receive cash incentives, rather than a salary, for ensuring the utilization of prioritized health services. Another important innovation is the Janani Bal Suraksha Yojana (JBSY) scheme that aims to reduce maternal and child mortality by providing cash incentives to pregnant women and ASHAs to increase the number of institutional deliveries. A third important innovation are Village Health and Nutrition Days (VHNDs) that are organized in all AWCs once per month to provide maternal, child health and family planning services through a single delivery platform at community level. VHNDs are organized by ASHAs and other community health workers with the support of community-based organizations, including Panchayati Raj Systems and women's Self-Help Groups.

In order to improve program implementation and service delivery, the NRHM has devolved greater responsibility for program planning, management and monitoring to local authorities. District Health Societies have been formed in all 38 districts to administer and monitor the NRHM at the grass roots level (GoB, 2009). Program Management Units, which include Health Managers, Educators and Accountants, have been established in District Health Societies and PHCs. Hospital Welfare Societies or Rogi Kalyan Samitis (RKS) have been operationalized in all 513 health facilities from the PHC upwards to plan and ensure effective functioning of these facilities and monitor the

HSCs in their jurisdiction (GoB, 2009). Village Health and Sanitation Committees (VHSC) are being established in all village panchayats to increase community participation in planning and monitoring health, nutrition, and sanitation interventions. VHSCs receive untied funds of Rs 50,000 for undertaking local initiatives. VHSCs were operational in only 8 percent (n=3,608) of villages as of Dec 2009 (GoB, 2009). District Health Societies prepared district level implementation plans for the first time in 2009. They were followed by PHCs and other block-level partners the following year.

4.4.3. Integrated Child Development Services (ICDS)

The Integrated Child Development Services (ICDS), which is under the purview of the Department of Social Welfare, is a direct nutrition program that aims to improve the health and nutritional status of women and children. The ICDS program delivers a package of integrated services to pregnant and lactating women and children less than 6 years of age through community-based Anganwadi Centers (AWC). Services include supplementary nutrition, IFA supplementation, growth monitoring, health and nutrition education, health check-ups, immunization, referral services and pre-school education. To date, ICDS projects have been operationalized in all 544 development blocks (GoB, 2011). These projects operate a total of 86,237 AWCs. This represents 94 percent of the IPHS requirement of one AWC for every 1,000 population. Similar to primary health facilities, three-quarters of AWCs are operated from rented spaces in private buildings and few have safe drinking water and toilet facilities. Under the Bihar Mahadalit Vikas Mission, which was established to undertake several targeted schemes for the development of the 20 most deprived communities amongst the scheduled castes, mini-AWCs have been established in all mahadalit *tolas* (i.e. hamlets) in order to extend

coverage to and ensure the inclusion of Scheduled Caste populations. To date, 5,440 mini-AWCs have been established throughout the state (GoB, 2011). In principle mini-AWCs provide the same services as AWCs only to a smaller population. In 2001, the Government of Bihar and UNICEF introduced a programmatic overly known as Dular to improve linkages between AWCs and the populations they serve by forming groups of local resource persons (LRP) to work in their villages to raise awareness of services, bring people to AWCs, and promote behavior change related to maternal and child care practices (Abbott, Barney, & Bassett, 2005). Dular, which was rolled out in four stages, currently covers all 38 districts.

Anganwadi Workers (AWW) receive an honorarium of Rs 1,500 per month to deliver the package of services to all pregnant and lactating women and children less than 6 years of age within the AWC catchment area. They must have a secondary level of education, be from the village where they serve, and belong to the majority caste. Anganwadi Helpers (AWH) assist AWWs in the preparation of the hot meal served to children, but do not receive any compensation. Lady Supervisors, who are based in the block office, are responsible for regularly visiting AWCs to monitor activities and provide support to AWWs. The Child Development Project Officer (CDPO), who heads the block office, oversees the operation of all AWCs in the block, of which there are 150 on average.

TABLE: STAFFING IN ICDS			
Position	**Sanctioned strength**	**Actual strength**	**% shortfall**
Anganwadi Worker	91,677	80,211	13%
Anganwadi Helper	91,677	80,211	13%
Lady Supervisor	3,288	241	83%
CDPO	544	508	7%
Source: Government of Bihar, Economic Survey 2010-2011			

Among AWWs and CDPOs, staffing levels are close to the mark. As a result, nearly all (93 percent) development blocks have a CDPO and nearly all (93 percent) AWCs have an AWW. Similar to the public health system, the ICDS program has a very large shortfall of field supervisors. 83 percent of all Lady Supervisor posts are vacant. This places the actual ratio of Lady Supervisor to AWWs at 1:333, which far exceeds the IPHS norm of 1:25. Women's groups, known as Mahila Mandals, have been formed in most villages to facilitate the delivery of maternal and child health services including nutrition education, IFA supplementation and antenatal care. Mahila Mandals, which include both adolescent girls and women as members, typically meet once a week on Routine Immunization Day at the AWC.

4.4.4. School Anemia Control Program

The Department of Health and Family Welfare is collaborating with the Department of Human Resource Development and UNICEF to implement the School Anemia Control Program in secondary schools throughout all 38 districts of the state. This program provides adolescent girls age 14-17 years with weekly IFA supplementation, biannual deworming, nutrition education, and life skills education. It also conducts community outreach to raise awareness among parents and community members of the causes and

consequences of anemia and to generate support for iron supplementation. Two nodal teachers implement this program with the support of a UNICEF volunteer who covers ten schools.

4.4.5. Targeted Public Distribution System (TPDS)

The Targeted Public Distribution System (TPDS), which operates under the Department of Consumer and Civil Supplies, provides a social safety net to BPL households by providing subsidized food commodities through Fair Price Shops operated by licensed dealers. The state receives all food commodities from the Central Government. The commodities are delivered to a couple of warehouses operated by the Food Corporation of India in Bihar, and subsequently dispatched to district warehouses. Fair Price Dealers must collect their allotment from the district warehouse and transport it back to their shops for sale to the public. Currently, there are 42,207 Fair Price Shop Shopkeepers in the state (GoB, 2011). A key performance indicator for the TPDS is the amount of food commodities lifted (collected) by Fair Price Shop Shopkeepers from government warehouses as a percentage of the food commodities allocated to the State by the Central Government. With respect to wheat, the percentage of wheat lifted by Fair Price Shop Shopkeepers increased substantially from 46 percent in 2005-06 to 92 percent in 2009-10. There has been a similar increase for rice, growing from 15 percent in 2005-06 to 59 percent in 2009-10 (GoB, 2011). The Chief Minister has made a concerted effort to improve the TPDS in Bihar, but this exercise has not produced the desired results and large leakages remain (IHD, 2010).

4.5. Barriers to the effective delivery of interventions

Barriers to the effective delivery of interventions to reduce maternal undernutrition and low birth weight occur at multiple levels in Bihar. At the implementation level they include: the acute shortage and inefficient distribution of human resources across multiple programs and at all levels of service delivery; lack of time and support for delivering interventions that depend heavily on interpersonal communication, such as nutrition education and family planning counseling; the irregular and inadequate supply of essential services, equipment, drugs, consumables and food entitlements (e.g. IFA supplements and contraception); and large exclusions of vulnerable people from social safety net schemes due to an ineffective targeting system. At the policy level, barriers include: relatively low prioritization of maternal nutrition within the reproductive health program; and the prioritization of permanent family planning methods over temporary ones. At the societal level, barriers include poverty; low education levels and awareness; women's low social status and gender discrimination; social inequality and caste discrimination; and a strong cultural imperative to produce sons.

