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India, Factor 11: Malnutrition

Iron Deficiency Anemia in India

India has the second largest population in the world, and it is expected to surpass China as the most populous country by 2022, despite India having a third of the land mass as China. With the birth rate equaling over twice the death rate, India's overwhelmingly young population has posed many issues for the country, including a lack of land and nutritious food, pollution, and disease (9). Because of this severe lack of resources, India continues to be one of the most poverty-stricken countries on earth, with 32% of the population living on less than \$1.25 USD per day, and 69% living on less than \$2 USD per day (5). The middle class of India (those living on \$10-\$20 USD a day) makes up only 3% of the population (8). Making the situation worse is a lack of food. 35.7% of children in India are underweight, giving India the second highest rate of childhood malnutrition (10), leaving these children at an increased risk of developing serious infections. One major type of malnutrition in India is iron deficiency anemia, which the World Health Organization has called "the single most important nutritional risk factor in India" (15). Anemia is caused by a lack of iron in a person's diet, which causes an extremely low number of healthy red blood cells in a person's blood, meaning there is little oxygen in the blood being transported throughout the body. This can cause a variety of symptoms, including fatigue, weakness, abnormal skin pigmentation, headaches, dizziness, chest pain, irregular heartbeat, and shortness of breath. In the long term, anemia can lead to organ damage. It is especially dangerous to the heart, as the muscle must work harder to compensate for the lack of oxygen in the blood (26).

Studies have shown that anemia is the leading cause of disability in India, with a staggering 51% of women aged 15-49 having anemia (2). That makes India the country with the most anemic population in the world, and the percentage of anemic women has continued to climb in recent years. Anemia is especially dangerous in this age group because of the heightened risk it adds during pregnancy. The mother is more prone to infections, and much more likely to require a blood transfusion during pregnancy. Though a blood transfusion may be medically necessary, many Indian families, especially the 47% of people working in subsistence agriculture (9), cannot afford the medical care that is so vital to the health of both the mother and the fetus. Most people in India do not have access to medical insurance, so most medical expenses are left to private households. The financial burdens that come from high out-of-pocket medical bills are a leading cause of Indian households falling into poverty. Burdens of medical bills are especially difficult, given that most Indian households consist of 5 or more people and are multi-generational. Largely due to the lack of medical care, anemia was a factor in 50% of maternal deaths, and was the direct cause of 20% of maternal deaths in 2014 (3). Complicating this issue even further, in India there are a frighteningly low number of doctors. The physician density is only 0.73 physicians per 1,000 people, and there are a mere 0.7 hospital bed per 1,000 people (9). Most hospitals are located in urban areas, and of the few doctors in India only 2% serve rural areas, so much of the Indian population is left without any sort of medical care.

Adding to the problem is the low literacy level in India. An estimated 71% of adults in India are literate;

however, there are large disparities between the literacy rates of men and women. Over 80% of men are literate, yet only 60% of women are considered literate (9). This reflects a long history of gender inequality in India dating back centuries, and beginning before birth. For many years, sex selective abortions were common in India. Since boys are more desired than girls to many people, if the sex of a fetus was determined to be female, the fetus would be aborted. This has led to a larger ratio of boys in India than girls (9). Laws were put in place to prevent these heinous actions, but these practices still continue. For that same reason, many young girls, especially those in rural areas, are denied education after primary school and forced to marry at young ages (7). This heightens a woman's risk of becoming anemic, as women with secondary and postsecondary educations are much less likely to suffer from anemia. A mother's education has the same effect on the risk her children have of becoming anemic (11). Adding to the issue of anemia is the fact that only half of women in India have access to contraceptives, so the average number of children per family in India is above the global average (9). This is one of the major reasons that anemia is so common in India, as women that have given birth to more than two children are twice as likely to be anemic than those who have not, and the children of women with iron deficiency anemia are much more likely to be anemic as well. During pregnancy, especially pregnancies in young women, much more iron is required; as much as twice the normal daily allowance of iron is needed (10). Women who do not get enough iron during pregnancy are at an increased risk of perinatal infections, pre-eclampsia, heavy bleeding during childbirth, and premature labor. Because many Indian women are uneducated on their own health, as well as fetal health, they are unaware of the importance of taking iron while pregnant. This is especially dangerous during delivery, as anemia can cause low oxygen transport between the mother and the baby, particularly if hemorrhage occurs during delivery (11). This is one factor contributing to high infant mortality and maternal death rates in India (39.1 per 1,000 and 174 per 100,000 respectively) (9).

