Original Research Article

RICE FORTIFICATION AND DISTRIBUTION: A NEED OF THE HOUR IN ANDHRA PRADESH, INDIA

ABSTRACT:

Malnutrition among mothers and children in India is extremely high. Every second woman in the country is anaemic, and every third child is stunted, according to the Food Ministry. [4] On the Global Hunger Index (GHI), India ranks 94th out of 107 countries, [1] placing it in the 'serious hunger' category. [3] In the Indian state of Andhra Pradesh, micronutrient deficiencies are frequent among mothers and children. According to the NFHS-5 survey, In Andhra Pradesh, 59 % percent of non-pregnant women in the age group of 15-49 years are anaemic. 63.2 percent of children in the age group of 6 to 59 months are anaemic. 53.7 percent of pregnant women under the age of 35 are anaemic. Food fortification is thought to be one of the most effective ways to prevent malnutrition. Food fortification is a low-cost method that has been shown to provide health, economic, and social benefits. Rice is the most effective vehicle for reaching the poorest people and one of only two staples that can contain a spectrum of minerals and vitamins when properly enriched. Rice fortification activities are most successful when collaborations are developed between the public and private sectors, as well as other parties who can help with advocacy, management, capacity building, implementation, and regulatory oversight.

Comment [EF1]: -Citations are not allowed in abstract

Keywords: Malnutrition, Fortification, Anemia, Rice fortification, food fortification, Andhra Pradesh

Introduction:

In low- and middle-income countries (LMICs), maternal and child malnutrition account for 45 percent of all fatalities in children under the age of five [1]. Hidden hunger, or a persistent deficiency of key vitamins and minerals in the diet, is a particularly common problem in LMICs [2]. Deficiencies in one or more micronutrients, such as iron, zinc, and vitamin A, limit millions of people's physical and cognitive abilities. Micronutrient deficiencies are projected to account for 7.3 percent of the global burden of disease, with iron and vitamin A deficiency ranking among the 15 top causes of global disease burden [3], contributing to the deaths of nearly one million children each year [1].

According to the World Health Organization (WHO), 42 percent of children under the age of five and 40 percent of pregnant women worldwide are anaemic [4]. Pregnant women with severe anaemia are twice as likely to die during or shortly after pregnancy as non-anemic women, and micronutrient deficiencies in the uterus can lead to low birth weight and brain and spinal defects in their children [5.]

Malnutrition refers to energy and/or nutrient deficits, excesses, or imbalances in a person's diet. Malnutrition caused by a lack of micronutrients, Vitamin and mineral deficiencies, often known as micronutrient deficiencies, can be combined. Micronutrients help the body make enzymes, hormones, and other compounds needed for normal growth and development. In terms of global public health, iodine, vitamin A, and iron are the most important; their shortage poses a serious threat to the health

Indicators	NFHS-5 (2019-20)	NFHS-4 (2015-16)

and development of populations globally, particularly children and pregnant women in low-income nations. [6,7,8]

When a person is overweight or obese, he or she is too big for their height.

The fat accumulation that is abnormal or excessive might be harmful to one's health.

Comment [EF2]: What is the correlation between this sentence and the topic in the previous paragraph?

DIFFERENT TYPES OF MALNUTRITION:

1. Micronutrient-related malnutrition, which includes micronutrient deficiencies (a lack of important vitamins and minerals) or micronutrient excess; and
2. Overweight, obesity, and diet-related non-communicable diseases (such as heart disease, stroke, diabetes, and some cancers).
3. Undernutrition can be divided into four categories: wasting, stunting, underweight, and vitamin and mineral deficiencies. Children, in particular, are more susceptible to sickness and mortality as a result of malnutrition. Wasting is defined as a low weight-for-height ratio. It usually suggests recent and significant weight loss due to a lack of food and/or an infectious condition, such as diarrhea, that led the person to lose weight. The risk of death for a young kid who is moderately or severely wasted is raised, but therapy is available Stunting is defined as a lack of height for one's age. It is caused by chronic or recurring malnutrition, which is frequently linked to poor socioeconomic situations, poor maternal health and nutrition, frequent illness, and/or unsuitable baby and young child feeding and care in early life. Stunting prevents youngsters from realizing their full physical and intellectual potential. Underweight children have a poor weight-for-age ratio. An underweight child may be stunted, wasted, or both.

Comment [EF3]: Where is the source of this statement?

Overweight and obesity:

BMI is a weight-for-height index that is often used to assess overweight and obesity. It is calculated by multiplying a person's weight in kilograms by the square of his or her height in meters (kg/m2).

Overweight is defined as a BMI of 25 or higher in adults, whereas obesity is defined as a BMI of 30 or higher. Obesity and overweight are caused by a discrepancy between the amount of energy consumed

(too much) and the amount of energy expended (too little) (too little). People worldwide are consuming more energy-dense foods and beverages (rich in sugars and fats) and engaging in less physical activity.