4.6. Promising innovations

In recent years, the Government of Bihar and its partners have introduced a number of promising innovations to improve the coverage and quality of primary health care services that could be applied to interventions aimed at improving maternal nutrition and reducing low birth weight. One of the most promising interventions is the use of household mapping and microplanning by the routine immunization program, Muskaan Ek Abhiyan, to increase the immunization coverage among pregnant women and children

less than 5 years. This has contributed to the increase in full immunization coverage among children from 21 percent in 2002-04 to 41 percent in 2007-08 (IIPS, 2008a). Another very promising innovation was the introduction of cash incentives to increase the utilization of health services that have been prioritized the NRHM, such as routine immunization, institutional deliveries, and sterilization. For example, the JBSY provides significant cash payments to consumers and ASHAs for using prescribed ANC, delivery and PNC services. Since the introduction of this scheme, the number of women delivering in health facilities increased nine-fold from 114,000 in 2006 to more than 1.1 million in 2008. A third promising innovation is the creation of an IT-based direct fund management system in two districts to eliminate the involvement of intermediary parties and increase the efficiency of fund disbursement within the ICDS program. The new system has reduced the breaks in the supply pipeline through greater speed and efficiency and eliminated an opportunity for corruption through elimination of intermediaries. A fourth significant innovation is the use of private public partnerships by the Department of Health to outsource the provision of primary health and family planning services to NGOs and the private sector in order to extend the coverage and reach.

4.7. Other potential delivery platforms

There are numerous opportunities for working with the Government of Bihar and its partners to improve the coverage and quality of interventions to reduce maternal undernutrition and low birth weight in Bihar. One of the most important is the Bihar Health Sector Reform project, also known as the “Sector Wide Approach to Strengthen Health” (SWASTH), which was launched in 2010 with support from the Department for

International Development (DFID) to improve the coverage and quality of health, nutrition, and water and sanitation services in Bihar. In addition to strengthening program management systems and empowering communities, SWASTH is talking to the Government of Bihar about establishing a Nutrition Authority, which would be headed by the Chief Minister, and developing a State Nutrition Policy to coordinate and guide the implementation of interventions by different programs and departments. Another important opportunity for improving the delivery of interventions to reduce maternal undernutrition and low birth weight is the work being done by the NRHM, Department of Social Welfare and the World Bank to strengthen and engage Panchayati Raj Institutions in the management of health and nutrition programs. Similaryly, the Mukhyamantri Nari Shakti Yojana (MNSY), the Swarnajayanti Grameen Swarozgar Yojana (SGSY) and the Bihar Rural Livelihood Program (Jeevika) all provide excellent opportunities to involve women's Self-Help Groups in service delivery and program management at the community level. An excellent opportunity for reaching out to adolescent girls is presented by the Kishoori Shakti Yojana and the Kastruba Gandhi Balika Vidyalaya, which are two large-scale programs for adolescent girls that are implemented through the ICDS.

5. Discussion

Maternal underweight and anemia are serious and growing problems in Bihar and are important factors in the persistence of high levels of child undernutrition. Numerous programs and platforms exist for delivering interventions to improve maternal nutrition in Bihar. However, the coverage and quality of these interventions is low and they are not

achieving the desired outcomes. This is a problem not with the design but the implementation of these interventions. This study aimed to assess the status of interventions to improve maternal nutrition and identify barriers to and opportunities for expanding the coverage of quality interventions to all adolescent girls and women of reproductive age in Bihar. Barriers impeding effective program delivery, which occur at implementation level include a severe shortage and inefficient distribution of human resources, an irregular and inadequate supply of equipment and supplies, low recognition that maternal undernutrition, and an ineffective targeting system that results in large exclusions of vulnerable people from social safety net schemes. Policy level barriers include low prioritization of maternal under nutrition in the RCH program and a family planning approach that prioritizes population stabilization over delaying and spacing births. Societal barriers include poverty, women's low social status, and caste-based discrimination. Innovation and opportunities for expanding the coverage and quality of existing interventions include universalizing household mapping and microplanning, the utilization of women's Self-Help Groups to plan and monitor service delivery, and developing a Nutrition Policy to guide program implementation. With the arrival to power of the current government, great strides have been made to rebuild these systems. Health facilities have been built, services have been outsourced to NGOs and private institutions, and personnel have been rapidly recruited through contractual hiring mechanisms. However, given the low baseline, much work remains to be done to improve the delivery of existing programs through innovative solutions.

5.1. Barriers

5.1.1 Implementation level

One of the biggest impediments to effective program delivery at implementation level is the acute shortage and inefficient distribution of human resources across programs and at all levels of service delivery. The primary health system has a shortage of human resources in nearly every professional category. At the aggregate level, the ICDS program faces a less severe shortage; however, at the supervisory level the shortage is much more acute. Secondary schools lack female teachers for the School Anemia Control Program, which provides counseling to adolescent girls on sensitive topics related to puberty. Although the Government of Bihar has been making a concerted effort to rapidly increase staffing levels through contractual hiring mechanisms, it faces several obstacles. First, the pool of qualified candidates is small due to the state's low education levels, the departure of qualified people to other states and countries, and pull of the private sector which offers better remuneration and opportunities for professional development. Second, it is especially difficult to find qualified female candidates, especially for the supervisory positions, not only because the percentage of women with secondary education is small, but also because prevailing social norms prohibit many women from working outside their villages. Third, people with higher education, especially doctors and specialists, typically do not want to live in rural areas. As a result, health facilities in urban areas are over-staffed while rural facilities are usually understaffed. Fourth, most of the preexisting training institutes for primary health and ICDS staff (e.g. ANM, LHVs and LSs) are defunct and it is taking time to make them operational again. The human

resource shortage makes it very difficult to provide services at high coverage levels. The lack of field supervisors makes it very difficult to provide high-quality services and the lack of female teachers presents a large obstacle to discussing puberty-related topics with adolescent girls.

A second barrier to program and service delivery is the irregular and inadequate supply of essential services, equipment, drugs, consumables and food entitlements (e.g. IFA supplements and contraception). Health facilities and AWCs frequently lack such essential equipment as scales and hemoglobin meters and community health workers often do not have a sufficient supply of supplements and contraceptives. For example, AHSAs had yet to receive drug kits containing a two-month stock of basic medicines at the time of fieldwork. Shortages are largely due to a lengthy supply-driven procurement process, limited capacity for estimating demand and making the necessary indents, and distribution bottlenecks that result in a pile up of supplies at district and block levels. In addition, AWCs frequently lack sufficient food supplies to provide daily hot meals and distribute take home rations because fund disbursement to AWWs for purchasing food is often delayed. When this happens, attendance declines at AWCs. Furthermore, Fair Price Shops, which sell subsidized food grains to BPL households, often do not have enough food in stock to meet demand. As a result, BPL cardholders are denied the full entitlement. The shortage of food stocks is due largely to insufficient allocations of food grains from the Central Government, the diversion of food grains for personal profit, a lack of warehouses, and the sale of food to pay the cost of its transport from district warehouses to Fair Price Shops. Poor households and those with low social status, such

as Scheduled Caste households, are the most likely to be denied their entitlements when supply falls short of demand. In order to eliminate corruption in PDS, the Chief Minister has proposed replacing the existing system with direct cash transfers made to the poor through the banking system (IHD, 2010).

A third barrier is the low recognition that maternal undernutrition is a serious problem in Bihar. At the state level, program managers appear to recognize the severity of maternal undernutrition in Bihar. However, based on field visits to Nalanda and West Champaran districts, the majority of district health officials and Medical Officers reported that seasonal illnesses (cough and cold) are the major health priorities and that undernutrition is not common in their area. Community health workers also reported that maternal undernutrition, including anemia, are not major problems, in part, because they provide IFA supplements. This may be a perception problem in so far as people do not notice undernutrition unless it is severe.