Nearly 80% of Indian children suffer from iron deficiency anemia (3). Iron is vital for a child's neural development, function, and metabolism. If a child does not receive adequate amounts of desperately needed iron, it can lead to defects in the function of neurotransmitters as well as the efficiency of myelination. This can affect a child's cognitive abilities, diminishing them up to 4%. Motor skills and language skills can also be negatively affected by anemia. Iron deficiency anemia can even lower a child's IQ as much as 10 points (13). Breast feeding protects most young children from becoming anemic, but if the mother is anemic the child also tends to be anemic, causing a weaker immune system and underdevelopment. Even in situations where anemia is not an immediately life-threatening condition, it has had severe economic consequences for India. According to a 2002 study, anemia has been the cause of a 17% loss of productivity among physical labor workers, and a 5% loss for moderately active laborers. It is estimated that approximately 1% of India's GDP is lost due to anemia every year, which could be equivalent to upwards of \$20.25 billion USD (3). A number of these economic losses are a result of childhood cognitive impairment due to iron malnutrition starting as a fetus and continuing throughout the critical early development years (14).

Anemia is a multifaceted issue, so in order to stop it there must be multiple approaches. The first issue that must be solved is the surface problem of people consuming enough iron in their diet. The most prevalent source of iron in many people's diets around the world is meat, but people in India are largely vegetarian (3). The amount of iron in a typical diet must increase, without drastically changing their diet altogether. As rice is a staple of an Indian diet, iron-fortified rice may be the solution to decreasing anemia throughout India. A similar technique was used in the Philippines to reduce iron deficiency anemia in schoolchildren, and the results were rather positive. At the beginning of the study, 100% of the children suffered from iron deficiency anemia, by the end of the six-month period only 33% were anemic (1). Similar results were seen in a study done in Uganda that showed iron-fortified rice was effective at

increasing hemoglobin levels in the blood of people suffering from iron deficiency anemia (4). The cost of fortified rice kernels continues to decrease. Currently it is approximated that the fortification process costs between \$6 and \$20 USD per cubic ton of rice, on top of the price of the rice which is approximately \$380 USD, and would likely have to be imported. However, fortified rice is most easily implemented with use of large-scale modern mills. This will require both national and international investment in India to build these large mills. Building such mills will create jobs for the 10.7% of unemployed Indians, substantially increase opportunities for Indian farms to make a fair profit off the rice they grow, and provide affordable, nutritious food for Indian women and children (12). The government can also put in place programs that will make getting iron-fortified rice easier for pregnant and nursing women, as well as children. With such practices in place, it is possible that the 1% of GDP lost to anemia each year will be regained. The cost that these projects require in the beginning will be far less than the economic gain that will come later from the productive work force it will create. This will also reduce the amount so many families must pay out of pocket for medical bills stemming from issues caused by anemia. With this saved money, families will be able to put more money into the economy and drive the country forward, so it can financially provide for subsequent generations. Although food fortification would be effective for a country like India, breeding crop plants enriched with nutrients is a long term, cost effective, and sustainable solution (24) (25). A study done in 10 Filipino convents showed that consumption of iron biofortified rice improved ferritin and total body iron in nonanemic women, having the largest impact on those who began with low baseline iron levels (27). This study strongly suggests that iron biofortified rice would be effective in increasing iron absorption and consumption in anemic populations. Once the nutrient dense crop plants are developed at research institutes, seeds of these crop plants can be handed over to farmers. Since farmers can locally grow these nutrient dense crop plants for consumption, this eliminates the cost incurred in fortification and other intervention measures. To achieve this, aid from international agricultural and research organizations that have proper funding and resources is vital.

The next thing that must be done is investing in women's education. It is shown countless times throughout history that education has been the catalyst for change. A 50-year study showed that higher-level education was able to improve one's access to and use of preventative care measures. It also found that an education has the same rate of return in health, as it does monetary wealth (16). It has been reported that adults that have the worst health also have the most limited literacy (17). Teaching women how to read and write is vital to solving the anemia epidemic plaguing India. It is proven that the more education a woman has, the lower her, and her children's, chance is of developing anemia. If women are to succeed in adequately providing for their families, they must be adequately educated on health, safety, and sanitation. So when they do become pregnant and have children, they know the importance of proper nutrition. Investing in education will also lead to more women entering the workforce in India; this again will grow the economy. When more people are making money, the government receives more tax revenue, allowing the government to invest more in projects that will help reduce poverty and improve nutrition, health care, and sanitation for millions. Many rural places in India have a long history of oppressing women; this must end. Through the help of international organizations building schools and providing a means for women to receive an education in rural areas, as well as the government allocating more of its education budget, now making up 14% of its total spending budget (22), to promote and encourage women's education, more women will receive the education necessary to better provide for themselves, and their families' needs. This investment includes financial incentives to families who send their daughters to school, especially secondary education programs, so families can afford to live without relying on their daughters to work.