Child Feeding Practices and Nutritional Status of Children	Urban	Rural	Total	Total
75. Children under age 3 years breastfed within one hour of birth[15] (%)	51.6	52.2	52.0	40.0
76. Children under age 6 months exclusively breastfed[16] (%)	61.4	70.4	68.0	70.2
77. Children age 6-8 months receiving solid or semi-solid food and breastmilk[16] (%)	(67.3)	45.4	50.8	56.1
78. Breastfeeding children age 6-23 months receiving an adequate diet[16, 17] (%)	15.2	5.8	8.2	6.5
79. Non-breastfeeding children age 6-23 months receiving an adequate diet[16, 17] (%)	19.5	7.8	12.1	11.9
80. Total children age 6-23 months receiving an adequate diet[16, 17] (%)	16.7	6.3	9.3	7.6
81. Children under 5 years who are stunted (height-for-age)[18] (%)	23.1	34.2	31.2	31.4
82. Children under 5 years who are wasted (weight-for-height)[18] (%)	17.6	15.5	16.1	17.2
83. Children under 5 years who are severely wasted (weight-for-height)[19] (%)	6.4	5.8	6.0	4.5
84. Children under 5 years who are underweight (weight-for-age)[18] (%)	25.1	31.4	29.6	31.9
85. Children under 5 years who are overweight (weight-for-height)[20] (%)	3.0	2.6	2.7	1.2
Nutritional Status of Adults (age 15-49 years)				
86. Women whose Body Mass Index (BMI) is below normal (BMI <18.5 kg/m^2)[21] (%)	11.9	16.2	14.8	17.6
87. Men whose Body Mass Index (BMI) is below normal (BMI <18.5 kg/m^2) (%)	15.0	17.2	16.5	14.8
88. Women who are overweight or obese (BMI ≥25.0 kg/m^2)[21] (%)	44.4	32.6	36.3	33.2
89. Men who are overweight or obese (BMI ≥25.0 kg/m^2) (%)	37.7	28.0	31.1	33.5
90. Women who have a high risk waist-to-hip ratio (≥0.85) (%)	52.7	47.2	48.9	na
91. Men who have a high risk waist-to-hip ratio (≥0.90) (%)	53.8	52.6	53.0	na
Anaemia among Children and Adults				
92. Children age 6-59 months who are anaemic (<11.0 g/dl)[22] (%)	58.7	65.0	63.2	58.6
93. Non-pregnant women age 15-49 years who are anaemic (<12.0 g/dl)[22] (%)	57.8	59.5	59.0	60.2
94. Pregnant women age 15-49 years who are anaemic (<11.0 g/dl)[22] (%)	56.2	52.7	53.7	52.9
95. All women age 15-49 years who are anaemic[22] (%)	57.8	59.3	58.8	60.0
96. All women age 15-19 years who are anaemic[22] (%)	62.3	59.1	60.1	61.1
97. Men age 15-49 years who are anaemic (<13.0 g/dl)[22] (%)	13.8	17.3	16.2	27.0
98. Men age 15-19 years who are anaemic (<13.0 g/dl)[22] (%)	12.8	21.4	18.7	29.3

Statistics of Andhra Pradesh state, India

Source: NFHS-5 http://rchiips.org/nfhs/NFHS-5_FCTS/FactSheet_AP.pdf

NEED OF Rice Fortification in Andhra Pradesh, India

In the Indian state of Andhra Pradesh, micronutrient deficiencies are frequent among mothers and children. According to the NFHS-5 survey, 59.0 percent of non-pregnant women in the age group of 15-49 years in Andhra Pradesh are anaemic. 63.2 percent of children aged 6 to 59 months are anaemic. 31.2% of Children under 5 years are stunted, 16.1% of Children under 5 years are wasted, 29.6% of Children under 5 years are underweight

Anemia affects 53.7 percent of pregnant women under the age of 35. The findings are concerning and point to major issues. Rice is the most effective vehicle for reaching the poorest people in Andhra Pradesh, and one of just two staples that, when fortified properly, may transport a spectrum of minerals and vitamins. Food fortification is thought to be one of the most effective ways to prevent malnutrition.

Food fortification (FF) is described as the addition of one or more necessary nutrients to a food, whether or not they are ordinarily present in the food, to avoid or correct a demonstrated nutrient deficiency in the general population or specific demographic groups [1]. As a result, fortification is distinct from

enrichment, which is the act of reintroducing nutrients to a portion of food that has been removed during refinement or production. Foods that are widely fortified with folic acid are commonly stapled foods. [8.9].

Food fortification's benefits and drawbacks

FF offers various advantages over other interventions in that it does not need a change in community dietary habits, may give a considerable amount of the required dietary intakes for a variety of micronutrients continuously, and does not require individual compliance. It may frequently be integrated into the existing food production and delivery system, allowing it to be sustained over time.

Fortified foods will sustain body stores of nutrients more efficiently and effectively than intermittent supplements if ingested on a regular and frequent basis Fortified foods are also better at reducing the risk of multiple deficiencies, which is a significant benefit for growing children who require a steady supply of micronutrients for growth and development, as well as women of reproductive age who need adequate nutrient stores for pregnancy and lactation.