A fourth barrier is an ineffective targeting system that results in large exclusions of vulnerable people from social safety net schemes. Many social safety net schemes, such as the TPDS, are targeted to poor households. This requires setting a poverty line and conducting an assessment of households that fall below it. Every few years, a survey is conducted by the Rural and Urban Development Departments to identify BPL households. Based on this survey, a list of BPL households is compiled in each village and sent to the District Magistrate who is responsible for issuing ration cards. In Bihar, there is a lot of social competition to get on the BPL list. As a result, considerations of

affinity, caste, influence, and power determine who gets added to the BPL list. Those who control the list take advantage of their power to extract money from households to add them to the BPL list, irrespective of their actual need. Exacerbating the problem is the fact that the Central Government allocates food commodities based on its own estimate of 6.5 million BPL households which is nearly half the Government of Bihar's estimate of 12.3 million BPL households.

5.1.2 Policy level

At policy level, an important barrier to the delivery of services for improving maternal nutrition is the fact that, apart from anemia, maternal nutrition is not highly prioritized within the NHRM's RCH program, even though it is recognized as a determinant of maternal and child health (GoB, 2009). The goal of the NRHM PIP (2010-11) is to reduce maternal, neonatal and infant mortality largely by increasing access to antenatal care, institutional deliveries, and full immunization. The RCH program, which has primary responsibility for maternal and child health, has four objectives that relate to maternal nutrition: 1) reduce anemia among pregnant and lactating women from 60 percent in 2008 to 40 percent by 2011; 2) increase IFA supplementation for 90 days from 10 percent in 2008 to 35 percent by 2011; 3) reduce low birth weight by providing nutritional support to pregnant mothers, and; 4) reduce teenage pregnancy. Strategies for reducing anemia include IFA supplementation, biannual deworming of all adolescent girls, an IEC campaign to promote the consumption of locally available iron rich foods, and the early diagnosis and prompt treatment of anemia by community health workers. Apart from IFA supplementation, targets have not been set for any of these interventions. Similarly, targets have not been set for reducing low birth weight and teenage

pregnancies. Furthermore, it is not clear whether providing nutritional support represents a new intervention or merely the existing nutritional supplementation provided through the ICDS program.

A second barrier at policy level is the prioritization of permanent contraceptive methods, mainly female sterilization, in family planning services. In Bihar, as in the rest of the country, population stabilization is the primary goal of family planning whereas improved maternal and child health is secondary. In order to encourage smaller families, the government provides cash incentives of Rs 10,000 to women under 30 years of age who undergo a tubal ligation after their second child. Additionally, it offers cash incentives to community health workers for bringing women to family planning clinics for tubal ligations and to service providers for performing these procedures. In contrast, there has been very little programming around the use of temporary contraception to delay and space births. As a result, the vast majority of couples are choosing female sterilization as their method of contraception (IIPS, 2008a). A family planning policy that prioritizes permanent methods can have a positive effect on maternal nutrition by limiting the total number of pregnancies a woman has during her lifetime. However, it does nothing to ensure safe intervals between pregnancies. Nor does it help young couples to delay the birth of their first child until the mother is older and better equipped physiologically to deliver a healthy baby.

5.1.3 Societal level

Poverty presents a major barrier to accessing essential services and entitlements and to adopting healthy behaviors. Poor households often do not have enough cash on hand to

purchase their full allotment of food from Fair Price Shops and women from poor households share with family members the nutritional supplements they receive during pregnancy and lactation from the ICDS program. As a result, these women are not receiving the intended nutritional benefit. Lack of cash may also prevent people from seeking health services, especially when health facilities are far away. Furthermore, poverty compels a substantial percentage of the male population to migrate to other states and countries in search of work. Without the protection of their husbands, women and children are less likely to receive adequate nutrition and health care (Rogaly & Rafique, 2003). In addition to access to services, poverty presents a major barrier to adopting healthy behaviors. For example, women receive information from community health workers on the importance of eating animal products, pulses, and green leafy vegetables during pregnancy to prevent anemia. However, few women are able to operationalize this information because they do not sufficient access to nutritious foods. Although many rural households produce nutritious foods like milk, eggs, fruits and vegetables, these foods are often sold in the market for badly needed cash. Due to population density and highly inequitable land distribution, many rural households do not own enough land to grow high quality foods for the market and still enough left for their own consumption.

Women's low social status is another major barrier because gender discrimination limits females' access to the resources required to sustain good health and nutrition, including health services, and limits their active participation in public life. Gender discrimination, which begins at birth, limits females' access to basic necessities such as food and education. In accordance with custom, adolescent girls and women serve food to the men

and children of the household, only eating after everyone else has had their fill of the best foods. When food is scarce, the burden is most heavily felt by adolescent girls and women, even when they are pregnant and nursing. By the time most girls reach puberty, they have dropped out of school. As the default family care givers, they are removed from school to care for younger siblings. As a result, low education levels prevent women from adopting behaviors and utilizing services that promote health and prevent disease. Prevailing social norms also restrict female mobility, making it difficult for adolescent girls and women to access resources located beyond the village, such as secondary schools and health facilities. Few women have the power to make decisions without their husband's approval, even when these decisions relate directly to their own health and their children's health. Historically, women have had limited participation in public life. Although 58 percent of all seats on village panchayats are now filled by women as a result of the Panchayati Raj Act, many of these women serve as proxies for their husbands and do not make independent decisions.

Social inequalities based on caste are pronounced in Bihar and caste-based discrimination plays a major role in limiting access to government services and other resources. Caste-based discrimination persists in spite of good faith efforts on the part of the government to prohibit discrimination and improve the socio-economic standing of Scheduled Castes (SC), Scheduled Tribes (ST) and Other Backward Castes (OBC) communities through various schemes and reservations in higher education and government jobs. However, many people do not like to acknowledge this fact. When asked about the role of caste-based discrimination in limiting access to health and nutrition services, many key

informants denied that caste-based discrimination exists in the delivery of any government service because government policy forbids it. However, not all key informants agreed with this view. A couple of key informants argued that caste-based discrimination continues to be a major impediment to the delivery of services to members of Scheduled Castes. One key informant used the ICDS program as an example. Although access to ICDS services should be universal, in practice, Scheduled Caste women and children are often excluded from these services. For example, AWWs belonging to the General Caste may avoid making visits to the homes of Scheduled Caste women to provide nutrition education and family planning counseling. When meals are served at the AWC, Scheduled Caste children may be segregated from other children and given less food. Scheduled Caste women may refrain from participating in Mahila Mandals. Indeed, it was due to caste-based discrimination in the ICDS program that led the Mahadalit Commission to mandate the establishment of mini-AWCs in all mahadalit hamlets, which are village satellites. The exact nature of caste-based discrimination depends heavily on the context of service delivery. For example, the social composition of a village and its political dynamics are very important factors for programs that are delivered at community level, but perhaps less important for services delivered through health care facilities.

5.2. Innovations

Muskaan ek Abhiyaan, was launched in October 2008 to increase the coverage of routine immunization by organizing two immunization days per week in every HSC and AWC. In order to reach every child with the full immunization, Muskaan introduced household

mapping and microplanning so that community health workers could identify to identify and track all pregnant women and newborn children living in the village until full immunization is achieved. In some areas of Nalanda and West Champaran Districts, AWWs, ASHAs and ANMs are using these maps to provide IFA supplementation to all pregnant women and adolescent girls. In West Champaran, where immunization coverage is the best, they are intentionally using this technique to improve outreach to SC/ST households. The NRHM PIP (2010-11) will use household mapping and microplanning to identify vulnerable groups, left out areas and communities having high percentages of BPL under each block and incorporating the same into the block micro plans to focus attention on them for providing Community and Home based ANC to them.