Public health funding also must be improved to reduce the gap between the rich and the poor. There is far

too much inequality between classes in India, especially in when it comes to health. India has one of the worst health care systems in the world, even though it is responsible for caring for 17% of the world's population. A much higher budget must be allocated to public initiatives involving health promotion and access to quality health care, specifically for the poor in rural areas. This includes clinics that will provide rural communities with access to affordable health care, so those suffering can receive proper treatment, especially pregnant women and young children. With clinics operating in communities, professionals become aware of individuals who need assistance meeting dietary needs and can make sure iron-fortified crops are properly being allocated to those who most desperately need them. They will be able to provide the necessary health education these most vulnerable people need to live happier, healthier lives and improve their communities and the lives of their children. These clinics could connect these so often ignored people with those who are best equipped to directly help them, as well as those who have the power to change national policies. Investment in public health has the power to greatly diminish anemia, as well as many other health conditions throughout India. To achieve this, part of India's over \$50 billion USD defense budget must be reallocated to fund clinics and treatment for those with anemia (23). In many cases anemia can be treated relatively simply with a blood transfusion, which costs less than \$15 USD (21). \$1 million USD invested in anemia treatment and prevention could provide blood transfusions for nearly 100,000 people. If \$10 million USD (0.2% of the defense budget) is invested in public health funding, a huge difference could be made in the lives of those living in rural India lacking healthcare and proper nutrition. These clinics have the power to eliminate anemia and do so much more. With combined international aid for both vertical programming going directly to programs that will combat anemia, and horizontal programming going towards a broad array of healthcare needs, India's healthcare system can be greatly improved (20).

With investment in public health come some changes in health care practices in India. Healthcare professionals must be trained in how to treat and prevent iron deficiency anemia most effectively. One change in procedure that can be implemented is delayed umbilical cord clamping. Delaying umbilical cord clamping by a matter of minutes can increase a baby's blood volume by 166 mL and consequently decrease their chance of having anemia requiring a blood transfusion by 61% in the first six months of life (18) (29). Though some concerns have been raised about potential risks of polycythemia and increased blood viscosity, a study done in Sweden between 2008 and 2009 showed no such complications when clamping was delayed by 3 minutes in low risk pregnancies (28). Delayed umbilical cord clamping one to three minutes after birth even comes recommended by the World Health Organization, which reported that it provided the greatest benefit to babies born to iron deficient mothers (29). This practice would decrease the chance of cognitive impairment and set India's children up to perform better in both school and in the workforce later in life, especially when combined with the implementation of other tactics to combat anemia. This practice would not cost any additional money and could allow children to grow and thrive in a way that would have been far more difficult before.

India is beginning to have major growth in its GDP, which looks promising for India's future, but economic changes will only benefit India if people are healthy. Everyone in India should have access to the nutrients they need. The first step in that process is investing in programs and facilities that will help people receive adequate nutrition, especially in rural areas. Nutritious food has the power to decrease one's susceptibility to harmful diseases and lengthen their life expectancy, not to mention the immense economic implications. Iron-fortified rice alone has the power to increase GDP by billions of dollars in coming years. This increased productivity has the potential to grow India's economy at an even faster rate, a rate that will be able to keep up with its extremely young, growing population. Women must be educated about the importance of proper iron consumption during pregnancy, and while breast feeding their children. Investments must be made that will make nutritional food, such as iron-fortified and

biofortified rice, affordable and readily accessible to these women and children who are most vulnerable. The female literacy rate must be increased through initiatives to encourage girls to attend primary, secondary, and postsecondary schools. This will drastically improve the lives of their children, as the children of educated women have much better long-term outcomes. Education will also open the door for women themselves to contribute more to their communities, families, and economies. The process is not simple, nor will it happen overnight, but if India is to become self-sufficient enough to provide for its ever-growing population, steps like these must be taken.

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