The limitations of FF are well known: FF alone cannot correct micronutrient deficiencies when large numbers of the targeted population have little or no access to fortified food, whether due to poverty or location, when the level of micronutrient deficiency is too severe, or when the metabolic demand for micronutrients is increased by the presence of infections. FF interventions may also be limited by a variety of safety, technology, and financial factors. As a result, comprehensive FF programme development necessitates not only an assessment of the program's potential influence on the population's nutritional condition but also its viability in a specific environment. It must also be regulated by suitable legislation [5].

DIFFERENT TYPES OF FOOD FORTIFICATION (FF):

Biofortification entails employing traditional breeding techniques and/or biotechnology to create micronutrient-dense staple crops. Biotechnology (genetic engineering) is a more modern method of biofortifying staple crops that have received a lot of attention in recent years. The transgenic 'Golden Rice,' which has twice the normal levels of iron and considerable amounts of beta-carotene, is the most well-known example of this method. [2]

Microbial biofortification entails the use of probiotic microorganisms (mainly lactic acid bacteria) that ferment to create -carotene in the human intestine or in the foods we eat.[3].

Commercial and industrial fortification is the process of adding micronutrients to commercially available items such as flour, rice, cooking oils, sauces, and butter while they are being manufactured. Home fortification is providing deficient populations with micronutrients in the form of packets or pills that can be added to meals prepared at home (basically a merger of supplements and fortification)

Rice is a staple food in India, consumed by almost two-thirds of the population. In India, per capita, rice consumption is 6.8 kilograms per month. In Andhra Pradesh, all most all people consume rice in different forms. As a result, fortifying rice with vitamins is a viable alternative for supplementing the

poor's diet. To put it another way, rice fortification is the addition of micronutrients to normal rice. Micronutrients are provided under dietary needs.

The macronutrients are carbohydrates, fat, and protein. They are the nutrients that you consume the most."Macronutrients are the nutritional components of food that the body needs for energy and to keep its structure and processes in good working order."

Rice can be fortified using a variety of methods, including coating and dusting. Extrusion is regarded as the greatest technology for rice fortification in India. This entails utilizing an extrusion machine to make fortified rice kernels (FRKs) from a combination. To make fortified rice, the fortified rice kernels are combined with ordinary rice.

Comment [EF4]: this description is incomplete, it is recommended that the author add explanations and examples of various types of biofortification

Process of producing Fortified rice kernels (FRK) using extrusion technology

The extrusion method involves mixing dry rice flour with a micronutrient premix before adding water.

This mixture is then fed through a twin-screw extruder with heating zones, which creates rice-like kernels. For use, these kernels are dried, chilled, and packed. The shelf life of FRK is at least 12 months.

The shape and size of the fortified rice kernel should "resemble the standard milled rice as closely as possible," according to Ministry of Consumer Affairs, Food, and Public Distribution rules.

The grain length and width should be 5 mm and 2.2 mm, respectively, according to the specifications.

10 g of FRK must be blended with 1 kilogram of normal rice, according to Ministry specifications.

Iron (28 mg-42.5 mg), folic acid (75-125 microgram), and vitamin B-12 are all present in 1 kilogram of fortified rice, according to FSSAI standards (0.75-1.25 microgram).

Zinc (10 mg-15 mg), vitamin A (500-750 microgram RE), vitamin B-1 (1 mg-1.5 mg), vitamin B-2 (1.25 mg-1.75 mg), vitamin B-3 (12.5 mg-20 mg), and vitamin B-6 (1.5 mg-2.5 mg) can all be added to rice per kilogramme.

CONCLUSION: The COVID-19 pandemic has posed a threat to global food systems since March 2020, with an estimated 100 million people facing hunger and food insecurity. Large-scale food fortification offers a potent, evidence-based, and cost-effective strategy to reduce hunger by delivering critical nutrients to entire populations. Many fortification programs are under jeopardy, and progress on anaemia prevention is slowing, due to disrupted supply chains, programming obstacles, and competing financial and political demands. In the Indian state of Andhra Pradesh, micronutrient deficiencies are frequent among mothers and children. In response to this situation, the Prime Minister's Office announced the National Nutrition Mission in early 2018, which focuses on staple food fortification as a cost-effective way to combat vitamin and mineral deficiency. Rice is the most effective vehicle for reaching the poorest people in Andhra Pradesh, and one of just two staples that, when fortified properly, may transport a spectrum of minerals and vitamins. The government's three primary food supplementation programs: (1) Mid-day Meal Scheme (MDM), (2) Integrated Child Development

Scheme (ICDS), and (3) Public Distribution System, distribute it to the most nutritionally vulnerable people (PDS). Government should encourage taking fruits and vegetables two times a day. Government should take appropriate promotional methods like conducting medical camps with the help of private hospitals and should encourage the people towards consuming vegetables, green leaves, and fortified rice.

Comment [EF5]: this conclusion section is not explained in the manuscript

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