Another important innovation is the use of cash incentives to increase the utilization of health services that have been prioritized by the NRHM. Some programs give cash incentives to service providers for meeting performance targets. For example, Muskaan Ek Abhiyan provides cash incentives to community health workers when they achieve their immunization targets. Other programs give cash incentives to providers and users of specified services. For example, the JBSY gives ASHAs Rs 600 for each woman they bring to a health facility for delivery and Rs 200 for each postnatal visit they make to the homes of mothers and their newborns. It also pays Rs 1,400 to women when they deliver their child in a health facility. As a result of these incentives, the JBSY has substantially increased utilization of ANC and PNC services and institutional deliveries (GoB, 2009). In addition to increasing the delivery of essential health services, the government is using financial incentives to delay the age of marriage until 18 and to keep adolescent girls in

school. For example, the Mukhya Mantri Kanya Vivah Yojana pays Rs 5,000 to women from BPL families who wait until at least 18 years of age to marry. The Mukhyamantri Kanya Suraksha Yojana places Rs 2,000 in a bank account for the first two female children born to BPL families. Girls may access this money when they turn 18, but only if they are not already married. The Government of Bihar also provides bicycles, uniforms and books to adolescent girls enrolled in secondary schools. Since the introduction of this scheme, school enrolments have soared and adolescent girls riding their bicycles to school have become a common sight on rural roads. These schemes are possible some of the most effective instruments for changing deeply entrenched social practices that have important cultural and economic dimensions, such as early marriage.

A third promising innovation is the use of information technology to streamline the disbursement of funds to individual AWWs workers for purchasing supplies and food for the Supplementary Nutrition Program. Since July 30, 2010, the Department of Social Welfare and UNICEF have been piloting an IT-based direct fund management system in two districts to eliminate the involvement of intermediary parties in fund disbursement. Under this new system, the District Project Officer will wire Rs 5,000 into individual bank accounts held by AWWs to cover food purchases. AWWs will transmit records of all food and fuel purchases to the District Project Officer via mobile phone. Once this money has been fully accounted for, the District Project Officer will release the next installment of Rs 5,000. Not only will this system reduce opportunities for corruption, but also this will ensures that AWWs will receive funds to purchase food in a more timely fashion. In the past, irregular and untimely receipt of funds from the CDPO resulted in

temporary suspensions of the cooked meals and supplementary food ration through the AWCs. This had the knock on effect of reducing utilization of other services provided by the AWC because the cooked meal provides a major incentive for people to attend the AWC (GoB, 2007).

A fourth significant innovation is the use of private public partnerships to increase the availability and quality of health and family planning services. Under the Public-Private Partnership (PPP) component of the NRHM, the government provides financial support to NGOs and private sector health facilities to provide free-of-cost health and family planning services. Such partnerships are particularly important in the realm of family planning because NGOs are usually in a better position than the government to develop new approaches and mobilize people and organizations at the grass roots level. For example, Janani is a national NGO with a network of franchised clinics (Surya Clinics) throughout the state that provide a full range of clinical services, including abortion, tubal ligations and Copper-T insertions. Janani is partnering with the NRHM to train and accredit healthcare facilities in remote areas to deliver clinical family planning services. It is also using social marketing techniques to increase the demand for and supply of affordable contraceptive products through commercial outlets. Janani is using incentives to increase the utilization of services provided by Surya Clinics. For example, Surya Health Promoters (SHPs), ASHAs and AWWs receive Rs 400 when they bring women to Surya Clinics for Copper-T insertions and tubal ligations. It is also providing incentives to private medical providers (PMPs) to perform Copper-T insertions. In providing incentives for Copper-T insertions, Janani is providing a counterbalance to the incentives

provide by the government to providers as well as women for tubal ligations. In August 2010, Janani launched a campaign that employs a combination of mass media and interpersonal communication to promote spacing and limiting. Janani has adopted a new approach to generating demand for temporary contraceptive methods. Instead of promoting the benefits of small family size, Janani is emphasizing the increased pleasure to be gained from having sex without the worry of pregnancy.

5.3. Other potential delivery platforms

Due to the favorable climate created by the current government, there are many opportunities for working with the Government of Bihar and its partners to improve the coverage and quality of interventions to reduce maternal undernutrition and low birth weight in Bihar. The Bihar Health Sector Reform project, also known as the Sector Wide Approach to Strengthen Health (SWASTH), is one of the most important opportunities. SWASTH is a 6-year multi-sectoral initiative funded by DFID that was launched in 2010 to increase utilization of quality health services for the poor and socially excluded with a focus on children and women of reproductive age. It aims to achieve this by increasing the scale and functioning of health, nutrition, water and sanitation services; supporting community initiatives to monitor services; strengthening program management systems; and building public private partnerships (GoB, 2009). The program will be implemented through the Departments of Health and Family Welfare, Social Welfare and Public Health Engineering with technical assistance provided by the Bihar Technical Assistance Support Team. In order to improve nutritional status, the program will strengthen the ICDS to make it more effective (e.g. provide hot snacks to pregnant & nursing women so

they are sure to consume); utilize women's Self-Help Groups to provide practical advice on health and nutrition, promote healthy behavior change, and provide nutritional supplements; integrate new types of nutritional supplementation (e.g. RUTF, sprinkles, and wheat fortified with NeFeDFA) into existing programs; and promote family planning to delay first birth and space births. In addition, SWASTH has initiated dialogue with Government of Bihar on setting up a Nutrition Authority headed by the Chief Minister and developing a State Nutrition Policy to coordinate and guide the implementation of interventions by different programs and departments.

A second important opportunity for improving the delivery of interventions to reduce maternal undernutrition and low birth weight is the work being done by the NRHM and the World Bank to strengthen and engage Panchayati Raj Institutions in the management of health and nutrition programs. The NRHM is establishing VHSCs within PRIs to plan and monitor the delivery of health, nutrition and water and sanitation services provides. For example, the Social Welfare Department has been actively involving PRI in the monitoring and establishment of AWCs (CARE, 2009). The NRHM is providing untied funds to VHSCs to undertake their own initiatives. However, this process has only recently begun in earnest and guidelines for and training of VHSCs is required so that they are able to execute their responsibilities and powers. The World Bank is working in Bihar to strengthen the PRI system so that they can better support program delivery through greater involvement in community outreach, planning, and monitoring. These efforts will contribute to women's empowerment since at least 50 percent of PRI seats must be held by women as mandated by the Panchayati Raj Act of 2006.

The Mukhyamantri Nari Shakti Yojana (MNSY), the Swarnajayanti Grameen Swarozgar Yojana (SGSY) and the Bihar Rural Livelihood Program (Jeevika) are three statewide programs that aim to help people out of poverty by organizing them into Self-Help Groups and providing access to microcredit and livelihood training. For example, JEEViKA introduced the System of Wheat Intensification or SWI in Bihar's drought-prone Gaya district in 2007 and 25,000 wheat farmers are piloting the scheme throughout the state. The system, based on low-tech methods, may be more labor-intensive than traditional techniques, but it requires less seeds, water, pesticide and fertilizer. In addition to empowering women, SHGs provide a powerful platform for providing practical advice on health and nutrition, promoting healthy behavior change, facilitating the provision of services (e.g. IFA supplementation), and monitoring the delivery of health and nutrition services within their communities to hold service providers accountable. In response to a poorly run PDS, SHGs formed through the Jeevika project in Purnia and Sheikwara districts obtained licenses to run the Fair Price Shops in their villages and show how a well-managed PDS can improve access to food and health outcomes.

The Kishoori Shakti Yojana and the Kastruba Gandhi Balika Vidyalaya are two large-scale programs for adolescent girls that are implemented through the ICDS. These programs provide potentially excellent opportunities to reach out-of-school adolescent girls with important information and services related not only to nutrition but also reproductive and sexual health, including the importance of delaying marriage and preventing teenage pregnancy. The Kishoori Shakti Yojana is an intervention for

adolescent girls (11-18 years) that is implemented through the ICDS program to break the intergenerational life-cycle of nutritional and gender disadvantage and provide a supportive environment for self-development. The Kastruba Gandhi Balika Vidyalaya provides bridge school courses to out-of-school adolescent girls that address lie skills education and hygiene. CARE provides support to strengthen the bridge course for the girls who are 6^{th}, 7^{th} and 8^{th} class in Madhubani.

5.4. Strengths and limitations

One of the main strengths of this study is that it combines interviews with key informants with field visits to health facilities, AWCs and schools. This is important because it allowed for examination of the gap between what is supposed to happen and what is actually happening at the point of program delivery. Another important strength of this study is its breadth; it examines barriers at multiple ecological levels (implementation, policy and society) across different interventions and delivery platforms. One of the main limitations of this study is that site visits took place in two of the better performing districts. Another important limitation of the study is that interviews were not conducted with people at the community level to identify and understand the types of barriers they encounter to accessing government services and entitlements.

6. Conclusions and Recommendations

Many years of poor governance under previous governments led to the near destruction of the public health system and the Integrated Child Development Services – two key platforms for delivering health and nutrition services at community level. With the arrival

to power of the current government, great strides have been made to rebuild these systems. Health facilities have been built, services have been outsourced to NGOs and private institutions, and personnel have been rapidly recruited through contractual hiring mechanisms. This has fueled an increase in the utilization of health services. Inpatient visits jumped 75 percent from 798,000 in 2007 to 1.4 million in 2008, while outpatient visits increased 532 percent from 10.5 million to 16 million over the same period. However, given the low baseline, much work remains to be done to improve the delivery of existing programs by finding innovative ways to overcome barriers at all levels by addressing the immediate, underlying and basic causes of maternal undernutrition.

Recommendation 1: Elevate priority given to maternal nutrition. The Government of Bihar should prioritize maternal undernutrition and low birth weight within NRHM Program Implementation Plans and the Health Sector Reform Plan. First, it should set clear targets for achieving reductions in maternal underweight, low birth weight and teenage pregnancies. Second, it should specify the interventions, such as nutritional supplementation, for achieving these health outcomes and describe their delivery mechanisms. Third, it should set clear performance targets for each of these interventions. Fourth, it should establish a system to monitor performance and provide feedback to service providers and community health workers.

Recommendation 2: Strengthen efforts to reach adolescent girls and women of reproductive age who are neither pregnant nor lactating. Supplementation during pregnancy may be too late for desirable birth outcomes. A large number of women are

already moderately or severely anemic when they become pregnant. Therefore, iron and folic acid supplementation should be started prior to pregnancy or even earlier. Reach adolescent girls, especially out of school and newly married women

Recommendation 3: Balance the cash incentives structure. Cash incentives are powerful motivators of human behavior, and, therefore, pose the danger of skewing the priorities or time allocation of community health workers, especially ASHAs who do not receive a salary or fixed daily wage and depend on cash incentives for their livelihood (Gill, 2009).

Recommendation 4: Strengthen the supervision of community health workers at the field level. Recruit people to fill all positions for field supervisor within the primary health system (i.e. Lady Health Visitor and Male Health Assistant) and the ICDS (i.e. Lady Supervisor). Cultivate a culture of supportive supervision and put in place a system for supervising community health workers that is characterized by constructive problem-solving and bi-directional flow of information. Adapt curricula used by training institutes to focus on building supportive supervisory skills.

Recommendation 5: Scale-up system for tracking target beneficiaries to ensure full coverage. Utilize household mapping and microplanning methods developed by Muskaan ek Abhiyan to ensure full coverage of interventions to improve maternal nutrition and reduce low birth weight. Ensure that every AWC makes and regularly updates village maps of household and registers to track the delivery of essential nutrition

interventions to adolescent girls (especially out-of-school girls) and women of reproductive age, including those who are neither pregnant nor lactating.

Recommendation 6: Empower women and girls. Targeted investments in the education, reproductive health, and economic and political rights of women can bring about progress in poverty reduction, sustainable development and peace. Therefore, efforts should be maintained to enroll and retain adolescent girls in school through incentive schemes and bridge schools like the Kastruba Gandhi Balika Vidyalaya. Women's forums, especially Self-Help Groups, should be utilized and strengthened as platforms for providing information about health and nutrition and equipping women with the confidence, skills, and resources required to act on this information, such as growing and selling nutritious foods for household consumption and income.

Recommendation 7: Empower community-based organizations to plan and monitor service delivery and introduce their own initiatives. In order to improve the coverage and quality of programs, it will be necessary to increase the accountability of program and service providers to the communities they serve. In order to increase accountability, it will be necessary to build the capacity of key community institutions, such as Panchayati Raj Institutions, to plan and monitor programs and service delivery. In particular, it will be necessary to provide training to Village Health and Sanitation Committees within village panchayats on their roles and responsibilities, including use of untied funds. It will also be important to engage and enhance the capacity of women's

Self-Help Groups to track the delivery of essential health and nutrition services to all adolescent girls, women and children in their communities.

Recommendation 8: Strengthen programming for behavior change interventions. Recruit and train supervisors and fill vacancies at community level. Put in place system of supportive supervision for community health workers and shift focus from service delivery to behavior.

7. References

Abbott, S., Barney, J., & Bassett, L. (2005). Dular Project Bihar, India: Final Evaluation Report. Boston: Tufts University.

ACC/SCN. (2000). Low Birthweight: Report of a Meeting in Dhaka, Bangladesh on 14−17 June 1999. In J. Pojda & L. Kelley (Eds.), *Nutrition policy discussion paper No. 18*. Geneva: ACC/SCN in collaboration with ICDDR,B.

Ahmed, F., Khan, M. R., Akhtaruzzaman, M., Karim, R., Williams, G., Torlesse, H., . . . Nahar, B. (2010). Long-term intermittent multiple micronutrient supplementation enhances hemoglobin and micronutrient status more than iron + folic acid supplementation in Bangladeshi rural adolescent girls with nutritional anemia. *Journal of Nutrition, 140*(10), 1879-1886. doi: 10.3945/jn.109.119123

Allen, L. H. (2005). Multiple micronutrients in pregnancy and lactation: an overview. *American Journal of Clinical Nutrition, 81*(5), 1206S-1212S.

Ashworth, A. (1998). Effects of intrauterine growth retardation on mortality and morbidity in infants and young children. *European Journal of Clinical Nutrition, 52 Suppl 1*, S34-41; discussion S41-32.

Barker, D. J. (2006). Adult consequences of fetal growth restriction. *Clinical Obstetrics and Gynecology, 49*(2), 270-283.

Bhutta, Z. A., Ahmed, T., Black, R. E., Cousens, S., Dewey, K., Giugliani, E., . . . Shekar, M. (2008). What works? Interventions for maternal and child undernutrition and survival. *Lancet, 371*(9610), 417-440. doi: 10.1016/s0140-6736(07)61693-6

Bhutta, Z. A., Chopra, M., Axelson, H., Berman, P., Boerma, T., Bryce, J., . . . Wardlaw, T. (2010). Countdown to 2015 decade report (2000-10): taking stock of maternal, newborn, and child survival. *Lancet, 375*(9730), 2032-2044. doi: 10.1016/s0140-6736(10)60678-2

Bhutta, Z. A., & Haider, B. A. (2009). Prenatal micronutrient supplementation: are we there yet? *CMAJ, 180*(12), 1188-1189. doi: 10.1503/cmaj.090652

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., de Onis, M., Ezzati, M., . . . Rivera, J. (2008). Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet, 371*(9608), 243-260. doi: 10.1016/s0140-6736(07)61690-0

Bryce, J., Coitinho, D., Darnton-Hill, I., Pelletier, D., & Pinstrup-Andersen, P. (2008). Maternal and child undernutrition: effective action at national level. *Lancet, 371*(9611), 510-526. doi: 10.1016/s0140-6736(07)61694-8

CARE. (2009). Diagnostic Report: Design and Implementaiton of Bihar Health Sector Reform Strategy - Management and Technical Support: CARE, Infrastructure Professionals Enterprise (P) Ltd, and Options Consultancy Services Ltd., UK.

Casanueva, E., Rosello-Soberon, M. E., De-Regil, L. M., Arguelles Mdel, C., & Cespedes, M. I. (2006). Adolescents with adequate birth weight newborns diminish energy expenditure and cease growth. *Journal of Nutrition, 136*(10), 2498-2501.

Ceesay, S. M., Prentice, A. M., Cole, T. J., Foord, F., Weaver, L. T., Poskitt, E. M., & Whitehead, R. G. (1997). Effects on birth weight and perinatal mortality of

maternal dietary supplements in rural Gambia: 5 year randomised controlled trial. *BMJ, 315*(7111), 786-790.

Cetin, I., Berti, C., & Calabrese, S. (2010). Role of micronutrients in the periconceptional period. *Human Reproduction Update, 16*(1), 80-95. doi: 10.1093/humupd/dmp025

Christian, P. (2010). Micronutrients, birth weight, and survival. *Annual Review of Nutrition, 30*, 83-104. doi: 10.1146/annurev.nutr.012809.104813

Christian, P., Khatry, S. K., & West, K. P., Jr. (2004). Antenatal anthelmintic treatment, birthweight, and infant survival in rural Nepal. *Lancet, 364*(9438), 981-983. doi: 10.1016/s0140-6736(04)17023-2

Conde-Agudelo, A., Rosas-Bermudez, A., & Kafury-Goeta, A. C. (2007). Effects of birth spacing on maternal health: a systematic review. *American Journal of Obstetrics and Gynecology, 196*(4), 297-308. doi: 10.1016/j.ajog.2006.05.055

Fall, C. (2009). Maternal nutrition: effects on health in the next generation. *Indian Journal of Medical Research, 130*(5), 593-599.

Fall, C. H., Fisher, D. J., Osmond, C., & Margetts, B. M. (2009). Multiple micronutrient supplementation during pregnancy in low-income countries: a meta-analysis of effects on birth size and length of gestation. *Food Nutr Bull, 30*(4 Suppl), S533-546.

Fishman, S. M., Caulfield, L. E., de Onis, M., Blössner, M., Hyder, A. A., Mullany, L., & Black, R. E. (2004). Childhood and Maternal Underweight. In M. Ezzati (Ed.), *Comparative Quantification of Health Risks: Global and regional burden of disease attributable to selected major risk factors* (pp. 39-135). Geneva: World Health Organization.

Fishman, S. M., Christian, P., & West, K. P. (2000). The role of vitamins in the prevention and control of anaemia. *Public Health Nutr, 3*(2), 125-150.

Gill, K. (2009). A Primary Evaluation of Service Delivery under the National Rural Health Mission (NRHM): Findings from a Study in Andhra Pradesh, Uttar Pradesh, Bihar and Rajasthan *Working Paper 1/2009 - PEO*. New Delhi: Planning Commission of India.

Gillespie, S., & Mason, J. (1991). Controlling Iron Deficiency − Nutrition policy discussion paper No. 9. Geneva: United Nations Administrative Committee on Coordination/Sub-Committee on Nutrition.

GoB. (2001). Census Statistics: Distribution of Population and Growth Rate Retrieved April 21, 2011, from http://gov.bih.nic.in/Profile/CensusStats-01.htm

GoB. (2007). Rapid assessment of ICDS Project in Bihar: Executive Sumary Report. Patna: Directorate of the Department of Social Welfare, GoB and UNICEF Bihar

GoB. (2009). National Rural Health Mission Programme Implementation Plan 2010-2011. Patna: State Health Society, Department of Health, Government of Bihar.

GoB. (2010). Economic Survey 2009-2010. Patna, Bihar: Government of Bihar Finance Department.

GoB. (2011). Economic Survey 2010-2011. Patna, Bihar: Finance Department, Government of Bihar

Godfrey, K. M., & Barker, D. J. (1995). Maternal nutrition in relation to fetal and placental growth. *European Journal of Obstetrics, Gynecology, and Reproductive Biology, 61*(1), 15-22.

GoI. (2009). Report of the expert group to review the methodology for estimation of poverty. New Delhi: The Planning Commission, Government of India.

Haider, B. A., & Bhutta, Z. A. (2006). Multiple-micronutrient supplementation for women during pregnancy. *Cochrane Database Syst Rev*(4), CD004905. doi: 10.1002/14651858.CD004905.pub2

Heikens, G. T., Amadi, B. C., Manary, M., Rollins, N., & Tomkins, A. (2008). Nutrition interventions need improved operational capacity. *Lancet, 371*(9608), 181-182. doi: 10.1016/s0140-6736(07)61691-2

Horton, R. (2008). Maternal and child undernutrition: an urgent opportunity. *Lancet, 371*(9608), 179. doi: 10.1016/s0140-6736(07)61869-8

Horton, S., Alderman, H., & Rivera, J. (2008). Copenhagen Consensus 2008: Malnutrition and hunger - executive summary: Copenhagen Consensus Center.

Horton, S., Shekar, M., McDonald, C., Mahal, A., & Brooks, J. K. (2009). Scaling Up Nutrition: What Will It Cost? *Direction in Development*. Washington, D.C.: World Bank.

Huybregts, L., Roberfroid, D., Lanou, H., Menten, J., Meda, N., Van Camp, J., & Kolsteren, P. (2009). Prenatal food supplementation fortified with multiple micronutrients increases birth length: a randomized controlled trial in rural Burkina Faso. *American Journal of Clinical Nutrition, 90*(6), 1593-1600. doi: 10.3945/ajcn.2009.28253

IHD. (2010). Poverty in Bihar: pattern, dimensions and eradication strategies New Delhi: Institute for Human Development, Asian Development Research Institute and UNDP.

IIPS. (1995). National Family Health Survey (MCH and Family Planning): Bihar. (pp. 340). Bombay: International Institute for Population Sciences and Population Research Centre, Patna University.

IIPS. (2001). National Family Health Survey (NFHS-2) India, 1998-99: Bihar. (pp. 352). Mumbai: International Institute for Population Sciences and Calverton, MD: MEASURE DHS+, ORC Macro.

IIPS. (2007). National Family Health Survey (NFHS-3), 2005–06: India: Volume I. (Vol. , pp. 590). Mumbai: International Institute for Population Sciences (IIPS) and Macro International.

IIPS. (2008a). District Level Household and Facility Survey III (2007-2008): Bihar fact sheet Mumbai: International Institute for Population Sciences.

IIPS. (2008b). National Family Health Survey (NFHS-3), India, 2005-06: Bihar. Mumbai: International Institute for Population Sciences (IIPS) and Macro International.

IIPS. (2010). District Level Household and Facility Survey 2007-08. Mumbai: International Institute for Population Sciences and Ministry of Health and Family Welfare, Government of India.

Kramer, M. S. (1987). Determinants of low birth weight: methodological assessment and meta-analysis. *Bulletin of the World Health Organization, 65*(5), 663-737.

Kramer, M. S. (2003). The epidemiology of adverse pregnancy outcomes: an overview. *Journal of Nutrition, 133*(5 Suppl 2), 1592S-1596S.

Kramer, M. S., & Kakuma, R. (2003). Energy and protein intake in pregnancy. *Cochrane Database Syst Rev*(4), CD000032. doi: 10.1002/14651858.cd000032

Leroy, J. L., Habicht, J. P., Pelto, G., & Bertozzi, S. M. (2007). Current priorities in health research funding and lack of impact on the number of child deaths per year. *American Journal of Public Health, 97*(2), 219-223. doi: 10.2105/ajph.2005.083287

Li, H., Stein, A. D., Barnhart, H. X., Ramakrishnan, U., & Martorell, R. (2003). Associations between prenatal and postnatal growth and adult body size and composition. *American Journal of Clinical Nutrition, 77*(6), 1498-1505.

Martorell, R., & Mason, J. (2009). Improving maternal, neonatal and child health outcomes through better designed nutrition policies and programs Ethiopia, India, and Nigeria: Bill and Melinda Gates Foundation.

Martorell, R., Ramakrishnan, U., Schroeder, D. G., Melgar, P., & Neufeld, L. (1998). Intrauterine growth retardation, body size, body composition and physical performance in adolescence. *European Journal of Clinical Nutrition, 52 Suppl 1*, S43-52; discussion S52-43.

Mason, J., Bailes, A., Beda-Andourou, M., Copeland, N., Curtis, T., Deitchler, M., . . . Vance, G. (2005). Recent trends in malnutrition in developing regions: vitamin A deficiency, anemia, iodine deficiency, and child underweight. *Food Nutr Bull, 26*(1), 59-108.

Mason, J. B., Deitchler, M., Gilman, A., Gillenwater, K., Shuaib, M., Hotchkiss, D., . . . Sethuraman, K. (2002). Iodine fortification is related to increased weight-for-age and birthweight in children in Asia. *Food Nutr Bull, 23*(3), 292-308.

McIntire, D. D., Bloom, S. L., Casey, B. M., & Leveno, K. J. (1999). Birth weight in relation to morbidity and mortality among newborn infants. *New England Journal of Medicine, 340*(16), 1234-1238. doi: 10.1056/nejm199904223401603

McLean, E., Cogswell, M., Egli, I., Wojdyla, D., & de Benoist, B. (2009). Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System, 1993-2005. *Public Health Nutr, 12*(4), 444-454. doi: 10.1017/s1368980008002401

Menon, P., Deolalikar, A., & Bhaskar, A. (2009). India State Hunger Index 2008: Comparisons of Hunger Across States. Washington, D.C., Bonn, and Riverside: IFPRI, Welthungerhilfe and University of California Davis.

Moore, S. E., Jalil, F., Ashraf, R., Szu, S. C., Prentice, A. M., & Hanson, L. A. (2004). Birth weight predicts response to vaccination in adults born in an urban slum in Lahore, Pakistan. *American Journal of Clinical Nutrition, 80*(2), 453-459.

Morris, S. S., Cogill, B., & Uauy, R. (2008). Effective international action against undernutrition: why has it proven so difficult and what can be done to accelerate progress? *Lancet, 371*(9612), 608-621. doi: 10.1016/s0140-6736(07)61695-x

Nishida C, Shrimpton R, & I., D.-H. (2009). Landscape Analysis on countries' readiness to accelerate action in nutrition. *SCN News, 37*, 4-9.

NSSO. (2006). NSS 61st Round: Employment and Unemployment Situation Among Social Groups in India 2004-05. Report No. 516(61/10/2). New Delhi: National Sample Survey Organisation and Ministry of Statistics & Programme Implementation, Government of India.

Rah, J. H., Christian, P., Shamim, A. A., Arju, U. T., Labrique, A. B., & Rashid, M. (2008). Pregnancy and lactation hinder growth and nutritional status of adolescent girls in rural Bangladesh. *Journal of Nutrition, 138*(8), 1505-1511.

Ramakrishnan, U. e. (2001). *Nutritional Anemias*. Boca Raton, FL: CRC Press.

Rasmussen, K. M., & Stoltzfus, R. J. (2003). New evidence that iron supplementation during pregnancy improves birth weight: new scientific questions. *American Journal of Clinical Nutrition, 78*(4), 673-674.

Rich-Edwards, J. W., Stampfer, M. J., Manson, J. E., Rosner, B., Hankinson, S. E., Colditz, G. A., . . . Hennekens, C. H. (1997). Birth weight and risk of cardiovascular disease in a cohort of women followed up since 1976. *BMJ, 315*(7105), 396-400.

Rogaly, B., & Rafique, A. (2003). Struggling to Save Cash: Seasonal Migration and Vulnerability in West Bengal, India. *Development and Change, 34*(4), 659-681.

Saiyed, F., Ayoya, M., & Aguayo, V. (2009). *School-based weekly iron and folic acid supplementation reduce anemia in adolescent girls in Bihar, India... but much remains to be done*. Poster presentation at the Micronutrient Forum, 12–15 May 2009 in Beijing, China. UNICEF, Patna - Bihar, India. Patna. Retrieved from http://www.micronutrientforum.org/meeting2009/PDFs/MN%20Forum_2009_Abstracts_Book.pdf

Sanghvi, T. G., Harvey, P. W., & Wainwright, E. (2010). Maternal iron-folic acid supplementation programs: evidence of impact and implementation. *Food Nutr Bull, 31*(2 Suppl), S100-107.

Scholl, T. O., Hediger, M. L., Schall, J. I., Khoo, C. S., & Fischer, R. L. (1994). Maternal growth during pregnancy and the competition for nutrients. *American Journal of Clinical Nutrition, 60*(2), 183-188.

Shah, P. S., & Ohlsson, A. (2009). Effects of prenatal multimicronutrient supplementation on pregnancy outcomes: a meta-analysis. *CMAJ, 180*(12), E99-108. doi: 10.1503/cmaj.081777

Shekar, M. (2008). Delivery sciences in nutrition. *Lancet, 371*(9626), 1751. doi: 10.1016/s0140-6736(08)60757-6

Shrimpton, R. (2010). *Maternal Nutrition: Strengthening Policy and Programme Recommendations. Unpublished Paper.*

Shrimpton, R., Huffman, S. L., Zehner, E. R., Darnton-Hill, I., & Dalmiya, N. (2009). Multiple micronutrient supplementation during pregnancy in developing-country settings: policy and program implications of the results of a meta-analysis. *Food Nutr Bull, 30*(4 Suppl), S556-573.

Shrimpton, R., Prudhon, C., & Engesveen, K. (2009). The Impact of High Food Prices on Maternal and Child Nutrition. *SCN News, 37*, 60-68.

Shrimpton, R., Thorne-Lyman, A., Tripp, K., & Tomkins, A. (2009). Trends in low birthweight among the Bhutanese refugee population in Nepal. *Food Nutr Bull, 30*(2 Suppl), S197-206.

Stoltzfus, R., & Dreyfuss, M. (1998). Guidelines for the use of iron supplements to prevent and treat iron deficiency anemia: International Nutritional Anemia Consultative Group (INACG), World Health Organization (WHO), United Nations Childrens Fund (UNICEF).

Stoltzfus, R., Mullany, L., & Black, R. (2004). *Iron deficiency anaemia*. Geneva: World Health Organization.

Torlesse, H., & Hodges, M. (2000). Anthelminthic treatment and haemoglobin concentrations during pregnancy. *Lancet, 356*(9235), 1083. doi: 10.1016/s0140-6736(00)02738-0

UN. (2010). The Millennium Development Goals Report 2010. New York: United Nations.

UNICEF/WHO. (2004). Low Birthweight: Country, regional and global estimates. New York: United Nations Children's Fund and World Health Organization.

UNSCN. (2010). Sixth Report on the World Nutrition Situation: Progress in Nutrition United Nations System Standing Committee on Nutrition (UNSCN).

Victora, C. G., Adair, L., Fall, C., Hallal, P. C., Martorell, R., Richter, L., & Sachdev, H. S. (2008). Maternal and child undernutrition: consequences for adult health and human capital. *Lancet, 371*(9609), 340-357. doi: 10.1016/s0140-6736(07)61692-4

Villar, J., & Belizan, J. M. (1982). The relative contribution of prematurity and fetal growth retardation to low birth weight in developing and developed societies. *American Journal of Obstetrics and Gynecology, 143*(7), 793-798.

Vir, S. C., Singh, N., Nigam, A. K., & Jain, R. (2008). Weekly iron and folic acid supplementation with counseling reduces anemia in adolescent girls: a large-scale effectiveness study in Uttar Pradesh, India. *Food Nutr Bull, 29*(3), 186-194.

WFP. (2009). Food security atlas of rural Bihar. New Delhi: World Food Program and Institute of Human Development.

WHO. (1995). Maternal anthropometry and pregnancy outcomes: a WHO collaborative study *Bulletin of the World Health Organization* (Vol. Supplement 73, pp. 32–37). Geneva: World Health Organization

WHO. (2001). Iron deficiency anaemia: assessment, prevention, and control. A guide for programme managers. . Geneva: World Health Organization.

World Bank. (2006). Repositioning nutrition as central to development: a strategy for large-scale action. Washington, D.C.: World Bank.

8. Appendices

8.1. List of key informants by position and organization

Organization	Title	Location	Level
Gates Foundation	Deputy Director	New Delhi	National
Micronutrient Initiative	Director	New Delhi	National
Micronutrient Initiative	Program Manager (Anemia)	New Delhi	National
PATH Finder	Sr Program Manager (MNCH)	New Delhi	National
Karuna Trust	Researcher	Bangalore	National
Bihar Voluntary Health Association	Director	Patna	State
Micronutrient Initiative	State Coordinator	Patna	State
CARE	State Director	Patna	State
PSI	Assistant Program Manager	Patna	State
PSI	Deputy Regional Director	Patna	State
Janani	Program Director	Patna	State
UNICEF	Nutrition Specialist	Patna	State
UNICEF	Health Officer - RCH	Patna	State
UNICEF	State Coordinator (MN Programs)	Patna	State
UNICEF	Child Development & Nutrition Officer	Muzzafarpur	Region
UNFPA	State Program Coordinator	Patna	State
Bihar Technical Assist. Support Team	SWASTH Interim Team Leader	Patna	State
NRHM	Executive Director	Patna	State

NRHM	Deputy Director-MCH	Patna	State
ICDS	Director	Patna	State
Women's Development Corporation	Project Director	Patna	State
Women's Development Corporation	State Project Manager	Patna	State
Department of Food & Consumer Protection	Director, PDS	Patna	State
State Institute of Health & Family Welfare	Director and Professor of Economics	Patna	State
A. N. Sinha Institute of Social Science	Director and Professor of Economics	Patna	State
Asian Development Research Institute	Associate Professor of Economics	Patna	State
District Health Society	Civil Surgeon	Bihar Sharif (Nalanda)	District
District Health Society	District Program Manager	Bihar Sharif (Nalanda)	District
District Health Society	District M&E Officer	Bihar Sharif (Nalanda)	District
ICDS	District Program Officer	Bihar Sharif (Nalanda)	District
Surya Clinic	District Manager	Bihar Sharif (Nalanda)	Facility
Primary Health Center	Block Health Manager	Rajgir (Nalanda)	Facility
Primary Health Center	Senior Medical Officer	Rajgir (Nalanda)	Facility
ICDS	Child Development Project Officer	Rajgir (Nalanda)	Block
Anganwadi Center	Anganwadi Worker	Rajgir (Nalanda)	Facility
Government of Asthawan	Block Development Officer	Asthawan (Nalanda)	Block
Primary Health Center	Block Health Manager	Asthawan (Nalanda)	Facility
Health Sub-Center	Auxiliary Nurse Midwife	Asthawan (Nalanda)	Facility
Anganwadi Center	Anganwadi Worker	Asthawan (Nalanda)	Facility
ICDS	CDPO	Gawnaha (W Champaran)	Block

Primary Health Center	Senior Medical Officer	Gawnaha (W Champaran)	Facility
Primary Health Center	Block Health Manager	Gawnaha (W Champaran)	Facility
Health Sub-Center	Auxiliary Nurse Midwife	Gawnaha (W Champaran)	Facility
Anganwadi Center	Anganwadi Worker	Gawnaha (W Champaran)	Facility
Government of West Champaran	Civil Surgeon	Bettiah (W Champaran)	District
Secondary School	Teacher	Bettiah (W Champaran)	Facility
ICDS	District Program Officer	Bettiah (W Champaran)	District
ICDS	Block Development Officer	Ramnagar (W Champaran)	Block

8.2. Key Informant Interview Guide

Section 1 INTRODUCTION	
Introduction	**To begin, would you kindly tell me a little bit about yourself and your professional role within this department?**
Section 2 PROBLEMS & DETERMINANTS	
Problems	**Thank you for sharing that with me. Now I would like to ask some questions about the types of health and nutrition problems that people have in Bihar. Since these problems will vary by age and gender, I will ask the same question for each group separately.** **In your opinion, what are the biggest health problems for women and adolescent girls in _____?**
Prompt #1	What about malnutrition?
Follow-up #1 Follow-up #2	Why do you think they are the biggest problems? Which groups of people are the most affected? (gender, caste, religion)
Determinants	**In your opinion, what are the causes of poor health and nutrition among women and adolescent girls in _____?**
Prompt #1	What about diet / food insecurity / infectious disease / parasites / early 1st pregnancy / short birth intervals?
Section 3 INTERVENTIONS AND PRIORITIES	
Interventions	**What are you doing to improve the health and nutrition of women of reproductive age?**
Prompt #1	MN supplementation / food fortification / food supplementation / therapeutic feeding / nutrition education & counseling / malaria control / TB control / deworming / increased birth spacing / delayed 1st pregnancy
Follow-up #1	How is it providing these interventions/services?

Priorities	**What are your priorities with respect to improving the health and nutrition of women of reproductive age?**
Follow-up #1 Follow-up #2	How are these priorities formalized? (e.g. plans, targets, budgets) How are these priorities communicated to personnel at state and district level?
Section 5 MONITORING AND EVALUATION	
Monitoring	**How does your department monitor the performance of its efforts to improve the nutrition of women of reproductive age?**
Prompt #1 Prompt #2	What are the key indicators / targets? How do you use this data?
Evaluation	**How do you assess the impact of your efforts to improve the nutrition of women of reproductive age?**
Follow-up #1 Follow-up #2	What are the key indicators / targets? How do you use this data?
Guidelines	**What technical guidelines does your department use with respect to improve the nutrition of women of reproductive age?**
Follow-up #1 Follow-up #2	How do you use these guidelines in your work? How useful are these guidelines for your work?
Section 4 ACHIEVEMENTS, CHALLENGES, INNOVATIONS	
Achievements	**What have been your greatest achievements with regard to improving the health and nutrition of women of reproductive age?**
Follow-up #1 Follow-up #2	Why do you consider these to be the most important achievements? What made these achievements possible?
Challenges	**What have been your biggest challenges to improving the nutrition of women of reproductive age?**
Follow-up #1 Follow-up #2	How are you responding to these challenges? What would help you to respond better to these challenges?

Innovations	**What has been your experience with trying new approaches and strategies for improving the nutrition of women of reproductive age?**
Follow-up #1	What worked well? Why?
Follow-up #2	What did not work well? Why?
Follow-up #3	What is the potential for scaling up the successful innovations?
Section 6 COORDINATION	
Coordination	**How do you work with other departments to improve the nutrition of women of reproductive age?**
Follow-up #1	How do you coordinate your work?
Follow-up #2	What are the challenges in coordination?
Section 7 FUTURE OPPORTUNITIES	
Opportunities	**In the future, what opportunities do you see for improving the nutrition of women of reproductive age?**
Follow-up #1	What would be needed to take advantage of these opportunities?
Section 8 CLOSING	
Closing	Ok, this brings us to the end of the interview. I have really enjoyed speaking with you today and want to thank you very much for sharing your knowledge and experience with me. Is there anything else that you would like to say that I did not ask about? Would you like to ask me any questions? Would you be willing to speak with me again on this subject if I have any more questions? Thank you again for your time and your insights into maternal nutrition and health in Bihar. Good bye.